


AAAS Selected Symposia Series

Communication and Behavior of Whales

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To NIXON GRIFFIS and the late LANDON K. THORNE for making so much of this work possible.

To WILLIAM CONWAY for midwifery during a protracted period of labor, and in appreciation of the affection he also feels for the people and wildlife of Argentina.

About the Book

Whales, perhaps more than any other animals, have in the last decade caught the attention of the world at large, both at a scientific and a popular level. This seems to have transpired as much through a series of unexpected and intriguing discoveries about their way of life and their communicative behavior as by other efforts. This volume documents some of the core studies that ushered in a dramatic change in focus and methodology. Research on dead whales gave way to studies of live populations in which identifications of natural markings of individual animals made possible long-term observations of communication and behavior. The authors present new findings on the changing songs of humpback whales, now considered evidence for the vocal transmission of a cultural trait in a non-human animal; the population dynamics of southern right whales, including the discovery of an unexpected function of callosities; the pod-specific vocalizations of killer whales; the behavior of gray whales and how it relates to tides; the behavior and migratory destinations of humpback whales; and several proven benign techniques for studying the biology of free-ranging marine mammals. An exhaustive annotated bibliography covers the literature on humpback and right whales from 1864 to the present. The volume demonstrates how broader knowledge of whales can come from these new research techniques, knowledge that is vital for preservation of the vast habitats required for the survival of these animals.

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Introduction

As recently as ten years ago, very little was known about the lives of baleen whales. The information that did exist was mostly derived from corpses provided by the whaling industry. A few scientists such as W.E. Schevill and W.A. Watkins had started recording sounds from whales at sea, but people working with live whales were few and far between.

That picture has changed dramatically in the past decade. Many of the people responsible for the change are presenting their work in this volume.

One of the main features common to all of the studies in this volume is that they are all based on passive observation techniques. There is no result in this book that was derived from killing, capturing, confining, or even touching a whale. In some cases, observations of corpses were included, but while they may have provided a useful confirmation, they were in no case required for the conclusions that were drawn. Two of the papers in this volume, in fact, give evidence contradicting old assumptions based on whaling studies: the paper by Darling and Jurasz and that by Payne and Guinee demonstrate migratory paths of humpback whales (*Megaptera novaeangliae*) in the eastern North Pacific that are very different from what has been assumed from southern hemisphere whaling studies.

One of the rewards I have experienced during the editing of this book has been a growing confidence in the practicality of benign research techniques for studying whales. The work reported here demonstrates that basic science can be done at a useful level of rigor (and usually for much less money) without resorting to intrusive techniques or commercial whaling operations. I hope that one of the main values of this book will be to demonstrate the value of benign research techniques for studying the basic biology and population structure of whales.

I appreciate fully, of course, that there are many worthwhile techniques for studying whales which are intrusive and that in some cases they may be the only practical route to obtaining answers necessary for species management. However, I assert that such questions are few and that a great deal more can be learned from non-intrusive techniques than is generally realized. The few examples given here barely scratch the surface of what is possible.

According to the accepted doctrine of 20 years ago, most major advances in cetology were made by taking a broad stance on the flensing platform and dissecting ever deeper into the abundant corpses. The argument for more research on cadavers was self-perpetuating because it had a neat catch, sometimes put forward by whaling industry spokesmen as an argument in favor of whaling: since serious science cannot be done without dead whales, the industry should be retained if only for its valuable contribution to knowledge. On the theory that any science solely dependent on the remains of the deceased is, by definition, moribund, I decided to ignore the accepted doctrine. Others had reached the same conclusion. We joined forces and this book is the result.

Population estimates, based on population models, have played an important role in the recent efforts to bring whaling under rational control. One of the main difficulties in gaining agreement between members of the Scientific Committee of the International Whaling Commission has been the lack of information from which to derive values for some of the basic biological parameters upon which the population models depend. Perhaps even more important is that we do not have the biological information to put into the models about the dependence of vital rates (e.g., natural mortality, rate of reproduction, etc.) on population density and on the age of animals. The techniques which have been used to pursue answers to these questions mostly derive from techniques used by the first scientists who worked with the whaling industry -- techniques which rely upon measurements and samples from dead whales.

Blue (*Balaenoptera musculus*), fin (*Balaenoptera physalus*), and sei (*Balaenoptera borealis*) whales were three of the most hunted, and thus most studied, species during the modern whaling period. Yet, some of the gaps in our knowledge of their life histories were still with us in the 1960's and 70's when these species were declining precipitously and when better answers were urgently needed to stop that decline.

In other words, even when we had hundreds of thousands of corpses from which to derive data, the answers to some very simple questions (the consequences of which are nevertheless very important) were not forthcoming. I believe that the reason these gaps are still with us is

because of a shortfall in imagination, coupled with dogged adherence to an approach long ago demonstrated to be inadequate to the task of providing the required information. The mephistophelean conclusion is that as long as a species is hunted commercially we will remain in relative ignorance about it. (This conclusion is supported by the recent unprecedented growth in the science of cetology at a time when the whaling industry is collapsing.) Once the hunt stops and we cannot rely on the old techniques any more, we are forced by necessity to use our imaginations to develop new approaches. These new approaches are bound to bring new understanding. Far from nurturing the growth of knowledge in whale biology, I feel that the availability of large numbers of corpses, and thus the possibility of more years of the old study methods, has actually held back the growth of this branch of science. Now that whaling is dying, we can look forward to solving some of the old problems as well as to gaining important new insights, not just into the remains of the whale but into the rest of the whale, the part that has escaped the whalers for so long.

Of the 14 papers in this book, 8 report on work performed entirely in my laboratory in Lincoln and/or the New York Zoological Society field station at Peninsula Valdés. Five cover research by members of a large student project studying humpback whales in Hawaii and working in connection with the laboratory in Lincoln. Only two papers were done entirely outside this sphere. The number of people in the main research group waxed and waned in response to the availability of funds and there were times when many of us were scavenging for funds and lived a cryptozoic existence (like raccoons) in the shadow of more affluent laboratories and scientific disciplines. Yet through these strains, all concerned managed to maintain a strong *comaraderie* within which it was always a pleasure work. As a result, there is a cross-fertilization or connectedness to many of these papers which is somewhat unusual for a symposium volume.

The papers on vocalizations of humpback whales start with an analysis (by Payne, Tyack, and Payne) of how the rapid and synchronous progressive changes occur in the songs of humpback whales. They show that the songs change in complex and unanimous ways when the whales are singing and are stored without much change during the relatively quiet feeding season. Guinee, Chu, and Dorsey then demonstrate that individual humpback whales modify their songs in accordance with the changes going on around them. Frumhoff follows with a paper showing that the aberrant songs of this species provide important clues as to which song elements are most unalterable and thus what the underlying structure of the song is like.

Ford and Fisher, in the only paper included here that is not on a mysticete, demonstrate that individual pods of killer whales (*Orcinus orca*) have their own dialects. The part of the sound repertoire that is unique to each pod remains highly stable over periods of at least ten years and probably longer. In addition, the extent of the vocal differences between pods appears to correlate with the degree of associations between the pods.

Clark then tackles the most complicated question regarding whale sounds, looking for indications of meaning in specific sounds. His subject is the southern right whale, *Eubalaena australis*. He finds that the acoustically simplest sounds are associated with contact over long distances while the most complex are associated with groups of socially active whales. The complexity of the sounds correlates with the complexity of the social context: this suggests that right whales may be using sounds to communicate a variety of messages.

The work dealing with behavior of mysticetes on their breeding grounds starts with a paper on humpback whales by Darling, Gibson, and Silber who demonstrate that, although individual humpbacks visiting the Hawaiian Islands each year may stay for 11 weeks, much of the population is not a static group but a passing parade. This has an important consequence -- the population of humpbacks visiting the Hawaiian assembly grounds is larger than had been thought previously. Another interesting finding from this work is the evidence for quite violent physical encounters between animals competing to escort females with calves -- encounters which may even result in bleeding wounds.

These results interact with the studies of humpback songs. Competition between individuals during the singing season provides evidence that song in whales may be part of a behavioral complex similar to that of other breeding, singing animals. The rapid replacement of individuals in a population makes it even more remarkable that whole groups of singers are able to concur at any time on the direction and extent of the changes that they are incorporating into their song.

The work of Glockner and Venus with the same species in the same area offers information on the behavior of female humpbacks and their calves, their preference for shallow water, along with new data on growth rate of the calf, external body features, and natural markings not formerly used to distinguish between individuals. Glockner and Venus also show that more than two thirds of calving females are accompanied by an adult-sized escort who exhibits protective behavior toward the female and calf.

Norris, Villa-Ramirez, Nichols, Würsig, and Miller offer interesting data on another species in its breeding lagoons,

the gray whale (*Eschrichtius robustus*). They demonstrate that the behavior in lagoon entrances includes courtship and considerable feeding. They also suggest that the lagoon entrances serve as a concentration mechanism for the whales' prey.

Payne and Dorsey present the results of a close examination of the callosities -- thickened patches of very rough skin -- on the heads of southern right whales and conclude that males have more and larger callosities than females. On their winter assembly areas in Argentina, the males are probably using their callosities rather like underwater horns to fight other males for access to females.

On the question of migration, Payne and Guinee offer evidence that the song of humpback whales can serve as a means of identifying stocks. The fact that humpbacks in two areas 4700 km apart are singing similar, if not virtually identical, songs at the same time suggests that (unlike South Atlantic right whales) the eastern and central Pacific humpback whales are a single population which must be mixing considerably every year. This speculation is confirmed by Darling and Jurasz, who compare photographs of naturally marked whales in the North Pacific. They find the same individual wintering, in two different years, in waters near Hawaii and near the Revillagigedo Islands 4700 km away. They also found seven individuals that were seen both in southeast Alaska and Hawaii. Since whales from both wintering areas feed in Alaskan waters, it may be there that the mixing postulated by Payne and Guinee is taking place.

The next section of the volume is given over to some of the new research techniques which have been useful in studies of the behavior of baleen whales. The paper by Payne, Brazier, Dorsey, Perkins, Rowntree, and Titus reports on the characteristics of callosities as a means of identifying right whales. An old spectre has always haunted studies based on natural markings -- what if there are look-alikes in the study group? These authors offer a new technique by which one can determine what the probability is that there are two or more animals with the same natural markings in a given population. The technique is broadly applicable and should be useful with other species. Payne et al. also argue that, contrary to the usual perceptions, natural markings are probably more useful than artificial tags for studies of large populations.

Glockner offers a new technique for determining sex of humpback whales from lateral views of their bodies. Using this technique, she presents evidence that both singers and the whales that escort females with calves are males.

The final section of the book is an annotated bibliography by Bird on right and humpback whale literature from 1864 to 1980.

I have had the pleasure of working directly with 20 of the 25 other authors who have contributed to this book. Of these, 12 were colleagues and/or students in the field and 17 worked in my laboratory in Lincoln, Massachusetts. The laboratory received its major support for all the years that this work was in progress from the New York Zoological Society. The Society also funded a field station at Peninsula Valdes, Argentina from which most of the data on right whales came.

I wish to acknowledge my debt to the members of my laboratory who have helped with the production of this volume. Jim Bird and Linda Guinee bore the major brunt of the effort. In addition to endless proofreading, correspondence, and cross-checking, they also produced the index. Linda typeset the entire book, a job that would have daunted anyone with less energy and good will. Victoria Rowntree and Eleanor Dorsey both assisted in ways too numerous to enumerate.

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