The International Management of Whales, Dolphins, and Porpoises: An Interdisciplinary Assessment

James E. Scarff
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The International Management of Whales, Dolphins, and Porpoises: An Interdisciplinary Assessment*

(Part One)

James E. Scarff**

"More than any other form of life, whales have come to epitomize the problems of management of our living resources."1

"If we prove unable to manage whales, it does not augur well for our ability to manage any of the other species for which there is so much greater incentive of exploitation. In other words, if we cannot find a way to manage whales successfully, it is unlikely we will be able to do so successfully with any other component of our living environment. . . . [T]here is probably no one group of animals which has the significance of whales to world conservation."2

—Dr. Lee Talbot, Senior Scientist
Council on Environmental Quality

For international conservationists, cetaceans—whales, dolphins, and porpoises—have become symbols of endangered species everywhere. The rapid decline of whale populations during this century is dramatic evidence of the power of human technology to affect the environment on a global scale. The inability of the International Whaling Commission, the major interna-

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** B.A. 1972, Stanford University (Political Science); J.D. 1975, University of California, Berkeley; M.S. 1976, University of California, Berkeley (Wildlife Ecology). Without the help and encouragement of the following people this article never would have been possible: Scott McVay, Dr. Sidney Holt, Dr. William Aron, Dr. Robert Brownell, Jr., Dr. Lee Talbot, Prudence Fox, Prof. Sho Sato, and Bemi Debus. I would also like to specially thank Peter Heineman, Karen Scholer, and the other editors at ELQ for all their encouragement and patience, and my parents who provided the financial support for this three year study.


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tional agency which regulates whaling, to adopt adequate conservation measures over the last 30 years, despite a high degree of scientific consensus on what conservation measures are necessary, has caused many conservationists to question the capability of international legal regimes to protect the environment, most particularly their capability to safeguard the living resources of the seas. Numerous articles in law journals in the last several years have addressed the International Whaling Commission’s failure to achieve its conservation objectives, and have suggested legal reforms necessary to its successful operation. The authors of those articles were trained in law or political science. Applying only the traditional analyses of those disciplines, they failed to understand the unique and multifaceted problems of whale management. In addition, those authors generally ignored the conservation problems of dolphins, porpoises, and other cetaceans not actively managed by the International Whaling Commission. This article, in contrast, draws heavily upon biological and economic as well as legal and political knowledge to analyze the international conservation problems of all cetaceans.

An interdisciplinary approach is essential for understanding the complex problems of cetacean management. In 1976, a group of international experts on cetacean biology and conservation concluded that “[f]or adequate research into marine mammals and their environments, interdisciplinary studies are an increasingly vital necessity, not merely a fashionable luxury.”

3. For more information on the International Whaling Commission, see note 137 infra and text accompanying notes 138-71 infra.


5. The most comprehensive studies of whaling regulation that have been done in this country are three Ph.D. dissertations, one by a geographer, G. Small, The Blue Whale (paper ed. 1971) [hereinafter cited as Small], and two by political scientists. The better of the latter two studies is P. Bock, A Study in International Regulation: The Case of Whaling (1966) (unpublished thesis, New York University, available from University Microfilms Inc., Ann Arbor, Michigan) [hereinafter cited as Bock]. See also M. Bradley, The International Whaling Commission: Allocating an International Pelagic Ocean Resource (1971) (unpublished thesis, Univ. of Michigan, available from University Microfilms Inc., Ann Arbor, Michigan). The latter two studies make no serious attempt at being interdisciplinary. Small’s study does combine some biology and economics, but his understanding of both those disciplines is weak and his understanding of law even weaker.

6. Working Group 20, Draft Report of Recommendations for a Research Program, Doc. FAO/ACMRR/MM/SC/Rep. 20 Add. 1, at 6 (Sept. 1976). (For an explanation of this citation form see note 14 infra.) This report went on to state:

Traditional disciplines presuppose a pattern of discreteness and separation of functions in natural processes which is in part fictional. They are useful for purposes of administrative convenience, and for some management objectives which require a “divide and conquer” approach. It is no longer possible, however, to assert with a
Biological characteristics of cetaceans, ecological features of the oceans, economic profit-seeking, and anachronistic legal concepts all interact in a manner that is frequently counter-intuitive. To comprehend the necessary legal reforms, one must understand not only international law, but also the precise manner in which biological and economic factors interact with international legal institutions.

This article is divided into two parts—one primarily descriptive, the other primarily analytical. The first part includes a description of international whaling and small cetacean fisheries and the biological, cultural, economic, and legal contexts within which they occur. The second part assesses current management from an interdisciplinary perspective.

The descriptive material is provided both for background information and to provide examples of biological, economic, and legal phenomena discussed in the later assessment sections. The background information details the unique biological and economic characteristics of cetaceans which affect their management, as well as the history and evolution of the whaling industry and the international law of whaling regulation.

The assessment sections focus on three critical questions. First, to what extent has the International Whaling Commission met its own objectives and what institutional barriers have hindered its efforts? Second, from both theoretical and practical points of view, how appropriate are these management objectives for any or all cetaceans? Third, what are the needs and opportunities for reform? The assessment sections attempt to answer these questions by integrating ethical, biological, economic, and legal considerations.

The reader’s own personal values will, of course, determine how he or she views particular cetacean management programs. The purpose of this article is to provide a basic framework for analysis of issues in international cetacean management.

I

WHALES—A DESCRIPTION OF THE RESOURCE

A. Introduction

Many of the problems in whale management have arisen from a basic clear conscience that traditional disciplines accurately correspond to the nature of things.

The sea and its mammals comprise a worldwide topic of inquiry, and one which must be understood at every possible level of awareness. The study of sea mammals must be interdisciplinary for the same reasons that it must be international; to study this topic only through isolated disciplines makes no more sense than it would to limit these inquiries according to national boundaries. Either approach would produce intolerable distortions of research results. Sea mammals need to be understood at every level of their significance, from anatomy and physiology to their complex impact upon social and economic history and upon human poetic and philosophical imaginations.
misunderstanding of the resource. Management actions and suggested reforms have too often been based on faulty, often unarticulated assumptions about whale population dynamics and ecology. Without accurate, sophisticated, and relatively detailed information concerning these biological subjects, management goals can be achieved only by coincidence. The description that follows covers many aspects of whale biology in some detail in order to express the complexity of the resource being managed and the current state of biological knowledge concerning whales. The geographic distribution of whales is discussed both to aid in the understanding of the history of whaling and to provide background for the later discussion of the various existing and proposed international agreements regarding jurisdiction over ocean spaces and cetaceans which inhabit those spaces. Finally, the changing nature of the human use of the resource is outlined since it necessarily affects management decisions.

B. Types of Whales

The order of Cetacea consists of two suborders, the Mysticeti or baleen whales and the Odontoceti or toothed whales; the suborders consist of 10 families, 39 genera, and approximately 78 species. The species can be further divided into hundreds of reproductively isolated populations or "stocks." Traditionally the whaling industry separated cetaceans into two main groups: large cetaceans or "whales," which were commercially valuable, and small cetaceans. Large cetaceans include nine of the ten mysticete species and one odontocete species, the sperm whale. Small cetaceans include one mysticete species and the other odontocetes—dolphins, porpoises and the "small whales." Because the history of exploitation and management of large and small cetaceans has been very different, a detailed description of small cetaceans and the fisheries for them is postponed until a later section. Table I describes the taxonomy and special characteristics of whales. Figure I shows the considerable differences in size and shape of various species, and the vast size of some of the species. For example, it has been estimated that large blue whales can reach a weight of over 200 tons or approximately 30 times the weight of a large elephant.


8. The exception is the pygmy right whale (Caperea marginata).

9. See text accompanying notes 279-323 infra.

### Table 1

**THE LARGE WHALES—CLASSIFICATION AND CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Suborder/Family/Species</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mysticeti (Baleen Whales)</strong></td>
<td>All filter feeders, generally feeding on small zooplankton (krill, diatoms, and copepods); only slightly sexually dimorphic.</td>
</tr>
<tr>
<td>Balaenidae (large right whales)</td>
<td>Found only in extreme arctic waters.</td>
</tr>
<tr>
<td>Bowhead whale <em>(Balaena mysticetus)</em></td>
<td>Slow swimmer, usually found close to shore.</td>
</tr>
<tr>
<td>Right whale <em>(Eubalaena glacialis)</em></td>
<td></td>
</tr>
<tr>
<td>Eschrichtidae (gray whales)</td>
<td>Slow swimmer, migrates very close to shore, breeds and bears young in coastal lagoons of Baja California, feeds on benthic amphipods.</td>
</tr>
<tr>
<td>California gray whale <em>(Eschrichtius robustus)</em></td>
<td></td>
</tr>
<tr>
<td>Balaenopteridae (rorquals)</td>
<td>Slow swimmer, migrates close to coasts.</td>
</tr>
<tr>
<td>Humpback whale <em>(Megaptera novaeangliae)</em></td>
<td>Fast swimmers, normally found in deep waters, summer feeding in extreme polar waters.</td>
</tr>
<tr>
<td>Blue whale <em>(Balaenoptera musculus)</em></td>
<td>Similar to blue whale, summer feeding in polar waters.</td>
</tr>
<tr>
<td>Fin whale <em>(Balaenoptera physalus)</em></td>
<td>Up to 60 ft. long, similar to fin whale but summer range more temperate.</td>
</tr>
<tr>
<td>Sei whale <em>(Balaenoptera borealis)</em></td>
<td>Up to 50 ft. long, very similar to sei whale but range more tropical.</td>
</tr>
<tr>
<td>Bryde’s whale <em>(Balaenoptera edeni)</em></td>
<td>Smallest rorqual, not commercially taken until the 1970’s.</td>
</tr>
<tr>
<td>Minke whale <em>(Balaenoptera acutorostrata)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Odontoceti (Toothed Whales)</strong></td>
<td>Feed on fish and cephalopods (squid); often highly social, sexually dimorphic.</td>
</tr>
<tr>
<td>Physeteridae (sperm whales)</td>
<td>Polygynous, very sexually dimorphic, slow to reach sexual maturity.</td>
</tr>
<tr>
<td>Sperm whale <em>(Physyper catodon)</em></td>
<td></td>
</tr>
</tbody>
</table>

* A synonymous name for the gray whale is *E. gibbosus.*

** Some taxonomists consider the southern right whales to be a distinct species (*E. australis*). Like gray whales, some southern right whales migrate close to coasts and breed and bear young in coastal lagoons.

### C. Abundance

It is estimated that before whaling began there were approximately 3.9 million whales in the oceans of the world. By 1975, whaling had reduced the number of whales to approximately 2.1 million. The mature and thus exploitable population of whales has decreased from about 2.4 million to a present level of about 1.2 million.11 These figures are deceptive for two related reasons. First, the selectivity of the whaling industry has caused proportionately much greater reductions in the populations of certain species, especially the larger baleen species. For example, while the worldwide population of whales has been reduced by about 46 percent, some baleen whale species in the Antarctic have been reduced by as much as 96 percent.12


12. See Table 2 in text.
Figure 1
SHAPES AND SIZES OF SELECTED CETACEANS

Drawings by Larry Foster, reprinted with permission of General Whale, 9616 MacArthur Blvd., Oakland, Ca. 94605.
Second, the figures on population reductions do not reflect reductions in whale biomass. The selective depletion of blue and fin whales has caused an 85 percent reduction in the total baleen whale biomass in the Antarctic, from an estimated 43 million metric tons to 6.6 million metric tons.\(^{13}\)

The following table shows present estimates of the population of each species by ocean area and the percentage of the initial stock remaining since man started whaling.\(^{14}\)

### Table 2

**Current Estimates of Whale Population Sizes in 1000's of Whales (% of Initial Population)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Southern Hemisphere</th>
<th>No. Pacific</th>
<th>No. Atlantic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowhead**</td>
<td>not present</td>
<td>1-2 (10%)?</td>
<td>&lt;0.1 (1%)?</td>
</tr>
<tr>
<td>Right**</td>
<td>3-4 (&lt;10%)</td>
<td>0.3-0.4 (unknown)</td>
<td>&lt;0.2 (unknown)</td>
</tr>
<tr>
<td>Gray**</td>
<td>not present</td>
<td>11-12 (~100%)</td>
<td>not present</td>
</tr>
<tr>
<td>Humpback</td>
<td>2-3 (3%)</td>
<td>2 (unknown)</td>
<td>&lt;1.5 (70%)?</td>
</tr>
<tr>
<td>Blue</td>
<td>7-8*** (4%)</td>
<td>1.5-2 (30-40%)</td>
<td>&lt;1 (10%)?</td>
</tr>
<tr>
<td>Fin</td>
<td>80 (20%)</td>
<td>14-19 (40%)</td>
<td>&gt;31 (unknown)</td>
</tr>
<tr>
<td>Sei</td>
<td>50-55 (33%)</td>
<td>21-23 (~50%)</td>
<td>&gt;2 (unknown)</td>
</tr>
<tr>
<td>Bryde's</td>
<td>&gt;10 (90%)</td>
<td>20-30 (~100%)</td>
<td>unknown</td>
</tr>
<tr>
<td>Minke</td>
<td>120-200 (80%)</td>
<td>unknown</td>
<td>&gt;10 (unknown)</td>
</tr>
<tr>
<td>Sperm δ</td>
<td>128 (50%)</td>
<td>74 (~41%)</td>
<td>38 (unknown)</td>
</tr>
<tr>
<td>Sperm ϕ</td>
<td>295 (90%)</td>
<td>103 (82%)</td>
<td></td>
</tr>
</tbody>
</table>

* These figures represent the sizes of the "exploitable populations" i.e., those animals above minimum legal harvest length. To estimate total stock size, multiply exploitable stock size by 1.5 for baleen whales and 2.0 for sperm whales.

** The estimates for these species are for total stock size, not exploitable stock size.

*** This figure includes "a few thousand" pygmy blue whales, a relatively small (70 feet long) subspecies (\(B.\ musculus brevicauda\)) found in the southern Indian Ocean.\(^{15}\)

\(^{13}\) Laws, *The Significance of Vertebrates in the Antarctic Marine Ecosystem*, in *Adaptations Within Antarctic Ecosystems* 11 (G. Llano ed., in press) (manuscript on file with Dr. A. Starker Leopold, College of Natural Resources, Univ. of Cal., Berkeley) [hereinafter cited as Laws].

\(^{14}\) Much of the information in this article comes from a series of background papers prepared for an international scientific conference entitled, "Mammals in the Seas: A Scientific Consultation on the Conservation and Management of Marine Mammals and Their Environment." This conference was held in conjunction with the work of the Advisory Committee on Marine Resources Research (ACMRR) of the Food and Agriculture Organization of the United Nations (FAO). All of the documents in this series which are cited will be cited by FAO document number.

D. Biological Characteristics

1. Behavior and Population Biology

It is essential for management experts to have complete and accurate knowledge of the biological characteristics of particular whale stocks in order to manage whales scientifically. Yet it is exceptionally difficult to obtain even the most basic biological information about whales because these species are totally aquatic; they are born and spend their entire lives in water and often never come within tens of miles of land. Consequently it is very difficult to determine either the number of whales in a given stock or changes in the stock size. The whales' aquatic habits also make it very difficult to observe their behavior in the wild over even short periods of time. Until recently there was no way to determine the age of individual whales because of the difficulties


16. For a more detailed discussion of the problems of censusing cetaceans, see text accompanying notes 467-71 infra. The failures of the IWC stand in striking contrast to the tremendous success of the Northern fur seal treaties. First negotiated in 1911 [Convention on the Conservation of North Pacific Fur Seals, July 7, 1911, 37 Stat. 1542, T.S. No. 564] and renegotiated several times since, most recently in 1976 [Interim Convention on Conservation of North Pacific Fur Seals, Feb. 9, 1957, 6 U.S.T. 2283, T.I.A.S. No. 3948, 314 U.N.T.S. 105, amended and extended Oct. 8, 1963, at U.S.T. 316, T.I.A.S. No. 5558, 494 U.N.T.S. 303, as of Sept. 3, 1969, 20 U.S.T. 2992, T.I.A.S. No. 6774, 719 U.N.T.S. 313 and by the 1976 Protocol, S. Exec. Doc. M, 94th Cong., 2d Sess. (1976)] [hereinafter cited as N. Pacific Fur Seal Convention], these treaties have allowed the seals to recover from a severely depleted state to their original abundance. See 39 Fed. Reg. 12053 (1974). A key factor in the success of these treaties has been the ability to accurately census the stocks on their breeding rookeries and to obtain accurate data concerning the recruitment rate. See Bartholomew, The Relation of the Natural History of Whales to their Management, in The Whale Problem 294 (W. Schevill ed. 1974). The simple fact that seals congregate on land to breed whereas whales disperse through vast areas of the tropical seas is enough to cause one legal management scheme to succeed and another similar one to fail. It should be noted in this context that the seals to be managed under the new Convention for the Conservation of Antarctic Seals, Feb. 11, 1972, 11 Int'l Legal Materials 251 (1972) [hereinafter cited as Convention for the Conservation of Antarctic Seals], particularly the crabeater seal (Lobodon carcinophagus), do not concentrate their breeding activities at land rookeries. See Siniff, Cline, & Erickson, Population Densities of Seals in the Weddell Sea, Antarctica in 1968, 1 Antarctic Ecology 377 (M. Holgate ed. 1970). The problems of censusing these seals will be more comparable to the problems of censusing whales.

17. An exceptional study of the behavior of wild whales is currently being conducted by Dr. Roger Payne in Argentina. See Payne, At Home With Right Whales, 149 Nat'l Geographic 322 (1976) [hereinafter cited as Right Whales].

18. For a comprehensive, but somewhat outdated discussion of the problems of aging
of relocating marked animals and the near impossibility of keeping any
whales in captivity due to their large size and vast appetites.19

The social behavior and morphology of whales also has profound effects
on the manner in which different species can be managed. Baleen whales
generally occur in small "pods" or groups of mixed sex, and it is assumed
that individuals form pair bonds.20 Female baleen whales tend to be slightly
larger than males, but the sexes are usually indistinguishable in the water.21
Consequently, it is infeasible to set annual harvest quotas for each sex and no
attempt has been made to do so. In contrast, sperm whales form large
polygamous herds composed of a mature male, 10 to 16 females, and
numerous calves. Non-breeding males travel singly or in separate groups.22
This behavioral segregation and the smaller size of females23 makes it
possible to set quotas by sex for sperm whales.24

Species generally represent the absolute reproductive barriers between
animals. Consequently, to a large extent whale management must be dis-
cussed on a species by species basis. Whereas a species represents animals
that are potentially capable of interbreeding, a "stock" or "population"
represents a genetically distinguishable breeding unit within a species.25
For example, fin whales from the North Atlantic do not breed with fin whales
from the South Atlantic, even though such interbreeding is physiologically
possible. Even within smaller areas a species usually is represented by several
distinct populations which do not interbreed because of geographical or

cetaceans, see Jonsgard, Age Determination of Marine Mammals, in THE BIOLOGY OF MARINE
19. Small gray whales have been kept in captivity for short periods of time. See generally T.
MILLER, THE WORLD OF THE CALIFORNIA GRAY WHALE 69-75 (1975) [hereinafter cited as
MILLER].
20. See MACKINTOSH, supra note 7, at 37-38.
21. SLIPER, supra note 7, at 47, 85.
23. A mature male sperm whale may weigh nearly four times as much as a mature female.
Lockyer, Estimates of Growth and Energy Budget for the Sperm Whale, Doc. FAO/AC-
MRR/MM/SC/38, at 5 (Feb. 1976) [hereinafter cited as Energy Budgets of Sperm Whales]. See
also Figure I in text.
24. See Table 2 in text.
25. A practical definition for a biological stock is:

a relatively homogeneous and self-contained population whose losses by emigration
and accessions by immigration, if any, are negligible in relation to rates of growth and
mortality.

Int'l Comm'n for NW Atlantic Fisheries, Proceedings of Joint Scientific Meeting, 1 SPEC. PUBL.
ICNAF No. 2, at 8 (1960), as quoted in Balaenopterids, supra note 14, at 2. An alternate term that
is coming into current use is "unit population" which is defined as follows:

Unit populations are subsets of species or subspecies which are sufficiently reproduc-
tively independent from other subsets of that species or subspecies that they are able to
maintain their genetic identity.

Bergen Working Group 6, Draft Report on Unit Populations, Doc. FAO/AC-
MRR/MM/MM/SC/WG 6, at 1 (Sept. 1976) [hereinafter cited as Draft Report of Working Group 6]; see
also note 28 infra; Sharp, Biochemical Genetic Studies: Their Value and Limitations in Stock
behavioral isolation. For example, North Atlantic fin whales apparently form six genetically and geographically distinct stocks.\(^2\)

Data from historic whaling operations frequently show a constant number of whales being taken from a large area. This information was often interpreted to mean that the resident population was stable. However, frequently such data masked the sequential depletion of several discrete stocks.\(^2\) Once a population has been depleted, biogeographical barriers may prevent immigration from surrounding stocks, and it may take hundreds or thousands of years for a species to reinhabit the range of an exterminated stock. Thus to be effective, management must concern itself with breeding stocks, not merely with species.\(^2\)

The number of animals that can be removed from a stock without lowering the population of that stock the following year is the "harvestable surplus" \((H_s)\). The size of this "surplus" depends on several characteristics of the species' biology, but it can be crudely expressed as follows:

\[
H_s = P(r-M)
\]

where \(P\) is the population size, \(r\) the gross recruitment rate (the rate at which juvenile animals enter the adult population),\(^2\) \(M\) the rate of natural (non-

---

\(26\) IWC Scientific Comm'n, 1975 Reports and Papers, at 144, 175 (1976); Sargeant, supra note 14.

\(27\) See Mackintosh, supra note 7, at 145 (fig. 18).

\(28\) A distinction must be made between a biological stock [defined as in note 25 supra] . . . and a management stock or unit, which could be defined (as by the 1975 IWC session) as the population unit which is most conveniently managed. . . . Whale management is unlike management of most fish stocks in that it is directed more at maximising [sic] recruitment than growth, and catching effort should therefore be adjusted so that over any period the harvesting of each biological stock is maintained at the desired level. This can sometimes be done through combining two or more biological stocks as one management unit, e.g. if they are thought to have the same net recruitment rate [see note 29 infra] and to mix completely on the whaling grounds; then there is no practical advantage in subdividing a quota between the two biological stocks. If however there is reason to believe that two biological stocks have different net recruitment rates, or are mixed incompletely on the whaling grounds, then additional measures, possibly but not necessarily including separate quotas for each biological stock may be required to ensure a proper balance of catching effort between the two biological stocks.

Draft Report on Large Cetaceans, supra note 14, at 12.

The most serious problem develops when two intermingling biological stocks have different net recruitment rates and/or are at different stages of depletion. The marine mammal scientists who recently examined this problem concluded: "when two or more populations occupy almost identical waters and each population cannot be easily identified from external characteristics alone, management measures should be directed to the population at the smallest stock level."


\(29\) The recruitment rate \((r)\) is somewhat analogous to the crude birth rate. It is more precisely described as:

\[
r = \frac{\text{No. of recruits (animals reaching maturity in one year)}}{\text{Total no. of individuals in parent stock from which recruits were born}}
\]

As an example, imagine a whale population \((P)\) composed of 200 animals of adults and juveniles at time zero \((t_0)\). This population will be designated as \(P_{t_0}(200)\). Of these 200 whales, 50 are mature females and half of these mature females give birth to one young each for a total of 25 young animals in year \(t_0\) \((Y_{t_0} = 25)\). The age of sexual maturity of this population is 10 years.
whaling) mortality among adults, and \((r-M)\) the net recruitment rate. Before the advent of intense human exploitation, whale populations probably existed at relatively stable equilibrium levels where both the *net* recruitment rate \((r-M)\) and the harvestable surplus equalled zero. Most populations of wild animals initially decrease in size when subjected to a new mortality factor such as hunting or whaling. Subsequently, mortality due to other factors \((M)\) often decreases and the gross recruitment rate \(r\) increases. Consequently, the net recruitment rate \((r-M)\) increases, and, if the new mortality factor is not too large, the population will produce a harvestable surplus.

The magnitude of this response varies among taxonomic orders of animals, among species, and even among populations of the same species living in different ecological circumstances. The basic anatomical and bioenergetic features of whales determine their maximum net recruitment rates. Understanding this aspect of whale biology is essential to understanding the particular management problems whales present.

Little is known about natural mortality rates for any of the various cetacean species, and virtually nothing is known about changes in those rates as a consequence of exploitation. However, estimated natural mortality rates are so low (5% population/year) that even drastic reductions in this rate would do little to increase the catchable surplus.

Five of the young born in the year \(t_0\) die before the year \(t_0\) when they would have reached sexual maturity \((Y_{10} = 20)\). The gross recruitment rate can therefore be calculated for this population:

\[
r = \frac{Y_{10}}{P_{t_0}} = \frac{20}{200} = 0.10
\]

Note that if the population is increasing or decreasing, the total population \((P)\) may not be the same at \(t_0\) as it was at \(t_0\). However, whether or not the population is stable or changing in size, the recruitment rate represents the productivity of the population (at time \(t_0\)).

Note also that mortality before sexual maturity is included as a component of \(r\).

Most populations of wild animals show continuing fluctuations in size. However, the relatively stable marine environment in which whales live, their long lifespan, and low recruitment rate all suggest that whale population fluctuations would be very small.

Natural mortality \((M)\) may decrease if human caused mortality "substitutes" for the former. Mortality factors frequently act in such a compensatory manner. See R. Dasmann, *Wildlife Biology* 163-65 (1964) [hereinafter cited as Dasmann].

The gross recruitment rate increases because 1) a higher percentage of females becomes pregnant each year, 2) the "resting period" between pregnancies is decreased, 3) animals become sexually mature at a younger age, and 4) juvenile mortality is reduced. See notes 34-40 and accompanying text infra.

For Antarctic fin whales, estimates of adult natural mortality rates are 3.7-4.8%/year, Ohsumi, *Revised Estimation of Recruitment Rate in the Antarctic Fin Whales*, INT'L WHALING COMM'N, 24TH REPORT 192, 193 (1974) [hereinafter cited as Estimation of Recruitment Rate], and 5%/year for sperm whales. SCIENTIFIC COMM., INT'L WHALING COMM'N, 28TH REPORT para. 11.1.2 (to be published 1978). These mortality rates should be contrasted with rates for upland game birds (70%/year) and big game mammals (40%/year). Dasmann, supra note 32, at 108.

The change is on the order of 1% for fin whales. *Estimation of Recruitment Rate*, supra note 34, at 193.
Whales in general manifest some of the lowest recruitment rates found in nature. Several features of their biology are responsible for these low rates. First, the age of sexual maturity is much higher for most whale species than for other animals. This is especially true for sperm whales where females do not attain sexual maturity until they are between 7-13 years old, and males do not reach sexual maturity until they are nearly 20 years old, and may not breed before the age of 30. Second, due to the very high bioenergetic costs of pregnancy and lactation, cetacean females bear only one calf at a time, with rare exceptions, and no female whales larger than minke whales are capable of regularly bearing young more frequently than once every two years.

Exploited whale stocks do exhibit lowered ages of sexual maturity and somewhat higher pregnancy rates. However, since the main factors causing low recruitment rates among whales are rooted in the fundamental physiology and bioenergetics of their existence, their net recruitment rate is only minimally responsive to human manipulation. A whale stock at between 30-70% of its initial population level will exhibit a maximum net recruitment rate \( (r-M) \) of only 5-7% annually.

Certain studies have demonstrated a high level of intelligence among all


37. For excellent discussions of the bioenergetics of whales see *Energy Budgets of Sperm Whales*, supra note 23; and Lockyer, *Growth and Energy Budgets of Large Baleen Whales from the Southern Hemisphere*, Doc. FAO/ACMRR/MM/SC/41 (Mar. 1976) [hereinafter cited as *Energy Budgets of Baleen Whales*].

38. Occasionally a female will bear young in two consecutive years. However, the energy demands of such reproductive activity probably prohibit the continuation of this rate for more than two years and the gain in production is offset by females who only bear young at three year intervals. Mackintosh, *supra* note 7, at 69-80, 110; Slijper, *supra* note 7, at 388-90. In contrast to the baleen whales, sperm whales’ gestation period is longer than one year and lactation continues up to two years. Thus the maximum long-term reproductive capacity of a female sperm whale is only one young every three years. *Energy Budgets of Sperm Whales*, supra note 23, at 1, 14-15; Best, *Review of World Sperm Whale Stocks*, Doc. FAO/ACMRR/MM/SC/8, at 25-27 (Dec. 1975).


40. Net recruitment rates for Antarctic baleen whales are on the order of 4-7%; for sperm whales, the rates are roughly 2% for females and 10% for males, due to their polygynous social structure. *Estimation of Recruitment Rate, supra* note 34, at 193; Allen, *Recruitment to Whale Stocks*, in *The Whale Problem* 352-58 (W. Schevill ed. 1974); *Biology of the Sperm Whale, supra* note 14, at 274-91; *Int’l Whaling Comm’n, 20th Report* 34-35 (1970). Note also that: the rate of increase of a population depleted well below its level of MSY [maximum sustainable yield], but completely protected thereafter, is less than the net recruitment rate in an equilibrium situation. For example, for recruitment rate 8%, recruitment age 5 years, and natural mortality rate 4%, the net recruitment rate in equilibrium situation is 4%, but the rate of increase in recovering unfished population in any year would be about 3% of the stock size in that year, or about 3.5% of the size of the parent stock (the stock size 5 years earlier). Gulland & Boerema, *Scientific Advice on Catch Levels, Int’l Whaling Comm’n, 24th Report* 200, 204 (1975).
cetaceans. Odontocetes especially have extraordinary mental capacities to handle acoustic information. Dolphins, and probably whales, are capable of complex intra- and inter-species communication. When combined with their social habits, long lives, and high intelligence, this ability to communicate may allow for the transmission of information necessary for survival from one generation to the next. If such a culture exists, it is unclear how much disruption a social group can tolerate from human “harvesting.”

Cetaceans are so different from other animals in the level of their intelligence, communicatory abilities, and complexity of social interaction that human experience in managing other species is only partially applicable, at best.

2. Distribution

A rudimentary knowledge of the zoogeography of cetaceans is necessary not only to understand their relation to the legal-geographic spaces of the law of the sea, but also to understand the history of whaling and the efficacy of various types of whaling regulations. Most of the large whales are found in all the major oceans of the world. However, bowhead and gray whales are found only in the Northern Hemisphere. A North Atlantic population of gray whales became extinct by the eighteenth century, possibly as a result of early whaling. The North Atlantic population of bowheads has become extinct, or nearly so, within the last century. Both species are still found in the North Pacific.


42. Most species of cetaceans have few natural enemies other than humans. It is unlikely that they have adapted to a mode of existence designed to endure sustained heavy losses. Currently, the only way of determining the effect of social disruption is by measuring population size variation. If one imagines such a criterion applied to humans, the crudeness of the criterion becomes apparent.


44. NW Atlantic Whale Stocks, supra note 43 at 158-60; Mansfield, Occurrence of the Bowhead or Greenland Right Whale in Canadian Arctic Waters, 28 J. FISH. RES. BOARD CANADA 1873 (1971) [hereinafter cited as Canadian Bowheads].
All baleen whale species show a similar pattern of distribution due to their dependence on krill and other zooplankton. In order to sustain life and grow at their phenomenal rates, baleen whales must find these food items in extremely dense concentrations. Krill feed upon phytoplankton and can exist in dense concentrations only in areas of extremely high phytoplankton productivity. The physical conditions necessary for large concentrations of krill occur only in polar waters and each summer baleen whales must migrate to these polar waters to feed. Historically, the largest summer concentrations of baleen whales occurred in Antarctic waters. Due to its different geography and consequent smaller populations of krill, the Northern Hemisphere has never supported as many baleen whales as the Southern.

In winter, the expanding ice pack and the need for warmer waters for bearing young force the baleen whales to migrate into subtropical and tropical seas. Because those seas have very little krill, most baleen whales do not eat, or eat very little, through the winter. Consequently a substantial portion of the enormous quantity of food consumed during the summer is stored as blubber to provide food during the winter fast. It is estimated that in the summer an adult blue whale gains three-fourths of a ton per week, a fin whale about one-third of a ton per week. They are clearly more valuable commercially at the end of the summer than at the beginning.

45. See Cartographic Division, Nat’l Geogr. Soc., The Great Whales, Migration and Range (Dec. 1976) (map) [hereinafter cited as The Great Whales, Migration and Range]. "Krill" is a general term used to refer to several species of zooplankton that are consumed by baleen whales. In the Antarctic, it consists largely of a small crustacean Euphausia superba. In the Northern Hemisphere baleen whales have a more varied diet that includes several species of krill and fish. SLUPER, supra note 7, at 255-59.

46. It has been estimated that a large blue whale will eat around two tons of krill per day. MACKINTOSH, supra note 7, at 64; other estimates run as high as four tons per day. See Energy Budgets of Baleen Whales, supra note 37, at 21-24.

47. These areas must have rich nutrients, cold water and long hours of sunlight. In certain regions of the polar seas, the cold polar waters meet the warmer temperate currents and a mixing of the waters occurs. This mixing causes nutrients from the bottom to be brought to the surface and made available to the phytoplankton. Oceanographers refer to the area of mixing of temperate and polar waters in the Southern Hemisphere as the Antarctic Convergence. On maps it appears as a line drawn between 50-55’S latitude. Krill occurs in the densest concentrations south of the Antarctic Convergence between 60-70’S. See Gulland, Distribution and Abundance of Whales in Relation to Basic Productivity, in THE WHALE PROBLEM 27 (W. Schevill ed. 1974) [hereinafter cited as Distribution and Abundance of Whales]; MACKINTOSH, supra note 7, at 43-45, 50-58; SLUPER, supra note 7, at 316-42.

48. In the Northern Hemisphere, the land and ice to open sea area ratio is much higher and the seas are shallower. Most of the northern seas have good fish populations but smaller amounts of krill.

49. See The Great Whales, Migration and Range, supra note 45. Since the seasons are six months out of phase between the Northern and Southern Hemispheres, whales in different hemispheres will migrate to tropical waters, mate and bear young six months apart; thus there is very little interchange between southern and northern populations of the same species.

50. MACKINTOSH, supra note 7, at 59; see also Energy Budgets of Baleen Whales, supra note 37, at 20-21.

51. SMALL, supra note 5, at 186-87; see also Energy Budgets of Baleen Whales, supra note 37, at 14-18.
Although all baleen whale species engage in extensive migrations from their subtropical or tropical winter ranges to more polar ranges, each species manifests a distinct temporal and geographic migratory pattern. Consequently the relative concentration of different species changes over different latitudes and over time. These changes are reflected in the whale catch. For example, sei, Bryde’s, and minke whales were not taken in the Antarctic for a long time partly because the whalers concentrated on blue whales which were found south of the former whales’ ranges.

Despite the need to study whales at their breeding grounds in order to distinguish stocks, very little is known about the breeding distribution of most stocks of whales, particularly rorquals. This is so because most research has been connected with the whaling industry’s summer operations, and because the rorquals generally disperse over a wide area during winter and consequently are harder to study. What little is known about stocks has been gained from whales that were marked and recaptured by shore stations or whaling vessels during migration.

The toothed whales do not feed on krill and, therefore, do not show the same distribution as baleen whales. Generally, odontocetes feed on fish and cephalopods, such as squid. Sperm whales are found in all the major oceans of the world from arctic to tropical waters. They migrate shorter distances than do baleen whales. The solitary males tend to be found closer to the poles than the females during the summer. Thus, not only can sperm whale quotas be set by sex, but whaling can be concentrated in those areas where the large majority of the whales found are “surplus” solitary males.

E. Uses of Whales

"Can he who has discovered only some of the values of whalebone and whale oil be said to have discovered the true use of the whale? Can he who slays the elephant for his ivory be said to have 'seen the elephant'? These are petty and accidental uses; just as if a stronger race were to kill us in order to make buttons and flageolets of our bones."

—_Henry David Thoreau_

In the homocentric world of the twentieth century, conservationists and

52. See _Mackintosh_, supra note 7, at 64-67, 87-94; _The Great Whales, Migration and Range_, supra note 45.
54. "Rorqual" is the popular term for baleen whale species belonging to the taxonomic family Balaenopteridae. See Figure I in text.
56. _Biology of the Sperm Whale_, supra note 14, at 258-59.
57. _Id._ at 239-67, 288-89; see also _Morzer-Bruyns_, supra note 7, chart 10.
resource managers are constantly required to justify the conservation of a resource in terms of its utilizable value to humans. Historically, the most economically important use of whales consisted of the manufacture of industrial and consumer products from their carcasses. Today, whales are also recognized as aesthetic and recreational resources of great value, as well as resources of considerable importance for scientific research. It may also be that the whales' role in the marine ecosystem has yet undiscovered value to humans.

The commercial products derived from baleen whales are quite distinct from those derived from sperm whales and other odontocetes. Except during the first half of the 19th century, baleen whales have been more economically valuable than sperm whales. In 1975, the Food and Agriculture Organization of the United Nations (FAO) estimated that baleen whales were worth approximately $190/ton as compared with $75/ton for sperm whales, and that baleen whales constituted approximately 77% of the value of the world whale catch.

Historically, the most valuable products of baleen whales have been their baleen (whalebone) and oil. By the early 1960's, meat became the most important product. Although much of this meat was initially used as animal food, approximately 85% of baleen whale meat is now consumed by humans. The meat is nutritious and somewhat similar to beef in taste.

The oil of all baleen species is very similar and is referred to as "whale oil." It is extracted from the blubber, meat and bones, and is processed into margarine and cooking oil. Numerous other products are made from the skin, baleen, and organs of baleen whales, but these tend to be of only secondary economic importance.

The most valuable product derived from sperm whales is sperm oil.

59. For an excellent discussion of the effect of such a viewpoint on legal institutions concerned with environmental protection, see C. Stone, Should Trees Have Standing? 91-111 (Discus paper ed. 1975).


61. Baleen consists of a series of horny plates which grow down from the upper jaws of baleen whales. These plates vary from 1 to 14 feet in length and from 2 to 18 inches in width, depending upon the species. A blue whale may have up to 800 plates of baleen in its mouth. See Small, supra note 5, at 16-19; Sluper, supra note 7, at 259-67.


63. Id. at 32.

64. "It is quite certain that the average North American exposed to a properly prepared grade A cut of whale beef, will welcome it as an excellent alternative to cow or steer beef." Foote, Investigations of Small Whale Hunting in Northern Norway, 32 J. Fish. Res. Board Canada 1163, 1189 (1975) [hereinafter cited as Foote]; Japan Whaling Ass'n, Are the Whales Really Threatened with Extinction? 25-26 (Tokyo 1973) [hereinafter cited as JWA I].

Unlike "whale oil," sperm oil is inedible and is more like a liquid wax. Because sperm oil does not smoke when burned, it was widely used as an illuminating fuel during the 19th century. Today, its main use is as a high-grade machine lubricant.66

Sperm whale meat has a very strong taste and is generally not eaten except in some local areas of Japan. New technological processes may be able to make the taste acceptable for widespread human consumption.67 As with baleen whales, almost all parts of sperm whales are made into byproducts. Two of the better known byproducts are teeth, which are used in scrimshaw, and ambergris.68

It has been estimated that the total value of whale products in 1972 was on the order of $100 million.69 Had the industry been able to market the maximum sustainable harvest from undepleted stocks at the same prices, the total value would have been on the order of $500 million.70 Approximately 95% of the whales caught in recent years were caught by ships from developed countries, and the products were almost entirely consumed by developed countries.71

The high-consumptive uses of whales must be evaluated in light of the recent dramatic increase72 in non- and low-consumptive uses of whales. In 1976, a conservative estimate of the value of these uses for all marine mammals73 exceeded $225 million.74 Each winter, hundreds of thousands of people in California watch the gray whale migration either from the shore or from commercial whale-watching boats.75 Others travel to Peninsula Valdez in Argentina to watch wintering right whales.76 In the last five years at least nine special television programs have been made concerning whales.77 The songs of the humpback whale were reproduced on a record album78 and used

66. See FOE, supra note 65, at 98-103; id. Oct. 1975 REPRINT, at 4-5; SMALL, supra note 5, at 104; BRANDT, supra note 65, at 25, 133-34.
67. See Draft Report on Large Cetaceans, supra note 14, at 41; FOE, supra note 65, at 45.
68. See FOE, supra note 65, at 98-100.
70. Id. at 40.
71. Id. at 32-33; FOE, supra note 65, at 107-15.
72. Low consumptive uses include the taking of animals (as for scientific research or oceanarium displays), but the drain on the wild population is so small as to be almost negligible.
73. This figure includes low consumptive uses of seals, sea otters, and sirenians.
as background music in a popular album by Judy Collins. Whales have also been favorite subjects of artists and sculptors since the days of ancient Crete.

Whales possess many anatomical, physiological, and behavioral traits of great scientific interest and value. Considerable study is being done on their large and complex brains and has recently begun on the eerie "songs" of the humpback whales, the possible extreme long-distance communication of fin whales, and the tremendously loud explosion-like sounds of the sperm whale. The unique respiratory adaptations of whales, especially the deeper-diving species, may yield important data for human utilization. Finally, the study of whales' social behavior and its relation to their ecology promises to make significant contribution to the developing science of sociobiology.

II

THE HISTORY OF WHALING AND EARLY REGULATION

"The history of whaling is made up of a number of chapters each covering a few centuries and all more or less repeating the same pattern. . . . Each began with new discovery and hopeful enterprise, passed through a phase of fierce competition and ruthless exploitation with improving techniques and ended at length in diminishing resources, exhaustion and failure."

—F.D. Ommanney

The long and complex history of whaling has been well described in many books and articles and will be treated only briefly here. This history reveals repeated patterns, the most obvious pattern being the sequential depletion of stocks and species mentioned by Ommanney above. Other recurring features of this history include subsidizing the hunting of rare species by simultaneous hunting of common species, and long delays before conservation measures were accepted.

The near cyclical nature of the patterns described by Ommanney strongly suggests that the same socio-economic factors were operating in each "chapter" of whaling history. As explored in the following sections, lessons of past failures were not learned and incorporated into new conservation measures. Many of those socio-economic factors are still operative but are not recognized or dealt with adequately.

80. See Foster, The Whale Object: a Portfolio of Drawings, in Mind in the Waters 97 (J. McIntyre ed. 1974); see generally Mind in the Waters, at 31-46.
85. F. Ommanney, Lost Leviathan 69 (1971) [hereinafter cited as Ommanney].
The following history also examines changes in both the cast of whaling nations and in the uses of whale products. The two major contemporary whaling nations, the Soviet Union and Japan, are often justified in claiming that they are damned for situations they inherited rather than created. Past changes in the use of whale products and the unpredictability of those changes highlight the importance of preserving future options in the management of cetacean resources.

A. Early Whaling

"Modern" whaling began in the 11th or 12th centuries when Basques first ventured out into the Bay of Biscay to hunt right whales. This species was common at that time, swam slowly and close to shore, and floated when killed—features which made them the "right" whale to kill. Despite primitive technology, early whalers depleted local stocks by the 13th century and were forced to move on to new stocks. By the 15th century, the Basques improved their technology and were able to catch right whales farther and farther from shore. The era of pelagic whaling had begun.

The new Basque technology was soon adopted by other nations, and by the 17th century, right whales were becoming extremely scarce in the North Atlantic. As a consequence, the whaling industry, dominated by Holland, began hunting the newly discovered stocks of bowhead or "Greenland right whales." However, by providing a new source of revenue, the common bowheads subsidized continued whaling of the "commercially extinct" right whales.

86. For example, sperm oil was initially sought as a fuel for lamps. It has been used more recently in automatic transmissions of cars and as a lubricant for intercontinental ballistic missiles; see text accompanying note 66 supra.

87. The most readable account of early whaling is I. Sanderson, Follow the Whale (1956). Other good accounts of early whaling include J. Jenkins, A History of the Whale Fisheries (London 1921); The Whale, supra note 65.

88. For the first centuries of this operation whales were hunted for their meat. During the 13th and 14th centuries, the Basques started hunting whales for their oil (for lamps) and for baleen to use in making "horn" windows and utensils. The meat was not used, and once the blubber had been stripped from the animal and the baleen removed, the carcass was cast adrift. See Sluiper, supra note 7, at 17. See also The Whale, supra note 65, at 96; Ommenney, supra note 85, at 70-73.

89. Pelagic whaling refers to the taking and processing of whales on the high seas. The Basques had developed "tryworks"—a combination of furnaces and pots used to separate the oil from the blubber—that could be used on deck, and it was no longer necessary to haul the whale to shore for processing. Ommenney, supra note 85, at 73.

90. "A detailed commentary on these North Atlantic catches [in 4 Int'l Whaling Statistics 10-18 (1933)] leaves no reasonable doubt that the declining catches at one place after another were in fact due to excessive hunting." Mackintosh, supra note 7, at 146; see also Sluiper, supra note 7, at 17 for an alternate view of the reasons for the decline of the right whale fishery.


92. Bowheads were common, if not abundant, in the arctic North Atlantic and the industry rapidly expanded. By 1680, Holland alone had 14,000 men working 260 whaling ships. In 1697, over 1,800 whales were caught just in the area near Spitzbergen. Sluiper, supra note 7, at 20-22.
The whalers moved further and further west in search of undepleted stocks. During the 17th century a small whaling industry became established in New England and the mid-Atlantic colonies. Overexploitation of local stocks was so severe that less than a century later the industry was on the verge of collapse. Only the chance discovery in 1712 that sperm whales could successfully be exploited revived the dying industry. Although the meat could not be eaten, the oil provided a smokeless lamp fuel.

Yankee whalers from Nantucket, New Bedford, and Mystic circumnavigated the globe in whaling voyages that often lasted as long as four years. By the middle of the 18th century, large stocks of right whales were discovered off South Africa, Australia, and New Zealand. These as well as humpback whales were caught when encountered, due to the easy kill and lack of danger in the chase. Nevertheless, the more dangerous sperm whale formed the mainstay of the world whaling industry. When the American industry hit its peak in 1846, it employed 70,000 people and 729 whaling ships sailed under the American flag. The eastern industry collapsed during the Civil War since most of the whaling fleet was destroyed in the hostilities. But the industry’s failure to recover after the war was due in large part to the depleted condition of the whale stocks.

During the second half of the 19th century, a second American whaling industry developed on the West Coast. Some whalers went north into the Bering Sea to hunt the bowheads that survived there. Others went south to hunt the California gray whale. Gray whales seek protected lagoons in which to bear their young. When the largest of these nurseries was discovered

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93. Id. at 25. See also Lipton, Whaling Days in New Jersey, 26 Newark Museum Q. (Spring/Summer 1975).
95. Apart from killing Sperm Whales, the men also wreaked what can only be described as carnage amongst the Southern Right Whales... During the first twenty years of the nineteenth century an annual average of just under 14,000 of these animals was caught.
96. Herman Melville’s Moby Dick (1851) still remains the classic and one of the best descriptions of the American sperm whaling industry.
97. Hill, supra note 94, at 85. See also Brandt, supra note 65, at 50.
98. The discovery of petroleum in 1859 seriously reduced the demand for sperm oil, and the development of the incandescent lamp in 1879 marked the end of the first great era of sperm whaling. Ommeney, supra note 85, at 92; Brandt, supra note 65, at 53-56.
99. Bowheads were generally hunted for both their oil and baleen, but the latter was so valuable that it was often the only part of the whale that was used. “At the peak of its demand in the late nineteenth century, the baleen from a single bowhead commanded a price of $9,000—the cost of an entire Arctic whaling expedition.” Hill, supra note 94, at 79. The classic account of the early bowhead fishery is W. Scoresby, An Account of the Arctic Regions with a History and Description of the Northern Whale-Fishery (Edinburgh 1820).
in Baja, California, by Charles Scammon in 1851, the fate of the gray whales was sealed. By 1890 the southern whaling industry was dead, and the gray whale was believed to be biologically extinct. 101

**B. Antarctic Whaling**

For the third time, the whaling industry appeared to have self-destructed. During the 19th century, gray, right, bowhead, and northern humpback whales had been driven to the edge of extinction. The remaining sperm whales were not sufficiently valuable to support the industry. As one commentator wrote:

> [A]ll the whale species slow enough to be approached by a rowboat had been virtually wiped out. The industry was all but finished. Nobody surveying the whaling scene in 1900 would have dreamed of what was to take place. Soon more whales would be killed in four decades than in the previous four centuries. 102

This Phoenix-like rebirth during the 20th century was not due to the recovery of previously exploited stocks, but rather to new technology. Whalers had long known of rorqual whales, 103 but had been unable to hunt them because rorquals swim faster than sailing ships and sink when killed. 104 Steam powered "catcher boats" gave whalers the speed they needed. In the 1860's, the Norwegians developed gun-fired harpoons with heads that exploded after impact with the whale and compressed air pumps to keep the carcasses from sinking. 105 By 1868, these techniques had been perfected and the relatively small populations of blue and fin whales in the North Atlantic became subjected to intense exploitation.

Following the rapid depletion of the rorqual stocks off Norway in the last decade of the 19th century, the whalers moved on to Iceland, the Faroe Islands, Newfoundland, and other areas of the North Atlantic. They took with them a new invention—the factory ship. The factory ship processed the whales caught by its fleet of a dozen or more small, fast catcher boats. Each chapter was the same: rapid development of a local industry, destruction of local stocks, and finally, a search for new whaling grounds. 106

The earlier drastic reduction in the number of southern right whales forced whalers to search farther south into inhospitable Antarctic seas. Just

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101. SMALL, supra note 5, at 5-6.
102. Hill, supra note 94, at 85.
104. As Melville put it: "The whalebone whales can at last resort to their Polar citadels, and diving under the ultimate glassy barriers and walls there, coming up among icy fields and floes; and, in a charmed circle of everlasting December, bid defiance to all pursuit from man." MELVILLE, supra note 103, at 588.
105. Bock, supra note 5, at 66 et seq.; SMALL, supra note 5, at 7-9.
106. The whalers rapidly depleted the local stocks at each site. The catch off Norway rose to 1,000 animals per year then fell to less than 400 by 1903. Off Iceland, kills increased from eight in 1883 to over 1,300 in 1902, then crashed to 54 by 1915. SMALL, supra note 5, at 7-9; Bock, supra note 5, at 68-69; MACKINTOSH, supra note 7, at 145.
prior to the turn of the century, Norwegian expeditions discovered large numbers of fin whales in the Antarctic. By 1904, the first Antarctic shore station had been established at South Georgia Island in the extreme South Atlantic. A year later the first factory ship went to the Antarctic. The era of Antarctic whaling had begun.

During the early years of Antarctic whaling about 90 percent of the catch consisted of humpback whales. In 1911, 8,500 humpbacks were killed compared with only 175 blue whales. But as the slow, coastal humpbacks became scarce, the fleets began hunting the faster, deep-water blue whales. By 1922 the annual catch of humpbacks had fallen to nine and the blue whale catch had increased to 5,700.107

By the time World War I broke out, Norway alone had about 60 whaling companies which operated 22 shore stations, 31 factory ships, and 145 catcher boats in the Antarctic. Their total catch in the Antarctic in 1913-14 amounted to almost 15,000 whales—80 percent of the world catch for that year and over three times the total annual world catch of a decade earlier.108

The rapid growth of the whaling industry was stopped by World War I. Although many whaling ships were converted to military uses, whaling continued during the war and approximately 10,000 whales were taken each year. The industry recovered rapidly after the war, and by 1931 the world catch had skyrocketed to 43,129 whales.109 Whale oil production increased nearly tenfold between 1920 and 1931. Because the industry had grossly depleted those species richest in oil (humpback, right, and blue whales), oil production in later years never exceeded the 1931 level despite an increase of more than 50 percent in the number of whales harvested annually.110

C. Whaling Regulation before World War II

Regulation of whaling in the first quarter of the 20th century was scant

107. SMALL, supra note 5, at 13. See Figure II in text.
108. Bock, supra note 5, at 68-69. The whales were so plentiful that extremely wasteful techniques were used to catch and process them:

For many years only the back and belly blubber of the whale was utilized; the thinner layers on the tail flukes, head, and jaws were ignored. The oil rich bones, the meat, and valuable organs were not used at all. In short, once the back and belly blubber had been flensed off, the entire whale carcass was cast adrift. On calm days many harbors in the Antarctic were cluttered with the stinking, decaying carcasses of dozens of half-skinned whales. SMALL, supra note 5, at 12. The loss rate of whales harpooned and not recovered later averaged between 20 to 25%. Id.
109. One factor that allowed for the dramatic increase in the number of whales caught was the development of the stern slipway by Norwegians in 1925. Whales could now be hauled on board the factory ship and processed in all but the roughest seas, whereas previously factory ships could only operate in calm water. This invention allowed factory ships to operate far from land and with much greater efficiency. By 1930, 38 factory ships equipped with stern slipways were operating in the Antarctic with 184 catcher boats. SMALL, supra note 5, at 13-14; Bock, supra note 5, at 70, 76; 16 INT'L WHALING STATISTICS 78 (1942).
110. 16 INT'L WHALING STATISTICS 78 (1942). See Figure II in text.
In the early years the industry depended largely on humpback whales from the Atlantic sector. From 1927 to 1936 blue whales predominated in the catch, and thereafter, until 1964, fin whales were the most common. Sei and sperm whales now outnumber fin whales and since 1971 increasing catches of minke whales have been taken. The southern right whale has been totally protected since 1935; in the Antarctic the humpback whale has been protected since 1964 and the blue whale since 1965.

and ineffective.\textsuperscript{111} A few conservationist voices were raised protesting the slaughter before World War I, but they received little attention.\textsuperscript{112} During the early post-war period, the matter of international regulation of whaling was brought up at several international meetings,\textsuperscript{113} but little substantive action\textsuperscript{114} was taken until 1931, when the first serious attempt was made to establish an international regulatory scheme for whaling.

The first Convention for the Regulation of Whaling, signed on September 24, 1931 was, at best, a very tentative step towards conservation.\textsuperscript{115} At worst, it was a complete whitewash of the problem. The Convention applied only to baleen whales and the regulations ignored the urgency of the biological situation.\textsuperscript{116} "Immature, undersized" whales were granted protection, but those terms were never defined.\textsuperscript{117} The extremely rare right whales were given limited protection,\textsuperscript{118} but no harvest quotas were established for any other species, and no overall quotas were established at all. No attempt was made to limit the number of whales taken by establishing shorter seasons

\textsuperscript{111} Although there was some awareness of the problem of depleting the whale stocks, the early regulation of whaling was not concerned with protecting the whales. Instead, governments were interested in protecting their national industries, encouraging them and taxing them, or curtailing their activities under pressure from fishing interests. Whatever benefits accrued to the whales were purely incidental.

Bock, \textit{supra} note 5, at 72. Bock's dissertation has a very good account of early whaling regulation.

\textsuperscript{112} \textit{Id}. at 74.


\textsuperscript{114} The whaling countries were not completely blind to the need for controls, but they preferred to implement their own national controls rather than create an international agency. In 1929, Norway prohibited its whalers from taking right whales, whale calves, and cows with suckling calves. Great Britain, Australia, and other countries adopted similar regulations. Many of these conservation measures were hardly overwhelming. For example, many countries established minimum length requirements for whales taken, those for blue whales generally being set at 65 feet for shore stations and 70 feet for pelagic whalers. However, Antarctic male blue whales do not achieve sexual maturity until they are 74 feet long, and females until they are 78 feet long. The animals were not being allowed to replace themselves in the population before they were being killed. Females with calves were protected, but pregnant females were not (nor could they be since neither sex nor pregnancy could be detected while the whale was in the water). Bock, \textit{supra} note 5, at 79-80; Small, \textit{supra} note 5, at 26-27; see also Mackintosh, \textit{supra} note 7, at 166-68.


\textsuperscript{116} 1931 Whaling Convention, \textit{supra} note 115, art. 2.

\textsuperscript{117} \textit{Id}. art. 5.

\textsuperscript{118} This protection applies to right whales, bowhead whales, and pygmy right whales (\textit{Caperea marginata}). \textit{Id}. art. 4.
or limitations on the number of ships used.\footnote{119}{119} Worse yet, several whaling countries—Japan, Germany, Chile, Argentina, and the Soviet Union—did not sign the Convention.

The failure of governments to achieve an international agreement led to independent efforts by the whaling companies to regulate the industry themselves. The companies were motivated less by a desire to save whales than by a desire to increase profits.\footnote{120}{120} In the summer of 1932, all the major whaling companies joined in an agreement to limit the production of whale oil. Individual companies were assigned harvest quotas to limit the amount of oil each company could place on the market. Quotas could only be made operational in terms of the number of whales killed. To solve this problem, the companies devised a "blue whale unit" (b.w.u.). One blue whale unit equalled either one blue, three humpback, or five sei whales. Quotas were assigned in blue whale units. Each company could capture its quota in whatever mixture of species was most convenient. This cartel lasted two years.\footnote{121}{121}

By 1936 comprehensive international regulation was no longer politically feasible. However, Great Britain and Norway, which together accounted for over 95 percent of the world catch, reached a bilateral agreement imposing limited restraints on their whaling industries.\footnote{122}{122} Subsequently the Norwegian government initiated a conference held in 1937 at which several additional nations agreed to be bound by the terms of the 1936 Anglo-Norwegian agreement.\footnote{123}{123} Further conferences were held in 1938\footnote{124}{124} and 1939, but the outbreak of World War II caused the cancellation of a fourth meeting scheduled for 1940.\footnote{125}{125} Although the conservation value of these prewar

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\footnote{119}{Probably the most important measure contained in the Convention was the requirement that the whaling ships collect at least a minimum amount of biological data from the captured whales and transmit this data to the recently formed International Bureau of Whaling Statistics (BIWS) in Norway. \textit{Id.} arts. 10-12; see also Bock, \textit{supra} note 5, at 80, 155-59.}

\footnote{120}{The industry was overcapitalized and overproductive. Production had increased from 1 million bbls. of oil in 1930 to 3.5 million bbls. in 1931. Partly due to the world-wide depression, there was no market for all this oil, and the price collapsed. Bock, \textit{supra} note 5, at 86-87.}

\footnote{121}{Although the cartel succeeded in reducing production, the price of oil failed to respond and it became increasingly difficult to allocate the quotas among the companies. During the 1934-35 season, whaling was again virtually unregulated. Attempts were made to revive the agreements, but the initiation of whaling by two Japanese and one German company without regard for quotas and the gradually deteriorating competitive situation of the Norwegian companies made such agreements increasingly unlikely. \textit{Id.} at 86-94. For an excellent description of the politics of this period, see Vamplew, \textit{The Evolution of International Whaling Controls}, 2 \textit{MARITIME HISTORY} 123, 124-32 (1972); see also Bettum, \textit{Some Observations on the Development of Whaling and its Central Problem Today}, 49 \textit{NORSK HVALFANGST-TIDENDE} 246 (June 1960).}

\footnote{122}{10 \textit{INT'L WHALING STATISTICS} 1 (1937).}

\footnote{123}{Agreement for the Regulation of Whaling and Final Act, June 8, 1937, 52 Stat. 1460, T.S. No. 933, 190 L.N.T.S. 79. For the first time, gray whales were internationally protected under this treaty (art. 4).}

\footnote{124}{Protocol amending the International Agreement and Final Act, June 24, 1938, 53 Stat. 1794, T.S. No. 944, 196 L.N.T.S. 131.}

\footnote{125}{For an excellent detailed description of all the prewar whaling conferences, see Leonard, \textit{Recent Negotiations Toward the International Regulation of Whaling}, 35 \textit{AM. J. INT'L L.} 90 (1941) [hereinafter cited as Leonard]; see also Bock, \textit{supra} note 5, at 84-110.}
conferences is questionable, they did establish the precedent of annual international conferences on whale conservation.126

During the 1938-39 season, there were 16 shore stations, 37 active factory ships, and 362 catcher boats operating in the Antarctic. The factory ships came from seven different nations: thirteen from Norway, ten from England, six from Japan, five from Germany, and one each from Panama, the United States, and the Soviet Union. While this was a substantial increase in equipment from the previous season, the catch of 45,783 whales and production of 3+ million bbls. of oil was lower than the previous year. The decline was further evidence of the depletion of the Antarctic stocks.127

During the war, most of the factory ships were used to transport oil and many were lost to submarines due to their slow speed. Of 41 factory ships in the industry in 1940, 27 were lost and four converted to different uses.128 There was no pelagic whaling in the Antarctic during the 1941-42 and 1942-43 seasons, and only one factory ship operated during the following two seasons. From 1939 to 1945, a total of 82,000 whales was killed, compared with 269,000 during the previous six year period.129

The period following World War II marked a tremendous opportunity for whale conservation. The drastic overcapitalization of the whaling industry that had occurred during the 1930's had been eradicated due to losses from the war. The two countries that had resisted international regulation most adamantly, Germany and Japan, were no longer capable of resisting regulation; the willingness of all whaling nations to establish international regulatory agencies was at its peak.

The first postwar conference occurred even before the end of the war in January 1944. That conference reaffirmed the conservation measures of the 1937-38 conferences, and set a quota of 16,000 blue whale units for the Antarctic region. The b.w.u. was changed to equal one blue whale, two fins, two and one-half humpbacks, or six sei whales.130 The blue whale unit,

126. Leonard, supra note 125, writing in 1941, felt that the prewar conferences had achieved some significant agreements on conservation goals. Right and gray whales were granted protection, closed seasons were established for shore and pelagic whaling, "sanctuaries" were established in breeding areas, minimum size limits were created (but see note 114 supra), and governments had assumed the obligation to license and inspect whaling operations, and to provide catch data to the Bureau of International Whaling Statistics. Chapman more recently argued that "[t]he effect of these activities was inconsequential. The regulations adopted were stop gap measures; they protected unimportant species, closed inconsequential areas . . . but never came to the core of the problem—the limitation of kill in a particular stock to a level corresponding with maximum sustainable yield." Chapman, The Theory and Practice of International Fishery Development—Management, 7 SAN DIEGO L. REV. 408, 428 (1970).

127. Bock, supra note 5, at 109-10. For a good account of Antarctic whaling between the wars, see OMMANNEY, supra note 85, and Harmer, Southern Whaling, 142 PROCEEDINGS LINNNEAN SOC. LONDON 85 (1931).

128. 17 INT'L WHALING STATISTICS 8 (1947) as adjusted in Bock, supra note 5, at 113.

129. Bock, supra note 5, at 110-14.

130. Note that this definition is slightly different than the previous definition. See text accompanying note 121 supra.
originally designed to limit oil production, became the means adopted for conservation. Blue whale unit quotas were based on the combined estimated sustainable yields from all species currently hunted. Since the relative values of the different species were taken into account in defining the b.w.u., it was anticipated that whalers would divide their effort between species and that each species would be harvested only at sustainable levels. This expectation failed to consider adequately the relative ease of catching the larger species, the different geographic distribution of the various species, and changes in the relative economic value of species as a consequence of changing uses.

With hindsight, the optimism of this period seems almost tragic. The measures that were adopted were grossly inadequate to accomplish their goal of conservation. The quota of 16,000 b.w.u. was far above what stocks could sustain, and while the blue whale unit was good in theory, it could not and did not prevent whalers from fulfilling their quotas with blue and humpback whales. Worse yet, none of the economic conditions that had led to the overcapitalization of the industry in the 1930's had been altered. Whales were still treated as a common property resource, and no attempts had been successful in limiting the incentive for companies to invest greater amounts of money in more equipment. Once more, the whaling industry was to repeat its self-destructive cycle.

III
THE INTERNATIONAL WHALING COMMISSION
A. The 1946 Whaling Conference

The reprieve that World War II provided for the whales ended almost as soon as the hostilities. The first postwar season began in late November 1945, at a time when the major whaling countries met in London to set season dates and quotas for the 1946-47 season. Whaling countries sent out nine expeditions, confident that stocks had recovered to their former abundance and that whale oil would alleviate the great shortage of edible oils and fats in war-ravaged Europe.131

The season was a disaster. Despite poor whaling conditions, the harvest left little doubt in the minds of most marine biologists that the whale stocks had not recovered.132 Against the background of the disappointing 1945-46 season and the general postwar spirit of international cooperation, the United States convened the second postwar international whaling conference in Washington, D.C. on November 20, 1946.

The conference was dominated by Norway, Great Britain, and the United States. Since the Soviet Union and the Netherlands were aspiring whaling nations, they too played active roles.133 The delegates drafted a

131. Bock, supra note 5, at 118-19.
132. Id. at 119-20.
133. Much of the conference itself was concerned with issues that appear peripheral from a historical perspective—the prohibition of the use of Norwegian harpooners on foreign ships, a
convention, which only slightly modified a proposal that had been presented by the United States. At the close of the conference, 14 nations, including all major pelagic whaling nations, signed, and later ratified the International Convention for the Regulation of Whaling, which established the International Whaling Commission (IWC).

B. The International Convention for the Regulation of Whaling

The Whaling Convention has dictated the pattern of whale management and conservation for the past 30 years. It has been amended only once during this period and continues to govern most whaling done in the world. Nations have rarely established alternate regulatory schemes. Because both the declared purposes and the structural framework of the IWC as determined by the Convention have had profound and often undesirable effects on the history of whale conservation, they will be examined in some detail in the following subsections.

1. Conflict of Purposes

One of the major problems of the Convention is that it strives to achieve several goals which have proven incompatible. Its first goal is defined rather nebulously as the conservation of whale stocks. The preamble recognizes "that it is in the common interest to achieve the optimum level of whale stocks," but "optimum level" is never defined. The preamble also refers
temporary extension of the season for the Soviet fleet, and minimum length restrictions for sperm whales. Id. at 120-34.

134. One of the significant changes made in the United States proposal concerned the independent status of the resulting regulatory agency. The United States had proposed that the agency be incorporated into the F.A.O. It was felt that such affiliation would have "greater impact on world thinking about whale conservation . . . there would be avenues of approach to all countries not only signatories of the convention." Id. at 129-30. The proposal met with strong opposition from England, Norway, and the Netherlands, and it was agreed to drop the proposal and reconsider it in several years. In 1951 the idea of joining with the F.A.O. was again quickly dismissed. INT'L WHALING COMM'N, 2ND REPORT 4 (1951).

135. The original signatories were Australia, Brazil, Canada, Chile, Denmark, France, the Netherlands, New Zealand, Norway, Peru, U.S.S.R., United Kingdom, United States, and South Africa. As of October 1976, there were 17 members: Argentina, Australia, Brazil, Canada, Denmark, France, Iceland, the Netherlands, Japan, Mexico, New Zealand, Norway, Panama, South Africa, U.S.S.R., United Kingdom, and the United States.

136. The major pelagic whaling countries in 1946 were Great Britain, Norway, and the Netherlands. The Soviet Union did not become a major whaling power until the early 1960's. See The Soviet Whaling Industry, 44 NORSK HVALFANGST-TIDENDE 106 (1955). Japan joined the IWC in 1951. See Bock, supra note 5, at 165-66, 228.


138. IWC Convention, supra note 137, Preamble. The Preamble also contains other paragraphs which very generally deplore the failure of past efforts at conservation without specifically establishing goals for the convention:
to the "optimum utilization" of whale resources and vaguely implies that such utilization occurs at the optimum population levels. The second major goal of the Convention is to "make possible the orderly development of the whaling industry." 140

The drafters did not recognize the contradictions inherent in the conjunction of these two goals and so did not provide for the resolution of the inevitable conflicts. They apparently assumed that the whaling industry desired the recovery of the whale stocks to "optimum levels" in order to assure its own orderly development. Had the delegates examined the situation in 1946 more carefully, they would have found that the whaling industry was already overdeveloped and that controls were needed to prevent any increases in the size of the industry. Instead of allowing the whale stocks to recover, the industry used the goal of industrial development to justify continued depletion of certain whale species.

The Convention also requires that the interests of "the consumers of whale products" be considered in the establishment of management goals and in the development of whaling regulations. 141 These interests are never defined, although the drafters probably were thinking only in terms of a steady and inexpensive supply of whale oil and meat. During the next 30 years, the industry, claiming it represented the interests of the consumers, used this provision to further its own interests. 142

The incompatibility of the Convention's goals is reflected in both the structure and history of the IWC. The political, economic, and biological factors which rendered these goals antagonistic are the subject of the section on the history of the IWC and of the later assessment sections.

2. Structure of the IWC

The International Whaling Commission was established as a permanent agency by, and receives authority from, the International Convention for the Regulation of Whaling. The Convention consists of a series of general regulations (Convention) and an appendix containing a great number of specific whaling regulations, designed to be amended frequently (Schedule).

The Commission is composed of one commissioner from each member country recognizing the interest of the nations of the world in safeguarding for future generations the great natural resources represented by the whale stocks;

Considering that the history of whaling has seen over-fishing of one area after another and of one species of whale after another to such a degree that it is essential to protect all species from further over-fishing;

Desiring to establish a system of international regulation for the whale fisheries to ensure proper and effective conservation and development of whale stocks.

Id.

139. Id. art. V, para. 2(a).
140. Id. Preamble, para. 8.
141. Id. art. V, para. 2(d); see also Preamble, para. 5.
142. For example, see JWA I, supra note 64, at 24-26, 33-35.
nation. Each nation also may send additional experts as non-voting delegates.\textsuperscript{143} The IWC meets once a year, in June, usually in or near London\textsuperscript{144} to review the previous year’s catch and to decide if new regulations are necessary. It has authority to promulgate regulations which apply to “factory ships, land stations, and whale catchers under the jurisdiction of the Contracting Governments [\textit{i.e.}, member nations] and to all waters in which whaling is prosecuted by such factory ships, land stations and whale catchers.”\textsuperscript{145}

The Commission is authorized to establish both permanent and \textit{ad hoc} committees.\textsuperscript{146} To date, three permanent committees—Finance and Administration, Scientific, and Technical—and numerous short-lived \textit{ad hoc} committees have been established. The Finance and Administration Committee consists of representatives from five member nations. It is responsible for the budget, expenditures, and personnel.\textsuperscript{147}

Any member nation may have any number of representatives on the Scientific and Technical Committees, although each nation is allowed only one vote on each committee. Each of the major whaling nations usually has several representatives present at the Scientific Committee meetings.\textsuperscript{148} That committee reviews catch data and research programs of member nations. Based upon this review, it makes recommendations to the Commission concerning sustainable yield quotas, rates of depletion of stocks, and research needs.\textsuperscript{149} The Technical Committee reviews the annual reports of infractions and drafts amendments to the Schedule for consideration by the Commission, based upon the Scientific Committee’s recommendations.\textsuperscript{150}

In the past the Commission’s effectiveness has been hampered by staff and budgetary limitations, but the situation is improving. Until early 1976, the staff of the IWC consisted of one part-time administrator and some part-time clerical help.\textsuperscript{151} Now the Commission employs a trained cetologist as Executive Secretary who has authority to hire one or more assistants.\textsuperscript{152} The Commission also has the authority to hire consultants to conduct

\textsuperscript{143} IWC Convention, \textit{supra} note 137, art. III, para. 1.

\textsuperscript{144} The current address of the International Whaling Commission is: The Red House, Station Road, Histon, Cambridge, CB4 4NP, Great Britain. An agenda of topics to be discussed is circulated to all members prior to each annual meeting. Before any amendment to the Convention or Schedule can be formally considered, notice must be sent to all members at least 60 days before the meeting convenes. \textit{INT’L WHALING COMM’N, RULES OF PROCEDURE} rule XII (amended 1959) [hereinafter cited as \textit{IWC RULES}].

\textsuperscript{145} IWC Convention, \textit{supra} note 137, art. I, para. 2.

\textsuperscript{146} IWC RULES, \textit{supra} note 144.

\textsuperscript{147} \textit{Id.} rule XVIII.


\textsuperscript{149} IWC RULES, \textit{supra} note 144.

\textsuperscript{150} \textit{Id.}

\textsuperscript{151} The Commission also elects two delegates to serve as Chairman and Vice-Chairman of the annual meetings. These officers perform general parliamentary roles and serve three year terms. \textit{Id.} rules VII-IX; \textit{see also} Bock, \textit{supra} note 5, at 146-55.

\textsuperscript{152} The current Executive Secretary is Dr. Ray Gambell.
research, so that it need not rely solely on the research of member nations, but it has used this power only infrequently. Until recently, the total annual budget of the Commission never exceeded £ 7,000 (approximately $20,000), which was spent primarily on organizing and holding the annual meetings and publishing the annual report. However, the budget for the 1976-77 fiscal year has been increased to approximately £ 62,000 ($100,000).

Although both the Convention and the Schedule contain regulations that bind the treaty signatories, the overwhelming bulk of the regulations are contained in the Schedule. Article V, paragraph 1, of the Convention defines the regulatory authority of the Commission to include:

- the fixing of (a) protected and unprotected species; (b) open and closed seasons; (c) open and closed waters, including the designation of sanctuary areas; (d) the size limits for each species; (e) time, methods and intensity of whaling (including the maximum catch of whales to be taken in any one season); (f) types and specifications of gear and apparatus and appliances which may be used; (g) methods of measurement; and (h) catch returns and other statistical records.

The preceding paragraph appears to give the Commission broad authority to provide for the conservation of whale stocks, but the following paragraph and other provisions restrict the exercise of that authority, rendering conservation difficult, if not impossible:

[A]mendments of the Schedule (a) shall be such as are necessary to carry out the objectives and purposes of this Convention and to provide for the conservation, development, and optimum utilization of the whale resources; (b) shall be based on scientific findings; (c) shall not involve restrictions on the number or nationality of factory ships or land stations, nor allocate specific quotas to any factory ship or land station or to any group of factory ships or land stations; and (d) shall take into consideration the interests of the consumers of whale products and the whaling industry.

The IWC's interpretation of these restrictions has further hindered implementation of conservation measures. The crippling effect of these restrictions and their interpretation will be examined in more detail below.

153. IWC Convention, supra note 137, art. IV, para. 1(a).
154. See Bock, supra note 5, at 153. INT'L WHALING COMM'N, 26TH REPORT 7 (1976).
155. Personal communication from Prudence Fox, Foreign Affairs Officer, Nat'l Oceanic & Atmos. Admin., Washington, D.C., Sept. 9, 1976 (letter on file with the author).
156. IWC Convention, supra note 137, art. V, para. 1.
157. Id. art. V, para. 2. The Convention exempts the taking of whales for scientific purposes from international regulation. Such taking is subject only to national regulation, although there is international supervision. Id. art. VIII. In November 1976, after the IWC set a zero quota on Bryde's whales in the South Pacific, see text accompanying note 277 and note 546 infra, Japan announced that it was granting its industry a scientific permit to take 240 Bryde's whales in that area. This permit met strong opposition from many cetologists. Its primary purpose seemed to be to replace those whales lost when the quotas on fin and sei whales in the Southern Hemisphere were reduced in 1976. Update, 79 AUDUBON 151 (Jan. 1977). The United States' delegation plans to recommend at the 1977 IWC meeting that the IWC Scientific Committee be required to approve scientific permits before issuance. 3 MARINE MAMMAL NEWS 4 (March 1977).
 Modifications of the Convention require the unanimous agreement and subsequent ratification of all member nations. The Schedule, however, can be modified by a vote of three-fourths of the Commission. An amendment to the Schedule becomes binding on all member nations 90 days after it is adopted. Any actions which do not require a modification of the Convention or Schedule may be taken by a simple majority vote of the Commission.

There are three ways to avoid or mitigate the effect of restrictive conservation measures adopted as amendments to the Schedule. First, if any government, whether or not it voted for the amendment, formally objects to the amendment within 90 days of the vote, the amendment is not binding on that government, and other member nations are given an additional period in which to object. If a nation does not object, it is bound by the amendment regardless of other nations’ objections. Second, when the IWC adopts a regulation, it can restrict the duration of the amendment. For example, whaling quotas usually have been limited to only one season and complete protection has been granted commercially important species only for specified periods of time. Third, a member can withdraw completely from the Convention by giving six month’s notice.

The enforcement provisions of the Convention and Schedule are of great interest to scholars of international law. In an illuminating discussion of international fishery treaties, Hayashi describes the enforcement scheme in the Convention and Schedule as "national enforcement with international supervision," and characterizes it as "the most detailed national enforce-

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158. Id. art. III, para. 2.
159. Id.
160. Id. art. V, para. 3. It is interesting to note that at the 1946 Conference, the two major whaling nations—Norway and Great Britain—did not want an objection clause. The United States argued in favor of such a clause, claiming it was essential to keep countries in the organization. IWC Conference, Minutes of the Tenth Session, Doc. IWC/47, at 9-13, cited in SMALL, supra note 5, at 177. The decision-making process of the IWC with its objection clause is very similar to that contained in the Convention for the Conservation of Antarctic Seals, supra note 16, at arts. VIII, IX. One difference is that amendments to the Annex (i.e., the Schedule) of the latter convention require only a two-thirds majority.
161. IWC Convention, supra note 137, art. XI.
162. Hayashi, Soviet Policy on International Regulation of High Seas Fisheries, 5 CORNELL INT’L L.J. 131, 148-55 (1972) [hereinafter cited as Int’l Reg. of Fisheries]. Hayashi describes six types of enforcement practices: 1) an international agency with potential authority to recommend enforcement schemes, 2) an international obligation to exercise national enforcement, 3) national enforcement with international supervision, 4) mutual inspection of national enforcement, 5) mutual enforcement, and 6) international inspection of national enforcement. Two examples of "mutual enforcement" treaties are the N. Pacific Fur Seal Convention, supra note 16, at art. VI, and the Convention with Canada on Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea, Mar. 2, 1953, art. II, para. 1, 1 U.S.T. 5, T.I.A.S. No. 2900, 222 U.N.T.S. 77.
163. Since the implementation of an international observer scheme in 1972, see text accompanying note 237 infra, the International Whaling Convention should be classified as "international inspection of national enforcement." See note 162 supra.
ment scheme spelled out in any international agreement."164

Each nation's specific enforcement obligations under the treaty can be classified into two types: obligations to enforce the provisions of the Convention and Schedule with respect to its own citizens and vessels, and obligations to make various reports to the IWC to facilitate international supervision of the enforcement process.

Pursuant to the first obligation, each nation is required to hire two "whaling inspectors" for each factory ship sailing under its flag,165 and to provide "adequate inspection" of each shore station by government inspectors.166 These government inspectors are distinct from the international observers discussed later.167 In addition, the Convention and Schedule specifically prohibit remuneration of gunners or catcher crews for the capture of protected whales,168 and require prosecution of violators of IWC regulations.169 To facilitate international supervision, each nation must transmit to the IWC copies of all its national laws, regulations, and amendments relating to whales and whaling.170 Each nation must also submit annual reports of infractions and measures taken to prosecute violators for review by the Technical Committee.171 During the controversy over the need for an international observer system, conservationists alleged that governments often concealed infractions to avoid the potentially adverse consequences of international publicity.172

By the standards of international law contemporary at the time of its adoption, the Convention for the Regulation of Whaling was progressive. It certainly represented an improvement over the prewar situation. At its inception it was heralded as one of the great achievements of international cooperation and conservation, but the history section that follows portrays an institution that failed to achieve its purposes. For most whale stocks and for most of the industry, conservation came too late. Biological and economic factors that are unrecognized in the Convention have prevented the Commission from attaining its objectives.

C. The IWC in Operation 1946-1976

The history of the IWC has been discussed extensively by other authors173 and will not be related in detail here. The abbreviated account

164. Int'l Reg. of Fisheries, supra note 162, at 150.
165. IWC Convention, supra note 137, Schedule para. 19(a) (amended 1974).
166. Id. para. 19(b).
167. See text accompanying notes 214-21, 237 infra.
168. Id. art. IX, para. 2; Schedule para. 20 (amended 1974).
169. IWC Convention, supra note 137, art. IX, para. 3.
170. Id. Schedule para. 25.
171. Id. art. IX, para. 4.
172. See note 213 infra, and accompanying text and text accompanying notes 711-15, Part Two infra.
173. The two best sources of information on the history of the IWC are the annual reports of the IWC, which, unfortunately, are not available until nearly two years after the meetings they
which follows is included only to illustrate points stressed elsewhere in this article and to give the reader some background information against which to evaluate evolutionary trends within the IWC.

The IWC made two major decisions at its first meeting which was held in 1949. First, it agreed to continue the Antarctic baleen whale quota of 16,000 b.w.u. which had been set at 1944 and 1945 whaling conferences. This quota affected the Antarctic whaling fleet of 18 factory ships (ten Norwegian, two Japanese, one Russian, five other), about 200 catcher boats, and an assortment of refrigerator boats, cold storage carriers and other boats. Once the season opened, each factory ship would call in its weekly catch. As the quota was neared, the Bureau of International Whaling Statistics would choose a closing date for the season. It was thus in the best interests of the whalers to catch whales as rapidly as possible, resulting in what was to become known as "The Whaling Olympic." Companies invested in bigger and faster catcher boats that could cover more area and operate in difficult weather. These bigger boats did not increase the total catch; they merely served to increase or maintain the operator's share.

describe; and the NORGES WHALING GAZETTE (NORSK HVALFANGST-TIDENDE) up to 1968, when it stopped publication. Other good accounts are contained in Bock, supra note 5 (through 1965); MACKINTOSH, supra note 7, at 137-59 (through 1965); and McHugh, The Role and History of the International Whaling Commission, in THE WHALE PROBLEM 317 (W. Schevill ed. 1974) [hereinafter cited as McHugh] (through 1972). Mr. McHugh was a former Chairman of the IWC, and his history is strongly biased in favor of the Commission. Other useful, if frequently biased, accounts occur in SMALL, supra note 5, and FOE, supra note 65, at 14-30.


175. The whaling industry depicted by Melville is long gone. A modern factory ship can weigh nearly 50,000 tons and support about 400 crew and factory workers. By the early 1960's, each of these ships cost approximately $16 million. SMALL, supra note 5, at 79-80, 84.

176. Id. at 80.

177. INT'L WHALING STATISTICS (1959), as cited in SLUPPER, supra note 7, at 395. Catcher boats vary between 350-700 tons and have a crew of about 22. They are capable of speeds up to 20 knots and carry a 90mm. cannon capable of firing a 200lb. explosive steel harpoon. Catcher boats frequently operate up to 100-200 miles away from the factory ship in search of whales. Catchers are now frequently equipped with ASDIC (sonar) to locate and chase whales and are sometimes aided in their searches by planes or helicopters. SMALL, supra note 5, at 79-81; MACKINTOSH, supra note 7, at 138-39.


179. 1949 Amendments to the Schedule, supra note 174, para. 8(d).

180. The Antarctic quota put every floating factory in a race against time with all other expeditions. Every day lost due to storms or lack of whales or with the factory working at less capacity meant an irretrievable loss in production. Financial success could be had only by killing as many whales as possible as quickly as possible before the order to stop whaling came out from Sandefjord. Factory ships and catchers alike worked twenty-four hours a day, seven days a week, weather and whales permitting, until the season was over. Pelagic whaling in the Antarctic was so exhausting and hectic that the whalingmen aptly dubbed it "The Whaling Olympic."

181. See SLUPPER, supra note 65, at 14-30.

182. Catcher boats were forced to operate at greater and greater distances from their
The whaling companies further increased their costs by sending out more catcher boats with each factory ship. 183

Second, the IWC decided that humpback whales no longer needed the protection given them since 1939. Scientists estimated that humpback stocks in the Antarctic had recovered enough to allow a sustainable harvest of about 1,250 whales per year. Instead of including humpbacks in the regular blue whale unit quota, the Commission established its first species quota of 1,250 humpbacks per year in the Antarctic.184 Operators were to call in weekly with their catch, but this quota did not work. During the 1949-50 season, 2,117 humpbacks were taken, almost 170 percent of the quota.185 The same quota was tried for the 1950-51 and 1951-52 seasons, but 1,630186 and 1,545187 humpbacks were taken in those years. In 1952, the species quota was abandoned, and humpback whales once again were included in the blue whale unit quota.188

In 1949, the IWC member nations had agreed to an Antarctic baleen whale quota of 16,000 b.w.u.189 This quota was maintained until 1953 despite increasing evidence that the stocks of whales, especially blue whales, could not tolerate this rate of exploitation.190 The situation of blue whales in the

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183. The whaling companies felt compelled to increase the number of catcher boats per factory ship in addition to increasing their tonnage and horsepower. . . . In 1948 there was an average of 9.5 catchers per factory ship; in 1956 there were 13.5 per factory ship. This increase in the number of catchers required the investment of more capital and added to the fixed costs of the companies. It also exacerbated the "Whaling Olympic." In 1948 a total of one hundred and thirteen days were [sic] required to kill the allotted number of whales; in 1956 only 58 days were needed. During these years production per catcher, measured in terms of oil, declined by almost 50 percent. Id. at 91-94.

184. 1949 Amendments to the Schedule, supra note 174, para. 6.
185. INT'L WHALING COMM'N, 1ST REPORT 2 (1950).
188. IWC Convention, supra note 137, Schedule para. 20(a) (amended 1952), INT'L WHALING COMM'N, 4TH REPORT 6 (1953), 3 U.S.T. 5094, T.I.A.S. No. 2699, 181 U.N.T.S. 364; see also SMALL, supra note 5, at 183.
189. 1949 Amendments to the Schedule, supra note 174, para. 8(a), INT'L WHALING COMM'N, 1ST REPORT 16 (1950).
190. See SMALL, supra note 5, figs. 6-8, at 64-67; McHugh, supra note 173, at 309; MACKINTOSH, supra note 7, at 179.
North Pacific was particularly desperate, and in 1954 the Commission attempted one of its first conservation initiatives. It amended the Schedule to ban the hunting of blue whales in the North Pacific,191 but Japan, Russia, and the United States formally objected to the amendment.192 Thus, although it remained in the Schedule, this ban was inapplicable to the three countries that were hunting blue whales in the North Pacific. The IWC was embarrassed and subsequently did not attempt to pass measures when key countries threatened to object.

From 1952 to 1962 the major opponent to the passage of conservation measures was neither Japan nor Russia, but the Netherlands. The Netherlands had not been a major whaling country for hundreds of years, but its delegate to the IWC during this ten year period adamantly relied on an unjustifiable biological analysis that resulted in higher population estimates than those made by the other members of the Scientific Committee.193 By 1956 the evidence of a decline in the whale stocks was so overwhelming that the IWC finally reduced the annual quota to 14,500 b.w.u. Two years later, an attempt was made to continue this quota, but the Dutch commissioner objected formally, and the quota was increased to 15,000 b.w.u., despite evidence that even the lower figure was far too high.194

After the 1958 meeting of the IWC, the Antarctic whaling nations began five years of intermittent negotiations for the purpose of dividing the Antarctic quota into national quotas in an effort to bring some rationality to the chaos of the "Whaling Olympic."195 Because agreement could not be reached on national quotas, the Netherlands and Norway withdrew from the Commission.196 Because each of the Antarctic whaling nations saw these negotiations as an opportunity to gain economic or political advantage,

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192. INT’L WHALING COMM’N, 6TH REPORT 5 (1955). See also INT’L WHALING COMM’N, 7TH REPORT 19 (1956). The IWC was similarly unable to protect the blue whale in the North Atlantic because of the objections of Denmark and Iceland. Id. at 18.

193. At meetings of the International Whaling Commission in 1955 and 1956 the majority of members of the scientific committees took the view that even if the evidence of a decline in the fin whale stock was not at that time quite conclusive it was sufficiently strong to call for new restrictive measures if only as a matter of prudence, and recommended that a reduction of the existing overall limit from 15,500 to (in effect) about 11,000 units would be appropriate. Unfortunately the recommendation was not unanimous, and it must be said that it was weakened by the dissent of one representative who alone took the view, on this and several subsequent occasions, that the evidence was not yet firm enough to justify such a recommendation. MACKINTOSH, supra note 7, at 180. See also SMALL, supra note 5, at 189-90.

194. INT’L WHALING COMM’N, 10TH REPORT 3, 16 (1959). See also McHugh, supra note 173, at 323.

195. INT’L WHALING COMM’N, 10TH REPORT 5-6, 24 (1959).

196. Id. at 25; 356 U.N.T.S. 363. Japan also withdrew but rescinded its withdrawal before the 1959 meeting of the IWC.
agreement became more and more difficult to achieve. Although national quotas were technically only a "distribution" problem, the ensuing political haggling prevented the Commission from achieving any reduction in the Antarctic quota. By 1959 the situation had deteriorated to the point where the Commission was unable to adopt any formal quota. However, as a result of voluntary restrictions by some nations, only 15,500 b.w.u. were taken during the 1959-60 season.

For the 1960-61 and 1961-62 seasons, the IWC "suspended" the Antarctic quota. Finally an agreement was reached in June of 1962 between the five Antarctic whaling nations establishing national quotas as percentages of the total Antarctic baleen whale quota set by the IWC for the 1962-63 and subsequent seasons.

Unable to secure quota reductions during the late 1950's, conservation-oriented countries sought improvement of the scientific basis of whale population assessments. In 1960 the Commission agreed to appoint a committee of three experts in population biology from countries not engaged in pelagic whaling to make a study of the whale stocks. This committee became known as "The Committee of Three." The major whaling nations stated that by 1964 they would abide by the committee's recommendations, and then used this promise of future compliance to justify the continued suspension of the Antarctic quota during the 1960-61 and 1961-62 seasons.

Although both Norway and the Netherlands had rejoined the IWC by the

197. For a good, clear account of this confused period of IWC history, see Bock, supra note 5, at 210-19.
198. INT'L WHALING COMM'N, 11TH REPORT 6 (1960).
199. Interestingly, Japan and Russia both formally objected to the suspension of the quota, so the pre-existing quota of 15,000 b.w.u. continued to apply to them. INT'L WHALING COMM'N, 12TH REPORT 3 (1961).
200. Arrangements for the Regulation of Antarctic Whaling, June 6, 1962, 486 U.N.T.S. 263, 271; INT'L WHALING COMM'N, 13TH REPORT 34 (1962). The quotas for each nation as a percentage of the total Antarctic quota were Japan (33%), the Netherlands (6%), Norway (32%), U.S.S.R. (20%), Great Britain (9%). Id. art. 3. The addition of new factory ships by any nation was generally banned except by purchase from another signatory of the treaty. Id. art. 4. Transfer of whaling ships would also involve a transfer of a percentage of the seller's quota, the exact percentage to be negotiated between the two countries involved. Id. art. 5; see also Agreement between Great Britain and Japan concerning the Sale to Japan of the Southern Harvester, Jan. 6, 1964, 502 U.N.T.S. 183; INT'L WHALING COMM'N, 14TH REPORT para. 2 (1963). The 1962 agreement has been re-negotiated several times and new agreements have been made to cover other regions, see INT'L WHALING COMM'N, 19TH REPORT 9-10 (1969) (Antarctic region); Agreement for the Regulation of North Pacific Whaling, July 30, 1971, 22 U.S.T. 1616, T.I.A.S. No. 7188; INT'L WHALING COMM'N, 21ST REPORT 10 (1971) (Antarctic); INT'L WHALING COMM'N, 22ND REPORT 10-11 (1972) (Antarctic, North Pacific); INT'L WHALING COMM'N, 23RD REPORT 11 (1973) (Antarctic); INT'L WHALING COMM'N, 24TH REPORT 8 (1974) (Antarctic, North Pacific); INT'L WHALING COMM'N, 26TH REPORT 14-15 (Antarctic, North Pacific).
201. INT'L WHALING COMM'N, 12TH REPORT 7-8 (1961). The original three scientists were Douglas Chapman, Univ. of Wash., Seattle; Sidney Holt, FAO, Rome; and K.R. Allen, New Zealand.
202. However, this promise was qualified by a provision referring to the interests of consumers of whale products and the whaling industry. Id.
203. See note 199 supra; see also SMALL, supra note 5, at 198.
Although the largest number of whales was caught in the 1937-38 season (see Fig. II supra), the greatest mass of whales, and hence the highest oil production, was taken during the 1930-31 season because most of the catch consisted then of blue whales, whose body weight is about twice that of fin whales. Catches are often measured in "blue whale units" in which one blue whale is taken as equivalent to 2 fin, 2.5 humpback, or 6 sei whales. This scheme, however, underrates the body weight of a sei whale which is approximately one-fourth that of a blue whale. Until the early 1960's, Norway had the largest interest in Antarctic whaling. For many years the United Kingdom's interest was second only to that of Norway. The last factory ship from the United Kingdom operated during the 1962-63 season and the last one from Norway went out in the 1967-68 season. Only Japanese and Soviet factory ships have operated in the Antarctic in recent years.

time of the 1963 meeting, the Commission's future was still in serious doubt. At this meeting the Committee of Three submitted its final report which recommended a total ban on the hunting of blue and humpback whales and a quota of no more than 7,000 Antarctic fin whales. Both the Committee of Three and the Scientific Committee recommended that the blue whale unit be abolished and that quotas be set by species. The Commission rejected these recommendations. It retained the b.w.u., continued to allow harvesting of blue whales, and adopted an Antarctic quota of 10,000 b.w.u.

The status of the Antarctic stocks had deteriorated further by 1964. The Scientific Committee advocated an Antarctic quota of no more than 4,000 fin whales and 5,000 sei whales (equivalent to 2,833 b.w.u.) for the 1964-65 season. The whaling countries violated their prior pledge to abide by the recommendations of the Committee of Three and ignored the advice of the Scientific Committee. No formal quota was agreed to, and it was not until after the IWC meeting that the whaling nations informally agreed to a quota of 8,000 b.w.u.

During the meeting to set the 1964-65 season quotas, the Netherlands joined with the other conservationist countries, but the Soviet Union and Japan resisted restrictive quotas. For example, the Committee of Three had recommended complete protection for the blue whale in 1963. In 1964 the Commission voted to protect the blue whale in the Antarctic, but Japan objected and other nations followed its lead. For unknown reasons, the

205. Id. at 40.
207. Id. at 16-18.
208. Id. at 37; see also Int'l Whaling Comm'n, 16th Report 17 (1966).
210. See text accompanying note 205 supra.
211. Int'l Whaling Comm'n, 16th Report 7, 18 (1966). The case of the blue whale is a good example of just how resistant the Commission was to scientific advice and conservation concerns. The estimated original stock of blue whales in the Antarctic was on the order of 150,000 whales. At a population size of between 100,000-125,000, this stock would produce a sustainable yield of approximately 6,000 whales a year. By the mid-1930's, the blue whale was being harvested at a rate of nearly 30,000 per year (see Figure II in text), and the total population rapidly dropped to about 40,000 whales. The blue whale remained the primary target of the whaling industry, and by the early 1950's the population had dropped to only 10,000 animals. In 1963, the Committee of Three estimated that there were only between 650 and 2,790 blue whales left in the Antarctic with a sustainable yield of no more than 0-200 animals per year. Int'l Whaling Comm'n, 14th Report 40 (1964). In the face of this overwhelming evidence of depletion and endangerment, the IWC still could not give the blue whale protection. Small, supra note 5, at 13-14, 57-70, 199-200; McVay, The Last of the Great Whales, 215 Scientific American 17-21 (1966) [hereinafter cited as The Last of the Great Whales].

The situation for the fin whale was little better: The sustainable catch in 1962-3 was put at less than 9,000, but the actual catch in that season was more than double this number. For 1963-4, the C_s [sustainable catch] was estimated to be about 4,800 but the catch was nearly 14,000. A maximum sustainable yield of round about 20,000 could be taken at the optimum stock size of
Soviet Union and Japan had expanded their whaling fleets. Between 1956 and 1962, the Soviet Union built three new factory ships to make up a fleet of four, and Japan acquired four ships for a total of seven.\textsuperscript{212}

In the early 1960’s the Committee of Three found declines in some humpback stocks that could not be explained if the quotas were being honored.\textsuperscript{213} As a consequence, several member nations demanded an international observer scheme such as the one that had been proposed by Norway as early as 1955.\textsuperscript{214} The creation of such a program under the IWC required an enabling amendment to the Convention, and a protocol effecting this change was signed by all the member nations in 1956.\textsuperscript{215} However, long delays were encountered before ratification; the member nations realized that agreement on implementation could not be achieved until other, more fundamental, issues had been resolved.

The major barrier to reaching agreement on an observer scheme in the early 1960’s was the nations’ inability to agree on national quotas. With the signing of the 1962 accord on national quotas,\textsuperscript{216} agreement on an observer scheme appeared imminent. The Antarctic pelagic whaling nations met in the spring and summer of 1963,\textsuperscript{217} and signed an agreement outlining a program of international observers.\textsuperscript{218} At the 1963 meeting of the IWC, the Schedule was amended so that observers would report directly to the Commission.\textsuperscript{219} As the observer scheme was about to be implemented, the Soviet Union changed its position and refused to accept the implementation rules unless the system of national quotas was revised in its favor, and shore stations, which had previously not been included in Antarctic quotas, were included.\textsuperscript{220} No compromise was reached on these matters, and by 1966 the agreement outlining the observer program had lapsed.\textsuperscript{221}

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\textsuperscript{212} If the catching had stopped in 1962 this could have been reached in 5 years or a little more. A year later the time required had grown to about 8 years.

Mackintosh, supra note 7, at 200.

\textsuperscript{213} See note 200 supra.

\textsuperscript{214} Mackintosh, supra note 7, at 170; Small, supra note 5, at 164-65; Report of the Scientific Comm., Int’l Whaling Comm’n, 15th Report 3 (1965).

\textsuperscript{215} Protocol to the Int’l Whaling Convention, supra note 137, art. II.

\textsuperscript{216} See note 200 supra.


\textsuperscript{218} Int’l Whaling Comm’n, 7th Report 12 (1956).


\textsuperscript{221} Int’l Whaling Comm’n, 18th Report 17 (1968).
In 1965 the IWC finally succeeded in granting "complete" protection to blue whales and set an Antarctic quota of 4,500 b.w.u. for the two species that were then the major targets of the industry—fin and sei whales. The ineffectiveness of this protection of blue whales was demonstrated during the following season when two non-IWC nations, Chile and Peru, killed almost 450 blue whales. Furthermore, the quotas for fin and sei whales were still far above the sustainable yield of these stocks.

At the 1966 meeting, negotiations concerning an international observer scheme began all over again. The Antarctic quota was reduced to 3,500 b.w.u., and a year later, further reduced to 3,200 b.w.u. Finally, 21 years after it had been established, the IWC had agreed on a quota that was below scientific estimates of the sustainable yield of the stocks.

During 1968, scientists realized that they had underestimated the age of sexual maturity for several species of whales and consequently had overestimated the recruitment rates of those species. As a result the estimated sustainable yield for Antarctic fin and sei whales of 3,300 b.w.u. had to be adjusted downward by over 20 percent. The Antarctic quota was reduced to 2,700 b.w.u. in 1969. This figure was below the sustainable yield but not sufficiently low to allow recovery of the severely depleted fin whales.

With the decline of Antarctic stocks, the focus of the industry switched from the Antarctic to the North Pacific, and from baleen whales to sperm whales. The large stocks of blue and fin whales that had been found close to the Antarctic pack ice no longer existed. The whalers that returned south now harvested the smaller inhabitants of warmer waters—sei, minke and a few Bryde's whales. In the 1957-58 season, 65 percent of the Antarctic catch had been taken south of 60° S; by 1969-70, 89 percent of the catch occurred north of 60° S.

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222. INT'L WHALING COMM'N, 17TH REPORT 18 (1967).
223. Id. at 20. The Commission also agreed that:
   There shall be reductions for the years 1966/67 and 1967/68 that will assure that the total catch for 1967/68 will be less than the combined sustainable yields of the fin and sei stocks as determined on the basis of more precise scientific evidence.

Id.; see also INT'L WHALING COMM'N, 18TH REPORT 80 (1968).
224. The Last of the Great Whales, supra note 211, at 21.
226. INT'L WHALING COMM'N, 18TH REPORT 7 (1968).
228. "Recruitment" is defined and discussed in the text accompanying note 29 supra.
231. Quotas for North Pacific baleen whales were first established in 1970. INT'L WHALING COMM'N, 22ND REPORT 21 (1972). North Pacific sperm whale quotas were first developed in 1970, id. at 22, and were formally incorporated into the Schedule in 1971. INT'L WHALING COMM'N, 23RD REPORT 20-21 (1973).
In December 1970, United States Secretary of the Interior Hickel added the eight largest species of whales to the United States endangered species list. This action banned the import of products made from any of these whales and forced the shutdown of the last American whaling station located in Richmond, California.

In 1971 the IWC finally agreed that in 1972 it would abolish the blue whale unit and set quotas by species. An Antarctic quota of 2,300 b.w.u. was set for the 1971-72 season. In addition, after a delay of nearly 15 years, an international observer scheme was finally implemented. Details of this system are described in the section on legal assessment.

1972 was another year of crisis for the IWC. The United Nations Conference on the Environment met at Stockholm, and the assembled nations unanimously adopted (with the whaling nations abstaining) Resolution No. 33:

It is recommended that Governments agree to strengthen the IWC, to increase international research efforts, and as a matter of urgency to call for an international agreement under the auspices of the IWC and involving all governments concerned for a 10-year moratorium on commercial whaling.

The Secretary-General of the United Nations Conference, Mr. Maurice Strong, appeared personally to present the resolution to the International Whaling Commission at its annual meeting, held shortly after the Stockholm Conference. The Commission had been directly rebuked by the world community. Japanese whaling interests argued that a 10-year moratorium on commercial whaling was completely unjustified scientifically and that the resolution had been railroaded through the UN Conference.

236. Id. at 7.
237. Observers were exchanged on a regional basis. Australia and South Africa exchanged observers at their shore whaling stations. Canada, Norway, and Iceland exchanged observers at their shore stations. The Soviet Union and Japan exchanged observers on their Antarctic factory ships and two American observers went to Japanese shore stations. INT'L WHALING COMM'N, 23RD REPORT 10 (1973). Due to practical difficulties the exchange of observers between Japanese and Soviet whaling fleets did not take place in 1971, but did occur in 1972, INT'L WHALING COMM'N, 24TH REPORT 27 (1974).
238. See text accompanying notes 716-19, Part Two infra.
241. When the draft of the resolution was under deliberation, no scientific discussion was conducted on the current status of the international management exercised over the harvesting of the whale stocks, nor were any reports presented by experts on the status of the whale stocks. That the draft was put to a vote without debate can only be regarded as a political move. No consideration whatsoever was given to the position of the Japanese delegation which had twice expressed its desire during the deliberations to refer the draft to scientists for discussion.

JWA I, supra note 64, at 3.
The Scientific Committee, under pressure from whaling countries, also concluded that "a blanket moratorium on whaling could not be justified scientifically." By this they meant that scientific evidence did not show that it was "required." The Scientific Committee argued that because most research on whales is carried out in connection with commercial operations, a moratorium would seriously curtail research and that the interests of whale conservation would be better served by an increase in research than a decrease in whaling. When the issue was voted on by the entire Commission, the United States' motion for a 10-year moratorium on commercial whaling was defeated by a vote of six to four with four abstentions.

Nevertheless, the 1972 meeting did result in several significant achievements. As agreed the previous year, the 1972-73 quotas on Antarctic baleen whales were set by species. Quotas were also set for Southern Hemisphere sperm and minke whales which previously had not been regulated by IWC quotas. Finally, a committee was established to study possible expansion of the IWC Secretariat.

The following year the United States once again presented a formal proposal to the IWC for a 10-year moratorium on commercial whaling. In a paper presented to the Scientific Committee calling for a moratorium on the taking of Antarctic fin whales, several American scientists stressed the biological inadequacies of current management schemes. An American delegate to the Commission reported that the representatives from the whaling countries:

were visibly shaken by the pro-conservation climate of the meeting. Throughout the meeting the Soviet and Japanese representatives reiterated the threat that unless talk of moratorium or significant quota reductions ceased, the International Observer Scheme might be stopped, and the IWC might be wrecked.

When the proposal on the moratorium came to a vote, it again failed to obtain the necessary three-fourths majority, but it did obtain a majority of votes: eight in favor, five opposed, one abstention.

The Commission did vote to retain a conservative quota for minke whales, to divide the sperm whale quota in the southern hemisphere into regional quotas, and, most importantly, to phase out Antarctic fin whaling by 1976. Within 90 days after the meeting, both Japan and Russia formally

243. Id.
245. Id. at 28-30.
246. Id. at 29, 31-32.
247. Id. at 9.
250. Talbot, supra note 1, at 26.
252. Id. at 27-28.
objected to these three regulations.\textsuperscript{253}

That action triggered a wave of international protest and caused several American conservation groups to organize a boycott of all Japanese and Soviet imports. The boycott was to last until those countries had publicly committed themselves to international cooperation and whale conservation. By the spring of 1974, 21 American conservation, humane, and environmental groups, with more than five million members,\textsuperscript{254} had pledged to support the boycott.\textsuperscript{255} Although it is difficult to evaluate the effect of the boycott, at least one observer at the 1974 meeting felt that its impact had been profound.\textsuperscript{256}

The 1974 and 1975 meetings of the IWC marked a turning point in the IWC’s history. At the 1974 meeting the 10-year moratorium was set aside in favor of an Australian proposal for “selective” moratoria. The Australian proposal, also called the “Australian amendment,” set out new, more precise, and more ecologically sound guidelines as a policy framework for the determination of annual harvest quotas. Each identifiable stock of each species was to be classified “according to the advice of the Scientific Committee” into one of three categories: Sustained Management Stocks, Initial Management Stocks, and Protection Stocks.\textsuperscript{257} The goal was to manage each stock in such a manner that eventually it could be classified as a Sustained Management Stock. A Sustained Management Stock would be managed in such a way that the population would be maintained “at or near” maximum sustainable yield (MSY)\textsuperscript{258} stock levels “and then at optimum levels as these are determined.”\textsuperscript{259} Initial Management Stocks would include those stocks which had not yet been subjected to intensive harvesting. They would be harvested at levels above the sustainable yield until populations were reduced to slightly above the MSY stock level. At that time they would be reclassified as Sustained Management Stocks. Protection Stocks were defined as those stocks below the Sustained Management Stock level. Protection Stocks would receive complete protection from commercial whaling until they recovered to “near MSY” stock levels at which time they also would be reclassified as Sustained Management Stocks. This proposal was

\textsuperscript{253} Id. at 6-8.

\textsuperscript{254} Hill, \textit{supra} note 94, at 86.

\textsuperscript{255} It should be noted that several conservation groups such as Project Jonah (Box 476, Bolinas, Cal. 94924) did not participate in the boycott.

\textsuperscript{256} The economic strategy adopted by the American conservation community is working. . . . No delegate to the London conference, speaking candidly, could deny the profound impact of the citizens boycott, and of official U.S. threats of economic retaliation.


\textsuperscript{258} For a definition of “maximum sustainable yield” and its value as a management goal, see text accompanying notes 362-82, 456-81 \textit{infra}.

\textsuperscript{259} \textit{INT’L WHALING COMM’N}, 26TH \textit{REPORT} 26 (1976).
adopted in principle at the 1974 meeting. Regulations for implementation were to be drawn up at the 1975 meeting.

The Australian amendment, also known as "The New Management Procedure," marked the strongest and most specific commitment to conservation that the IWC had ever undertaken. However, there remained enough vagueness in this plan to concern conservationists. First, although a stock would be exploited only if the scientists determined it to be "at or near" MSY stock levels, there was considerable disagreement between whaling and non-whaling nations as to how to define "near MSY." Second, there was no consensus on the rate at which Initial Management Stocks should be reduced to the MSY stock level. This was of particular concern because estimates for MSY and present stock levels for lightly harvested species often differed by as much as 100 percent.

Because the resolution of these two questions was left largely up to the Scientific Committee, the Committee became the object of unprecedented political pressure. At the 1975 meeting of the IWC, member nations agreed, upon the advice of the Scientific Committee, that "at or near" MSY stock levels meant 10 percent below to 20 percent above the estimated MSY stock level. The member nations also decided that quotas for Initial Management Stock could not be higher than 90 percent of the estimated MSY for that stock. With these definitions, the New Management Procedure was formally adopted into the Schedule and all the known stocks of whales were placed in one of the three categories.

The 1974 meeting accomplished other reforms in addition to adopting the Australian amendment. First, the Commission agreed to expand the existing secretariat to include its first full-time employee: a biologist-administrator was to be hired to coordinate the research of nationally sponsored scientists and to aid in the work of the Commission. Second, regional quotas for Southern Hemisphere sperm whales were established for the first time. Finally, the United States formally introduced a draft protocol to amend the Whaling Convention. Consideration of this protocol

260. Id. at 2.
261. See note 513 infra.
262. INT'L WHALING COMM'N, 26TH REPORT 3 (1976).
263. Int'l Whaling Comm'n, Amendments to the Schedule para. 6(a)-(c) (1975) [hereinafter cited as 1975 Amendments to the Schedule]; see also Chairman's Report para. 7, INT'L WHALING COMM'N, 27TH REPORT (to be published 1977) (on file with the Office of Ecology and Environmental Conservation, NOAA, Dep't of Commerce, Wash., D.C.) [hereinafter cited as 1975 Chrmn's Rep.].
264. 1975 Amendments to the Schedule, supra note 263, para. 6(b).
266. 1975 Amendments to the Schedule, supra note 263, para. 15.
was postponed for further study in expectation of relevant developments at the Third United Nations Conference on the Law of the Sea.\footnote{Chairman's Report, Int'l Whaling Comm'n, 26th Report 9-10 (1976).}

Further gains were made at the 1975 meeting. For the first time, quotas were set for fin and minke whales in the North Atlantic,\footnote{1975 Amendments to the Schedule, supra note 263, para. 13.} and catches of minke whales at South African and Brazilian shore stations were included in the Southern Hemisphere quotas.\footnote{Aron, Some Notes on the Catch Limits Established by the 27th Meeting of the Int'l Whaling Comm'n I (on file with the Office of Ecology and Environmental Conservation, NOAA, Dep't of Commerce, Wash., D.C.).} Finally, separate quotas were set for sei and Bryde's whales.\footnote{Id. para. 6(c).} Although Russia and Japan fought protective classification of some particular stocks vigorously, the Scientific Committee's advice was largely adopted and neither country formally objected to the new regulations.

At its 1976 meeting, the full Commission reaffirmed its commitment to the principles of the New Management Procedure, both by formal pronouncement and by adoption of specific conservation measures.\footnote{For a different perspective on this meeting than the one presented in the text see 1976 Meeting of the Int'l Whaling Comm'n, 25 Animal Welfare Inst. Information Rep. 4-5 (1976).} The quota recommendations of the Scientific Committee were accepted in their entirety, even though the Committee had called for drastic cuts in sperm whale quotas on the basis of new population models. Fin whales received complete protection in the Antarctic, and the quota for Southern Hemisphere sperm whales was cut from 10,740 to 4,791 and divided into nine regional quotas.\footnote{Circular communication from Dr. Ray Gambell to all contracting governments listing Amendments to the Schedule, paras. 6(c), 14, at 2, 3 (July 2, 1976) (on file with the Office of Ecology and Environmental Conservation, NOAA, Dep't of Commerce, Wash., D.C.) [hereinafter cited as 1976 Amendments to the Schedule].}

In 1976, the IWC's membership and regulations became more comprehensive in several ways. For the first time, quotas were established for minke whales in the North Pacific and for sei and sperm whales in the North Atlantic, leaving no stock of whales without its own quota.\footnote{Id. para. 6(c).} The Commission also adopted rules requiring members to report catch statistics for several species of small whales which previously had been ignored by the IWC.\footnote{See text accompanying note 291 infra.} Finally, New Zealand officially rejoined the IWC, and the Netherlands, which quit whaling and left the IWC in the mid-1960's, said that it might rejoin in the near future.\footnote{Personal communication from Dr. Sidney Holt, Dec. 3, 1976.} Table 3 summarizes the status of whales managed by the IWC as of January 1977.
Table 3
IWC CLASSIFICATIONS AND QUOTAS FOR WHALES, JANUARY 1977

<table>
<thead>
<tr>
<th>Species</th>
<th>Region</th>
<th>No. of stocks</th>
<th>Status*</th>
<th>Quota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>all oceans</td>
<td>4+ (?)</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td>Bowhead</td>
<td>No. Hemis.</td>
<td>2 (?)</td>
<td>PS</td>
<td>0**</td>
</tr>
<tr>
<td>Gray</td>
<td>No. Pac.</td>
<td>2 (?)</td>
<td>PS</td>
<td>0***</td>
</tr>
<tr>
<td>Humpback</td>
<td>all oceans</td>
<td>8+</td>
<td>PS</td>
<td>10****</td>
</tr>
<tr>
<td>Blue</td>
<td>all oceans</td>
<td>&gt;9</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td>Fin</td>
<td>So. Hemis.</td>
<td>6-8 (?)</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>2-3 (?)</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. Atlan.</td>
<td>2</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>SMS</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>IMS</td>
<td>90</td>
</tr>
<tr>
<td>Sei</td>
<td>So. Hemis.</td>
<td>1</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>2-3 (?)</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. Atlan.</td>
<td>1</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>5</td>
<td>SMS</td>
<td>1,863</td>
</tr>
<tr>
<td></td>
<td>No. Atlan.</td>
<td>1</td>
<td>SMS</td>
<td>132</td>
</tr>
<tr>
<td>Minke</td>
<td>No. Pac.</td>
<td>1</td>
<td>SMS</td>
<td>541</td>
</tr>
<tr>
<td></td>
<td>No. Atlan.</td>
<td>4</td>
<td>SMS</td>
<td>2,483</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>6-8 (?)</td>
<td>IMS</td>
<td>8,900</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>1-2</td>
<td>IMS</td>
<td>0</td>
</tr>
<tr>
<td>Bryde’s</td>
<td>So. Hemis.</td>
<td>(?)</td>
<td>IMS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>2 (?)</td>
<td>IMS</td>
<td>1,000</td>
</tr>
<tr>
<td>Sperm δ</td>
<td>So. Hemis.</td>
<td>2</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>2</td>
<td>SMS</td>
<td>1,342</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>5</td>
<td>IMS</td>
<td>2,942</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>(?)</td>
<td>IMS</td>
<td>4,320</td>
</tr>
<tr>
<td>Sperm δ + ?</td>
<td>No. Atlan.</td>
<td>(?)</td>
<td>SMS</td>
<td>685</td>
</tr>
<tr>
<td>Sperm ?</td>
<td>So. Hemis.</td>
<td>2</td>
<td>PS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>4</td>
<td>SMS</td>
<td>578</td>
</tr>
<tr>
<td></td>
<td>So. Hemis.</td>
<td>3</td>
<td>IMS</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>No. Pac.</td>
<td>(?)</td>
<td>IMS</td>
<td>2,880</td>
</tr>
</tbody>
</table>

** This does not include the 30+ whales annually killed by Eskimos. See text accompanying notes 410-40 infra.
*** This does not include the approximately 180 whales taken each year by Russian whalers for Siberian natives or those taken by American Eskimos. See note 429 infra.
**** These whales can be taken only by natives of Greenland. 278

IV
THE CONSERVATION OF SMALL CETACEANS

During the last few years, conservationists and scientists have become increasingly aware of the widespread and serious problems involving the

277. 1976 Amendments to the Schedule, supra note 273; see also note 157 supra.
278. 1975 Amendments to the Schedule, supra note 263, para. 7.
conservation of smaller cetaceans. Dolphins, porpoises, and small toothed whales are killed in substantial numbers in fisheries for them and "incidentally" in fisheries for salmon, sharks, and other fish. Currently, there exists international management and protection of only one small cetacean species—the minke whale.

Because of the common role of the institutions, scientists, and regulatory measures in both small cetacean and whale management, and because of the biological similarity of the species involved in both areas of management, it is logical to discuss the problems of small cetacean and whale management together. Indeed, the biological characteristics of all cetaceans are so similar that any management distinction between large and small cetaceans is biologically arbitrary. The following ethical, biological, economic, and legal assessment sections contain integrated discussions of small and large cetacean management. This section contains background information on the history of international small cetacean conservation efforts, including the IWC's role in that history; basic biological characteristics of small cetaceans which differ from those of large whales; and a survey of the scope and type of problems involved in small cetacean conservation.

A. Small Cetaceans and the IWC

Because many scientists on the IWC Scientific Committee conducted research on small cetaceans in addition to their research on whales, the annual meetings of the committee provided an informal forum during the late 1960's for discussion of the problems of small cetacean management. Many of these scientists thought the IWC was the logical agency to develop a program of international management for small cetaceans. However, as late as the early 1970's, the scope of the small cetacean fisheries and the adequacy of existing biological knowledge to provide management guidelines were largely unknown. The full Commission of the IWC was preoccupied with controversial revisions of its large whale management program and the members of the Scientific Committee acted on the small cetacean problems cautiously and slowly.

As a result of conversations held at the 1970 IWC meeting, Dr. Edward Mitchell, a member of the IWC Scientific Committee, began the first comprehensive review of worldwide fisheries for small cetaceans. The

279. Small cetaceans are generally defined as those species not traditionally taken by the whaling industry. This list includes some beaked whales over 40 feet in length and one species, the minke whale, which has been taken by pelagic whaling operations since 1970 and is currently under IWC management. Small cetacean fisheries are generally considered to be those operations which do not capture sperm whales or the larger balaenopterids, even if they do catch minke whales.

280. The IWC does manage the minke whale. See text accompanying note 277 supra.

281. See note 279 supra.

282. See text accompanying notes 235-68 supra.

project was financially supported by the International Union for the Conservation of Nature (IUCN). When completed in 1974, this investigation revealed a virtual absence of any regulation, apparently severe depletion of many stocks, and thoroughly inadequate data on both the biology of the exploited species and the size of many fisheries.

In 1974 the Scientific Committee established a special subcommittee on small cetaceans to identify the most urgent research needs for conservation and to clarify small cetacean taxonomy. The subcommittee’s report of a special meeting held in April, 1974, remains one of the basic documents available concerning small cetaceans. In December of the same year, a newly formed FAO Working Group on Small Cetaceans and Sirenians met at La Jolla, California to begin its independent investigation into the problems of small cetacean conservation.

The IWC's jurisdiction over small cetaceans is unclear. The Convention refers only to "whales," not to "cetaceans." The distinction between "whales," "small whales," and "dolphins and porpoises" is ambiguous taxonomically. The IWC has operationally defined whales to mean all the mysticetes plus the sperm whale, but such a definition is not mandated by the language of the Convention. At the 1975 meeting of the IWC, the Scientific Committee proposed (upon the recommendation of its Small Cetacean Subcommittee) that the Commission "consider initially the management [by the IWC] of those small cetaceans which are taken in deliberate, direct fisheries." Since the Commission was embroiled in the controversial implementation of the New Management Procedure, it took no action.

At the 1976 meeting of the IWC, the Small Cetacean Subcommittee reiterated its suggestion that the full Commission consider managing "all cetaceans taken deliberately for their own value." Pursuant to this and other recommendations of the subcommittee made at the 1976 meeting, the Commission adopted an amendment to the Schedule that requires member nations to collect catch and effort data concerning their "small-type whaling" operations. "Small-type whaling" is defined as "catching

284. For more information concerning the IUCN, see text accompanying note 865, Part Two infra.
287. IWC Convention, supra note 137, Preamble; note that "whales" are not defined in art. II; see also id. Schedule para. 1 (1974).
290. "Effort data" includes information about the number of boats in the fishery, the length of the season, the number of net sets, etc.
291. 1976 Amendments to the Schedule, supra note 273, para. 22.
operations using powered vessels with mounted harpoon guns hunting exclusively for minke, bottlenose, pilot or killer whales."

The IWC’s role in the conservation of small cetaceans has been expanding cautiously. It remains to be seen whether the IWC will continue to expand its role to include protective regulation of direct and indirect fisheries for small cetaceans, whether one or more new international organizations will be created to manage small cetaceans, or whether management of small cetaceans will be absorbed by existing fin fishery commissions. The answer to the question of which organization is most likely to achieve desirable conservation goals is complex and requires a detailed examination of the resource and its conservation problems. Because the present opportunities for shaping future small cetacean management are great, and because several member governments of the IWC, including the United States, desire that the IWC assume greater jurisdiction over small cetaceans, the small cetaceans and their problems will be briefly described here. The assessment sections which follow will discuss the adequacy of the IWC as a management agency with respect to both whales and small cetaceans.

B. A Survey of the Small Cetaceans

The seven families of small cetaceans are listed in Table 4 along with some family characteristics and some important or typical species. The conservation problems most relevant to this article primarily concern delphinids and ziphiids.

Small cetaceans share most of the biological characteristics of the large cetaceans discussed above. Three differences are noteworthy. First, their general dependence on fish and/or squid causes them to have more tropical distributions and to migrate over shorter distances than whales. Also, small cetaceans are often more coastal in their distribution than whales. Second, the reproductive patterns of small cetaceans are often more variable than those of

292. Id. para. 1. Note that the definition of small-type whaling as contained in this letter refers to "bottlenose" whales rather than "bottlenosed" whales. If the former definition is used, it would seemingly apply only to whaling on Hyperodoon spp., whereas if the latter, more inclusive definition is used it would also apply to Berardius bairdii and probably any other species of Ziphiid whale. It appears that the latter spelling was intended since that is the one used in Report of the Technical Committee, Int’l Whaling Comm’n, 28th Report (to be published 1978) (on file with the author).

293. For example, the International Commission for the Northwest Atlantic Fisheries is concerned primarily with traditional fish resources, but it also has jurisdiction over some marine mammals (seals) in its area. Convention for the Regulation of Northwest Atlantic Fisheries, Feb. 8, 1949, 1 U.S.T. 477, T.I.A.S. No. 2089; Protocol to the Convention for the Regulation of Northwest Atlantic Fisheries, July 15, 1963, 17 U.S.T. 635, T.I.A.S. No. 6011, 590 U.N.T.S. 292.

294. The best summary of the taxonomy, behavior, and ecology of the small cetaceans is contained in Report of the Meeting on Smaller Cetaceans, supra note 285; for an excellent, and extremely comprehensive bibliography of articles on dolphins and porpoises, see D. Truitt, Dolphins and Porpoises: A Comprehensive Annotated Bibliography Of The Smaller Cetacea (1974). Other good accounts of small cetaceans are contained in Mammals Of The Sea, supra note 7; Leatherwood et al., supra note 7; Mörzer-Bruyns, supra note 7.
### Table 4

**THE SMALL CETACEANS—CLASSIFICATION AND CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Suborder/Family</th>
<th>No. of species</th>
<th>Characteristics</th>
<th>Important or typical species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MYSTICETI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balaenopteridae (rorquals)</td>
<td>1*</td>
<td>Pelagic, under IWC jurisdiction.</td>
<td>Minke whale <em>(Balaenoptera acutorostrata)</em></td>
</tr>
<tr>
<td>Balaenidae (right whale)</td>
<td>1*</td>
<td>Unknown, rare, under IWC jurisdiction.</td>
<td>Pigmy right whale <em>(Caperea marginata)</em></td>
</tr>
<tr>
<td><strong>ODONTOCETI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physaceridae (sperm whales)</td>
<td>2*</td>
<td>Tropical and subtropical, rare.</td>
<td>Pigmy sperm whale <em>(Kogia breviceps)</em></td>
</tr>
<tr>
<td>Delphinidae (dolphins)</td>
<td>~33</td>
<td>Very diverse, coastal and pelagic, may occur in schools of up to 1000 individuals, most are small, but killer whales up to 30 feet in length.</td>
<td>Killer whale <em>(Orcinus orca)</em></td>
</tr>
<tr>
<td>(Phocoenidae)** (porpoises)</td>
<td>6</td>
<td>Similar to dolphins, all are small.</td>
<td>Dall’s porpoise <em>(Phocoenoides dalli)</em></td>
</tr>
<tr>
<td>Ziphiidae (beaked whales)</td>
<td>18</td>
<td>Pelagic, deep sea, most are rare, 16-35 feet long.</td>
<td>Bottlenose whales <em>(Hyperoodon spp.)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Beaked whales <em>(Mesoplodon spp.)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Baird’s beaked whale <em>(Berardius bairdii)</em></td>
</tr>
<tr>
<td>Monodontidae</td>
<td>2</td>
<td>No. Hemis. arctic waters only. Belugas locally abundant, narwhals uncommon.</td>
<td>Beluga <em>(Delphinapterus leucas)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Narwhal <em>(Monodon monoceros)</em></td>
</tr>
<tr>
<td>Platanistidae (river dolphins)</td>
<td>5</td>
<td>Found in internal or coastal waters, small.</td>
<td>Ganges susu <em>(Platanista gangetica)</em></td>
</tr>
</tbody>
</table>

* Only those members of a family which are considered small cetaceans are counted here.
** A few taxonomists consider the phocoenids to be a subfamily of Delphinidae.

Whales. Like whales, females give birth to a single infant, but the interval between births may vary between species from less than one year to as much as three to four years. Third, small cetaceans tend to be more social than whales. Many delphinids often form schools of over 1,000 animals.

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295. For more information on this species, see Ross, Best, & Donnelly, *New Records of the Pygmy Right Whale (Caperea marginata) from South Africa, with Comments on Distribution, Migration, Appearance, and Behavior*, 32 J. FISH. RES. BOARD CANADA 1005 (1975); MITCHELL, *supra* note 283, at 31.

296. For more information on small sperm whales see MITCHELL, *supra* note 283, at 51; *Report of the Meeting on Smaller Cetaceans, supra* note 285, at 904-05.

C. Uses of Small Cetaceans

As in the case of baleen whales, the most common product derived from small cetaceans is meat for local human or animal consumption. In contrast to baleen whales, the oil from the small odontocetes is similar to sperm oil and is used as a lubricant. The bones, sinew, and skin of small cetaceans are often utilized to make various by-products.298

Most of our knowledge concerning cetacean social behavior and physiology has been gained from studying small cetaceans in captivity. Because small cetaceans up to the size of killer whales can be readily kept and studied in captivity, their scientific and recreational value probably currently exceeds that of whales. The study of captive dolphins has been of great value to scientists doing research in mammalian physiology, neuroanatomy, and psychology.299 Small cetaceans have entertained millions of people at oceanaria around the world,300 on television,301 and in films.302 Oceanarium displays and films not only entertain, but they also help educate people in many aspects of marine biology and animal behavior.303

Porpoises and several small species of whales have been trained to aid men in the recovery of objects lost at sea and to serve as messengers between surface and undersea installations.304 In some areas of the world, porpoises help natives fish.305 Finally, many small cetaceans can be used as indicators of marine pollution due to their position at the top of oceanic food chains.306
Virtually every common species of small cetacean is captured directly or incidentally in one or more fisheries. Some rare species, not currently being harvested, may have become rare as a result of earlier, unrecorded periods of human exploitation. It is only within the last several years that any information has become available concerning small cetacean fisheries. These fisheries are of two main types: direct fisheries where small cetaceans are the target species and fisheries where cetaceans are taken "incidentally" to the capture of a different target species, usually fish.

Direct fisheries usually kill the animals caught. Most are local in nature and small in scale. However, in the North Atlantic a widespread fishery has existed for several decades on the "small whale quartet"—northern bottlenose whales (Hyperoodon ampullatus), killer whales, long-finned pilot whales (Globicephala melaena), and minke whales. A large scale fishery for three species of dolphins—common dolphins (Delphinus delphis), harbour porpoises (Phocoena phocoena), and bottlenose dolphins—exists in the Black Sea with perhaps as many as 100,000 animals being killed annually. Japanese fishermen fish for both Dall's porpoises and striped dolphins (Stenella coeruleoalba) off the coast of Japan.

"Aboriginal whaling" for small cetaceans is still done in many areas of the world. North American Eskimos have taken belugas and narwhals for centuries. Inhabitants of the Faroe Islands still engage in the famous pilot

307. MITCHELL, supra note 283, at 51.
312. MITCHELL, supra note 283, at 18, 59-64; Sergeant & Brodie, Identity, Abundance, and Present Status of Populations of White Whales, Delphinapterus leucas, in North America, 32 J. FISH. RES. BOARD CANADA 1047 (1975).
whale "drives" although the event has recently become more important as a tourist attraction than as a source of meat.\textsuperscript{314}

Important live-capture fisheries have developed for species of scientific interest and for oceanaria displays. The number of animals taken in the live-capture industry is very small compared to the number killed in the other direct fisheries. However, the live-capture fisheries often concentrate their activities in small geographic areas and may cause depletion or changes in distribution and behavior of local stocks. Concern for this problem is strongest in the United States where the government has issued stringent regulations concerning the live-capture of cetaceans.\textsuperscript{315} Controversies have developed concerning the capture of killer whales in the Puget Sound area\textsuperscript{316} and of bottlenose dolphins in Florida and elsewhere.\textsuperscript{317}

Many fin fisheries catch small cetaceans "incidentally" in the process of catching their target species. In many cases, such catches are truly accidental, but in the case of the eastern tropical Pacific tuna fishery the fishermen deliberately seek out porpoises. For unknown reasons, yellowfin tuna (\textit{Thunnus albacares}) tend to associate closely with schools of three different species of small cetaceans: spotted porpoises (\textit{Stenella graffmani}), spinner porpoises (\textit{S. longirostris}) and white-bellied dolphins (\textit{Cephalorynchus eutropia}). Tuna fishermen take advantage of this association and set their purse-seine nets around the porpoise schools in order to trap the tuna beneath. In the early 1970's, over a quarter of a million porpoises were killed and discarded annually in this fishery.\textsuperscript{318} Recently, the United States has attempted to regulate the tuna fishery to reduce porpoise mortality, but still nearly 100,000 animals are killed each year.\textsuperscript{319} In contrast, the total direct catch for all


318. MITCHELL, supra note 283, at 87-89.

species of dolphins in Japan is only 25-30,000 animals annually.320 Another indirect fishery, the Japanese North Pacific gill-net salmon fishery, in recent years may have taken as many as 20,000 Dall's porpoises a year from a population now estimated at 30-50,000.321 Porpoises (Phocoena spp.) are also taken incidentally in another salmon gill-net fishery and in cod traps and mackerel nets in the North Atlantic.322 The franciscana or La Plata dolphin (Pontoporia blainvillei) is caught in a shark-net fishery off the coast of Uruguay.323

In summary, the small cetacean fisheries present complicated and diverse conservation problems. There is a manifest need for greater data concerning both the biology of the species involved and the scope of the industries. There is also an obvious need for international regulation in some form. The following assessment sections will examine these issues in greater depth.

V

ETHICS AND MANAGEMENT

Surely... wise [whale] management is going to call for cooperative decisions by poets as well as biologists. Whale conservation is too important to be left to either group.

—Victor B. Scheffer, former Chairman
U.S. Marine Mammal Commission

Cetacean management decisions raise three main ethical issues: (a) the morality of risking or actually causing the extinction of species or smaller taxonomic units, (b) the humaneness of hunting techniques, and (c) the ethical propriety of killing cetaceans for human use. Distinguishing these three issues is important, for objections to whaling on the basis of endangering stocks and inhumaneness can be met by more conservative management and improved technology without discontinuing whale harvesting. Ethical


320. MITCHELL, supra note 283, at 28.
321. Id. at 97-98; KASUYA, supra note 310, at 12. See also Ohsumi, Incidental Catch of Cetaceans with Salmon Gillnet, 32 J. FISH. RES. BOARD CANADA 1229 (1975).
322. MITCHELL, supra note 283, at 95-96.
323. Id. at 101; Brownell, Progress Report on the Biology of the Franciscana Dolphin, Pontoporia blainvillei, in Uruguayan Waters, 32 J. FISH. RES. BOARD CANADA 1073 (1975).
324. The Status of Whales, supra note 11, at 2.
objections to the killing of cetaceans, however, can be overcome only by a cessation of cetacean harvesting altogether.

A. The Risk of Extinction

In addition to the biological and ecological reasons for preventing species from becoming endangered or extinct, there are strong ethical reasons of more general persuasive power. Human-caused extinction violates the religious principles of many people. Even people without traditional religious beliefs often believe that the total elimination of unique life-forms is morally wrong. Human-caused extinction may also violate moral principles by unnecessarily decreasing the resources available to future generations of human beings.

The IWC Convention does not refer explicitly to moral principles, but because it declares the prevention of the extinction of whale stocks to be a purpose of the IWC, its goals are consistent with the ethical opposition to extinction. Although no species managed by the IWC has become extinct, many conservationists argue that the IWC has taken unconscionable risks in the management of endangered species in violation of its legal and ethical obligations.

B. The Humaneness of Hunting Techniques

The second ethical question concerns the humaneness of whale and small cetacean hunting technology. Although it is difficult to establish criteria for evaluating the relative humaneness of methods of killing cetaceans, several criteria have been proposed: the length of time until loss of consciousness or death, the percentage of animals struck but not killed, and/or the amount of pain felt by the animal.

Large commercial operations kill whales by firing a 90mm, 150 pound
explosive harpoon from a small cannon into the back of the whale. If the harpoon strikes the whale's lungs or heart, the animal may die immediately or within a few minutes. If the harpoon is not so accurately placed, which often happens because much whaling is done in very high seas, it may take up to an hour and several harpoons before the animal dies. The enormous size of whales and their aquatic habits make humane killing a difficult technological problem.

Neither the IWC Convention nor the Schedule contains any provision concerning the humane killing of whales, but the IWC has occasionally considered this issue. In 1958, the Second United Nations Conference on the Law of the Sea called upon all nations to adopt provisions for the humane capture and killing of marine mammals. The IWC "fully accepted the spirit of this resolution" and soon thereafter began a somewhat cursory review of the humaneness of various existing hunting techniques. After its report was issued in the early 1960's, the IWC did not reconsider the matter until


331. The question of the cruelty of whaling comes up from time to time in the press and, inevitably, one is often asked about it. The answer is that the explosive harpoon is the most barbarous instrument used for slaughtering animals by any livestock industry.

OMMANNEY, supra note 85, at 144; see also FOE, supra note 65, at 59-60. In disagreement, the whalers argue: "As anyone who has witnessed the taking of whales knows, a whale, when harpooned, dies almost instantly." JAPAN WHALING ASS'N, ARE THE WHALES REALLY THREATENED WITH EXTINCTION II 10 (Tokyo 1973) [hereinafter cited as JWA II].

No objective studies of the humaneness of explosive harpoons were made until the early 1970's. During 1971 and 1973, the length of time from harpooning until apparent death was recorded for 181 whales (167 sperm and 14 minke) killed off South Africa. More than half of the whales required two or more harpoons before dying. The median death times for three harpooners varied from about two minutes to four minutes for sperm whales and averaged slightly over five minutes for minke whales. The maximum death time for sperm whales was 19 and one-half minutes, and for minke whales was 10 and one-half minutes. Approximately 10 percent of both species were estimated to have been killed instantly. These times are comparable to those achieved by electric harpoons. Best, Death Times for Whales Killed by Explosive Harpoons, INT'L WHALING COMM'N, 26TH REPORT 208 (1976).

332. During the early 1950's, one whaling company began using electric harpoons but the company quit whaling before enough comparative data had been accumulated. This experiment was generally viewed as a failure by other whaling companies. See S. CARRIGHAR, THE TWILIGHT SEAS 103 (1975); OMMANNEY, supra note 85, at 144. See also references contained in note 335 infra.

333. [The Conference] Requests States to prescribe, by all means available to them, those methods for the capture and killing of marine life, especially of whales and seals, which will spare them suffering to the greatest extent possible.


1975, \(^{336}\) when it established a subcommittee to re-investigate the problem. \(^{337}\) The subcommittee report, presented at the 1976 meeting of the IWC, concludes that the explosive harpoon is the most humane method presently available, because skillful use of this harpoon generally causes the most rapid loss of consciousness. \(^{338}\)

The humane killing issue is not limited to large whales. Several small fisheries catch porpoises with small hand-held harpoons. \(^{339}\) Conservationists also object to the inhumane treatment of porpoises in the tuna-porpoise fishery. \(^{340}\)

C. The Ethics of Killing Cetaceans

The third and most difficult ethical question concerns the ethical propriety of hunting whales or other cetaceans. Since nearly the beginning of recorded history, certain peoples have perceived dolphins, porpoises, and often whales as being sacred animals, or at least animals worthy of special treatment. \(^{341}\) Today, those who believe cetaceans deserve special protection increasingly object to management decisions based upon a policy of maximizing consumptive uses of these animals.

Considering the significance of this issue in the current whale conservation movement, it is remarkable that before 1970 there was relatively little international concern over the morality of killing cetaceans. Increased popu-

\(^{336}\) Once when the United States requested this issue to be put on the agenda of the annual meeting, the Japanese delegation objected because they had not been given the required 60 days notice, Hill, \textit{supra} note 94, at 87.

\(^{337}\) Since 1972, the United States has been required under the Marine Mammal Protection Act to seek re-negotiation of marine mammal treaties to include provisions requiring humane killing, 16 U.S.C. § 1378(a)(4) (Supp. V 1975); see also note 334 \textit{supra}.

\(^{338}\) This subcommittee felt that further investigation should be made into the possible use of drugs, especially etorphine hydrochloride (M99), as anesthetics to bring on unconsciousness as rapidly as possible. One problem needing investigation was the possible contamination of the meat for human consumption by the use of massive doses of a drug. \textit{INT'L WHALING COMM'N, 28TH REPORT} (to be published 1978) (Scientific Comm. Report para. 18).

\(^{339}\) See \textit{MITCHELL, supra} note 283, at 9; G. Pilleri, \textit{An Inhuman Method of Capturing Small Odontocetes in Japan}, \textit{3 INVESTIGATIONS ON CETACEA} 347 (G. Pilleri ed. 1971).

\(^{340}\) See \textit{PROJECT JONAH, NET PROFIT} (1974).

\(^{341}\) In the 2nd century A.D., the Greek poet Oppian of Cilicia wrote:

\textit{The hunting of dolphins is immoral, and that man can no more draw nigh the gods as a welcome sacrificer nor touch their altars with clean hands but pollutes those who share the same roof with him whose willfully devises destruction of dolphins. For equally with human slaughter the gods abhor the deathly doom of the monarchs of the deep. Quoted in Reiger, \textit{Dolphins Sacred, Porpoises Profane}, 77 AUDUBON 3 (Jan. 1975) [hereinafter cited as Reiger]. For a good account of ancient mythology and attitudes toward dolphins, see \textit{The History of the Dolphin, supra} note 305, at 7-15.}

Other cultures have not perceived cetaceans similarly and have made no special moral judgments regarding them. The Romans considered porpoise meat a rare delicacy at their feasts. Reiger, \textit{supra}. The Japanese traditionally viewed whales as fish. Until the middle of the 19th century, religious beliefs prevented most Japanese from eating the meat of four-footed animals, and they viewed Western habits of eating beef and pork as unethical. However, since whales were "fish," they were an accepted part of the Japanese diet. JWA I, \textit{supra} note 64, at 24.
lar and scientific awareness of the intelligence, playfulness, and grace of cetaceans caused a dramatic change in public attitudes toward these animals. Numerous popular books and articles widely and quickly publicized most of the new discoveries. During this period many oceanaria and aquaria created for the first time popular shows involving trained bottlenose dolphins, killer whales, and other cetaceans. Trained dolphins and whales also appeared in television shows and films. The increased public exposure of cetaceans, combined with the new appreciation of their intelligence and other "human" characteristics, caused a dramatic increase in public concern about cetacean management in general and the morality of killing cetaceans in particular.

Despite the strong, articulated convictions of many people that whaling is immoral, the IWC has continued to manage every stock of every species of whale based on the assumption that maximum sustainable harvesting is the socially optimal policy. The IWC has never recognized nor discussed the ethical justification for killing whales, and whales have never received protection from the IWC for ethical, moral, or aesthetic reasons. As one

342. Rightly or wrongly, whether an observer can or cannot justify hunting cetaceans often depends on the observer's conception of the particular species' similarity to human behavior or capacities, especially intellectual capacities. The universality of this phenomenon was demonstrated when in 1966, the Soviet Union banned fishing for porpoise in the Black Sea. This decision was taken, according to Alexander Ishkov, Soviet Minister of Fisheries, because research has shown that dolphins have brains "strikingly close to our own." Dr. Ishkov, therefore, regards the dolphin as the "marine brother of man," noting, "[t]heir catch should be discontinued in all seas and oceans of the world."

Can Leviathan Long Endure, supra note 232, at 72. It is possible that the main reason for the Soviet Union's action was the extremely depleted state of these stocks. See references contained in note 309 supra. For a good discussion of intelligence as a moral criterion, see On Awareness, supra note 41, at 69.

The great diversity of cetacean species is probably reflected in a wide range of mental capacities. Rorquals might indeed mentally be the "cows" of the sea while bottlenose dolphins or sperm whales may have intelligences more comparable to primates. If "intelligence" is a widely acceptable moral criteria, then the diversity of cetacean intelligences would probably necessitate a parallel diversity of ethical decisions.

343. Whales have traditionally been perceived as very stocky, awkward-looking creatures with about as much aesthetic appeal as an gigantic overfed pig. See The Whale, supra note 65, at 68-77. Such an image was the product of whaling technology, and most drawings are extremely inaccurate representations of the true shape of whales, especially the rorquals. Drawings and photographs were generally made of dead whales which had been pumped full of compressed air and hauled out of the water. At death, the throat muscles of the rorquals would relax further adding to their bloated appearance. Recent underwater photographs of live humpback, minke, and other unidentified rorquals have shown very streamlined, sleek animals of considerable grace and aesthetic appeal. See Figure I in text; L. Foster, Whales of the World (Dec. 1976) (Nat'l Geogr. Soc. poster); Williamson, The True Body Shape of Rorqual Whales, 167 J. Zool. 277 (1972); J. Cousteau, The Whale: Mighty Monarch of the Sea (1972) [hereinafter cited as Cousteau].

344. Cousteau, supra note 343; Mowat, supra note 314; V. Scheffer, The Year of the Whale (1969); Lilly, supra note 41; Fichtelius & Solander, supra note 41; Carrighar, supra note 332; F. McNulty, The Great Whales (1973); R. Nickerson, Brother Whale (paper 1977); see also references in note 303 supra.

345. See notes 300, 303 supra.

346. See notes 301-02 supra.
delegate to the IWC bluntly put it, "The IWC wasn’t set up to regulate non-whaling." 347

This attitude has been shared by many American resource managers. Some have argued that the question of exploitation or non-exploitation of cetaceans is an "irrelevant luxury in a world short of food." 348 Others have argued that cetaceans should be protected because the value of low-consumptive uses exceeds the value of high-consumptive uses. 349 The United States government has never endorsed the principle of complete and permanent protection for any cetacean species. Its National Marine Fisheries Service is staffed by adherents to the philosophy of rational utilization and with few exceptions 350 these people equate complete protection with waste.

This strictly utilitarian attitude is excessively simplistic and, worse, ignores non-economic human values. What is needed is a management program capable of balancing all the values involved in particular management decisions, including ethical values. Before discussing such a balancing scheme in more detail, it is necessary to describe more precisely the ethical costs and benefits of cetacean harvesting.

Cetacean management decisions obviously must take into account the morality of the destruction of intelligent life. 351 A second cost that is less frequently discussed but which must also be considered is the possible disruptive effect of harvesting on the social behavior of the species caught. It is quite possible that whaling could be causing a significant, "non-natural" behavioral and/or genetic evolution of social behavior. 352 The magnitude of


348. See Norris, supra note 303, at 244. The ethical question is neither irrelevant nor effete. The mere scarcity of animal protein does not justify the killing of all animals as the protection of livestock of India and taboos on cannibalism demonstrate. Obviously, the decision to forego hunting cetaceans is going to be more costly in some situations than in others, but the relative "necessity" of hunting cetaceans never eliminates the ethical question.

349. This is an economic argument, not an ethical argument, and if presented for ethical reasons may well backfire since commercial whaling need be only minimally altered to maximize economic returns. For example, the annual Russian harvest of over 150 grey whales has had no visible effect on the commercial whale watching business in southern California.

350. One notable exception is Dr. Victor Scheffer, former Chairman of the United States Marine Mammal Commission. In a recent article he wrote:

I believe that we ought to stop killing them [whales] unless for human survival only, and then humanely. I see no need to extend this protective ethic to rabbits, or chickens, or fish. Whales are different. They live in families, they play in the moonlight, they talk to one another, and they care for one another in distress. They are awesome and mysterious. In their cold, wet, and forbidding world they are complete and successful. They deserve to be saved, not as potential meatballs but as a source of encouragement to mankind.

The Status of Whales, supra note 11, at 8.

351. The perceived magnitude of this cost varies dramatically between cultures. The Japan Whaling Association argues plainly that: "The whales, too, should be effectively utilized, just like cattle, hogs and other animals." JWA I, supra note 64, at 33.

352. The dearth of detailed knowledge concerning social behavior of cetaceans has made it presently impossible to detect evolutionary changes in their behavior. A good articulation of this idea in reference to terrestrial social carnivores is expressed in Haber, Wolves and the En-
this selective pressure would vary both with the intensity of harvesting and with differences in social behavior among the species harvested. Consumptive uses of cetaceans could be altering radically, perhaps irrevocably, valuable characteristics of cetacean behavior. Our present limited scientific capacity to recognize changes in cetacean social behavior requires that management agencies give very serious consideration to the evolutionary risks of high-consumptive use.

Against these ethical costs must be weighed the benefits derived from killing cetaceans. Benefits as well as costs vary among species and uses. The killing of dolphins for sport or the use of whales as military practice targets are examples of uses which have weak ethical justifications. The killing of marine mammals for subsistence food by groups such as Eskimos, however, represents an entirely different ethical situation.

Much of the ethical debate has focused on the "necessity" of using baleen whalemeat for human food, especially in the Japanese diet. Anti-whaling groups argue that this use is unnecessary because whales do not provide any product not obtainable from other raw materials and because many whale products are used for trivial purposes. In rebuttal, although baleen whalemeat is not a unique source of animal protein for human use, its use for food may be of considerable importance if there are no reasonably available alternative sources of animal protein, and if the additional amount of animal protein provided by whales is deemed "necessary." Furthermore, the

dangered Species Concept—a Different View, PROCEEDINGS OF A CONFERENCE ON ENDANGERED SPECIES III (June 1974) (Washington, D.C.); see also McVay, To the Apologist, Defender and Stooge of the Whaling Industry: EJS, in MIND IN THE WATERS 226 (J. McIntyre ed. 1974).

353. "It is only because of sheer necessity that Japan is engaged in whaling." JWA I, supra note 331, at 1. Probably the best and most balanced view of this issue is in Myers, supra note 347. Myers points out that while whale meat constitutes only a minor fraction of Japanese protein consumption, whales uniquely provide a "domestic" source of high quality meat (and exportable by-products) during a time of shrinking per capita food supplies and difficult balance of payments problems.

354. McIntyre, Let Us Act, in MIND IN THE WATERS 224 (J. McIntyre ed. 1974) [hereinafter cited as Let Us Act]; for a fairly complete list of substitute products see FOE, supra note 65, at 101-06 and October 1975 Errata Slip and Update; see also Vietmeyer, Can a Whale Find Life in the Desert? 77 AUDUBON 101 (Sept. 1975); NAT'L ACADEMY OF SCIENCES, PRODUCTS FROM JOJOBA: A PROMISING NEW CROP FOR ARID LANDS (1975); Rothfus, Substitutes for Sperm Oil, Doc. FAO/ACMRR/MM/SC/62 (June 1976); Calhoun, Limnanthes alba (Meadow Foam) Oil as a Potential Substitute for Sperm Whale Oil, Doc. FAO/ACMRR/MM/SC/56 (June 1976).

355. Turning magnificent, intelligent, ecologically critical animals into shoe polish, car wax, margarine and lubricating oil may be the ultimate nonsense of the modern world.

Project Jonah, Newsletter 17 (Winter/Spring 1976/1977); see also Let Us Act, supra note 354, at 224.

356. It is quite incorrect, as some have alleged, that whales are hunted for "trivial" purposes; this might have been true when a main product was baleen but it is certainly not so today. The most valuable product from baleen whales is meat for human consumption, and next the oil, then lower grade meats, meals and extracts. In no case are baleen whales hunted wholly or even mainly for "trivial" products, unless meat is to be classed as a luxury. If whaling is vulnerable to such criticism it is perhaps that its products are consumed mainly in those countries having less need for them than others.
"trivial" products made from whales are generally incidental by-products made in addition to whalemeat to ensure complete utilization of the carcasses.\(^{357}\)

The inter-specific diversity of whales, dolphins, and porpoises, and the inter- and intra-cultural variability of human consumptive uses of cetaceans requires that ethical decisions regarding harvesting be made on a species by species \textit{and} stock by stock basis, and be periodically reviewed. In each case, the ethical costs of harvesting a species must be compared with the particular human benefits that will result from the harvest. Such an approach would allow greater flexibility and a more precise tailoring of management practices with human needs and scientific knowledge.

Despite the lack of governmental or foreign support for complete protection of cetacean stocks, conservationists are probably correct in arguing that for several whale species and many small cetaceans species the socially optimal policy would either provide complete protection or allow only low-consumptive uses. Such a policy could be implemented for individual species on a global or regional basis, or through the establishment of cetacean sanctuaries within which all species of cetaceans would be protected.\(^{358}\)

The present protected status of depleted whale stocks and the current non-exploitation of many stocks of small cetaceans will permit the implementation of a policy of non- or limited exploitation at a minimal economic cost because industries are not economically dependent on the exploitation of these stocks.

International values and concerns have changed over the past thirty years, and international law should reflect those changes. At a minimum, the International Convention for the Regulation of Whaling and any future treaties governing cetacean management should recognize the non-consumptive values of cetaceans and should allow for complete protection of stocks and species where circumstances suggest that such a policy would maximize the values, including ethical values, of that resource for the world community. Such a provision need not commit nations to long-term policies of non-exploitation, but need only recognize low-consumptive uses or complete protection as legitimate management goals.

VI

BIOLOGICAL ASSESSMENT

The general term "biological conservation" encompasses diverse objectives and a wide range of specific management techniques. Because of this diversity it is a complex and difficult task to assess the biological impacts of...
any management program, particularly one as intricate as the IWC's regulation of whaling. The biological objectives of existing organizations can be identified either directly by reference to the organization's charter or official policy or indirectly by examination of the organization's record. This section discusses the IWC's management objectives both in policy and in practice. These objectives are compared with other widely advocated conservation objectives, and are evaluated with reference to their impact on whale stocks and marine ecosystems. The section closes with a discussion of the problem of scientific and statistical uncertainty surrounding IWC management decisions, along with suggestions as to how that uncertainty might best be handled.

A decision as to the proper objective or set of objectives for marine resource management must take into account many factors including the biological characteristics of the resource, the economic and technological characteristics of industries that affect the resource, and the feasibility of implementing a desired management program. The problems of implementation are of particular concern. A universally-desired goal such as "healthy ecosystems" may be infeasible because of the inability of scientists to define the objective quantitatively or the extravagant expense involved in measuring the relative health of ecosystems. With respect to cetaceans, the feasibility of implementation is especially important. The biological characteristics of cetaceans, along with the ambiguous and inexact nature of scientific data about them require novel legal arrangements for successful management programs.

Understanding the interaction between biological, economic, and legal factors is crucial to understanding the problems of cetacean conservation. The division of this Article into biological, economic, and legal assessment sections has been done for the sake of organizational clarity, not because these divisions reflect distinct and separate problems. Although this section focuses primarily on biological factors, the issues discussed must be evaluated in light of the economic and legal assessment sections that follow.

A. The Choice of Goals

The first part of this subsection deals with the problems of extinction, its costs to society, and the biology of populations at low levels. The second part deals with the more general and complex problem of determining what constitutes a biologically optimum population level. This problem is reconsidered in the later section on economic assessment, where various economic definitions of optimum population levels are discussed.

1. The Danger of Extinction

The most drastic evidence of biological mismanagement is the man-caused extinction of a species. Every species is a biological and scientific

359. Extinction is a natural phenomenon—it has generally occurred without the help of man.
resource of large but necessarily indeterminate value. It represents a unique and irreplaceable response of evolution to the ecological demands of existence. Subspecies and smaller genetically distinct populations are also discrete resources. They embody a considerable amount of genetic variation which represents a resource of great value to the species itself and to scientific researchers. For reasons discussed below, the elimination of a particular stock of cetaceans may result in the long-term absence of that entire species from that area—local extinction.

Harvesting of species, such as whales, which are major components of marine ecosystems has caused and will continue to cause major, and only partially predictable, changes in those ecosystems. If this harvesting results in the elimination of species, processes of ecological adjustment impossible for humans to reverse are initiated. Since we know so little about the relationships between the structure, complexity, stability, and productivity of marine ecosystems, and since it is highly unlikely that we can predict accurately the economic, scientific, or ethical needs of future human generations, it is imperative that current management preserve as many options for the future as possible. The first step must be to prevent the extinction of species.

Species of animals driven to extinction in the recent past appear to have had a critical minimum population size. Once the population dropped below that level, the species could not naturally survive in the wild. Although in some instances it might show temporary signs of recovery, the ecological prerequisites for its survival could only be generated by larger numbers. Depending on the species, this critical minimum population size may be as high as tens of thousands of individuals, or as low as a few dozen.

However, since the development of agricultural and hunting technology, the rate of species extinction has increased at an alarming rate, largely as a byproduct of human actions. Humans will not be able to prevent the extinction of many species, especially microscopic species, but just a little human care could have a profound effect on the rate of extinction of large vertebrates. For a good summary of the human role in recent animal extinctions see V. ZISWILER, EXTINCT AND VANISHING ANIMALS at vii (rev. Eng. ed. 1967) (paper) [hereinafter cited as ZISWILER]; K. CURRY-LINDAHL, LET THEM LIVE (1972).

360. The value of discrete populations was recognized in the Endangered Species Act of 1973 which is designed to protect species, subspecies, "and any other group . . . of the same species or smaller taxa in common spatial arrangement that interbreed when mature." 16 U.S.C. § 1532(11) (Supp. V 1975). The value of discrete populations was also recognized by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which protect species, subspecies, and "geographically separate populations." Convention on Int'l Trade, note 686, Part Two infra, art. I(a). For more information on this treaty see text accompanying notes 686-93, Part Two infra.

361. See text accompanying notes 25-28 supra.

362. The "structure" of an ecosystem refers to its species diversity, relative abundance of species, and the pattern of energy flow through the various trophic levels of the system. The "stability" of an ecosystem refers to the homeostatic capacity of animal and plant communities in that system to resist changes in the system often induced by external factors (such as whaling). Most work on these problems has been done on terrestrial ecosystems. For a good discussion of the concepts and principles involved, see R. RICKLEFS, ECOLOGY 743-75 (1973); R. MAY, STABILITY AND COMPLEXITY IN MODEL ECOSYSTEMS (1974).

363. Perhaps the most striking example of this phenomenon is the passenger pigeon, which was doomed while tens of thousands still remained. ZISWILER, supra note 359, at 3-4, 57-59.
histories of extinct species suggest that relatively social animals tend to have relatively high critical minimum sizes.\textsuperscript{364}

Since the critical minimum population can be determined accurately only after a population has dropped below it, biologically sound management requires that the stocks of harvested species be managed so as to provide considerable safety margins between the managed stock sizes and those minimum population sizes that are potentially critical. This is especially important in managing whales where, due to the impossibility of maintaining "reserve" populations in captivity\textsuperscript{365} or of transplanting individuals from one area to another,\textsuperscript{366} species and stocks must survive in the wild if at all.

Given that management must maintain stocks above the critical minimum level, the question remains whether a biologically optimum stock size exists, or whether all stock sizes greater than the minimum are biologically just as desirable.

2. \textit{The Search for the "Optimum Population Level"}

There has been a tremendous amount of discussion over the last few years among biologists, resource managers, and lawyers attempting to define ultimate goals for the management of natural resources, in particular for the management of fish and marine mammal resources.\textsuperscript{367} The literature on marine resource management variously refers to goals such as "maximum sustainable yield," "optimum sustainable populations," "optimum sustainable yield," "optimum population levels," "full utilization," and "optimum ecological resource management."\textsuperscript{368} Certainly, no consensus has been reached as to which, if any, of the above goals accurately represents the most socially desirable objective. This is partly due to our extremely limited understanding of the operation of marine ecosystems. Another part of the problem is the difficulty of balancing competing biological, economic, political, and ethical concerns in establishing management objectives.

Ideally, goals for management of living resources should be the product of

\textsuperscript{364} Id. at 60.

\textsuperscript{365} Some species can be so maintained; several species of wildlife, in fact, survive only in zoos. Two famous examples are Przewalski's horse and Pere David's deer. Probably hundreds of other species have good chances of survival only in zoos. See id at 85-88; D. Ehrenfeld, Biological Conservation 192-95 (paper 1970).

\textsuperscript{366} Many species of wild animals have been successfully transplanted to new areas, or to areas of their former range where they had been eradicated. The American bison is perhaps the classic example. Currently, dramatic and apparently successful efforts are being made to re-establish the peregrine falcon in the eastern United States. See P. Matthiessen, Wildlife in America 150-51 (paper 1969); Zimmerman, That the Peregrine Shall Live, 77 Audubon 38 (1975); Ziswiler, supra note 359, at 88-90.

\textsuperscript{367} For a good introduction to this debate, see Roedel, Optimum Sustainable Yield as a Concept in Fisheries Management, Am. Soc. Fish. Spec. Publ. No. 9 (1975) [hereinafter cited as OSY in Fisheries Management].

\textsuperscript{368} These terms are defined and discussed later in this section.
a deliberate melding of biological, economic, social, and political values designed to produce the maximum benefit to society from stocks that are sought for human use, taking into account the effect of harvesting on dependent or associated species.\textsuperscript{369} This definition clearly recognizes the importance of the ethical considerations discussed earlier in this Article, and the importance of ecological, economic and political factors which are discussed in later sections.

To provide a practical tool, however, the optimum population level has to be defined far more precisely than in the above quoted definition, and in particular management contexts. The following subsections explore recent attempts by biologists and lawyers to define more precisely the socially optimum population levels for marine resources. Until very recently, these definitions have paid no more than lip service to economic considerations. For this reason, and because an explanation of economic definitions of optimum population levels at this point would unnecessarily add a large amount of complexity to an already confusing subject, this discussion is postponed until the following section.\textsuperscript{370}

The following discussion traces the evolution of management goals. It proceeds upon an assumption which previous sections have suggested is unnecessary and may be undesirable.\textsuperscript{371} This assumption is that the social value of the cetacean resource will be maximized when the consumptive uses are maximized consistent with sustainable yield.\textsuperscript{372}

\textbf{a. Maximum Sustainable Yield}

During the 1950's and early 1960's, conservation of exploited natural resources, especially fishery resources, became equated with the principle of maintaining populations at that size which theoretically would yield the largest harvest indefinitely. This level is known as the "maximum sustainable yield" (MSY) stock level. This concept became widely incorporated into treaties governing the conservation of fishery and seal resources.\textsuperscript{373}

The popularity of MSY as a management goal was based upon a misunderstanding of both the ecological and economic aspects of fisheries and whale management. MSY appeared to offer an objective criterion which would prevent a stock from becoming endangered, which would ensure the

\textsuperscript{369} OSY in Fisheries Management, supra note 367, at 85.
\textsuperscript{370} See text accompanying notes 558-63, 598-606, Part Two infra.
\textsuperscript{371} See text accompanying notes 348-57 supra.
\textsuperscript{372} Not all authors make this assumption. See OSY in Fisheries Management, supra note 367, at 86 (zero harvest for ecological reasons) and 88 (zero harvest for aesthetic and ethical reasons); see also Gordon-Clark, Objectives for the Management and Conservation of Marine Mammals, Doc. FAO/ACMRR/MM/SC/123 (Aug. 1976).
\textsuperscript{373} The Convention on Fishing and Conservation of the Living Resources of the High Seas, done April 29, 1958, 17 U.S.T. 138, T.I.A.S. No. 5969, 559 U.N.T.S. 285, art. 2 defines conservation as "the aggregate of the measures rendering possible the optimum sustainable yield from those resources so as to secure a maximum supply of food and other marine products." See also N. Pacific Fur Seal Convention, supra note 16, Preamble.
maximum sustainable revenue from the resource in perpetuity, and which could be calculated by a simple mathematical formula.

The International Whaling Convention was drafted prior to the general acceptance of MSY as a management goal and makes no reference to MSY. Instead, it refers rather vaguely to "optimum levels" and "optimum utilization." The initial goal of the IWC was to establish whaling quotas on a sustainable yield basis. It was thought not to be possible to manage the whale resource on the basis of maximum sustainable yield because dozens of stocks of several different species in radically different stages of depletion were being combined into one blue whale unit quota. Scientists on the Scientific Committee of the IWC, however, began advocating MSY as the proper management goal during the mid-1960's as a result of the report of the Committee of Three. From the mid-1960's until the mid-1970's, the "optimum levels" mentioned in the convention were construed to mean MSY levels. During this period, the precise definition of "optimum levels" was not critical to management decisions since most of the exploited stocks were either far below MSY levels or considerably above them, and management decisions were based more on political and economic than on biological considerations.

Economists were among the first to attack MSY, because only rarely did it maximize the sustainable revenue. Biologists began to question the desirability of MSY as a goal because they could not accurately calculate MSY stock levels or yields due to insufficient data and limited knowledge of the population dynamics of the managed species. During the late 1960's and early 1970's, ecologists launched the third and most serious attack on MSY. They argued that as traditionally practiced, MSY management failed to consider adequately the short- and long-term ecological consequences of single species management schemes. These ecologists stressed examples of ecosystems where "theoretically available" future harvests never materialized due to unforeseen changes in the ecosystems resulting from harvesting single species.

The root of the ecologists' criticism of MSY management was that the assumptions usually employed to calculate MSY were ecologically unjustified. First, population models used for the calculation of MSY were generally deterministic whereas the biological processes they sought to model
were stochastic.\(^{379}\) Second, these models generally assumed that the "carrying capacity"\(^{380}\) of the habitat remained constant, whereas ecological studies more often found that the carrying capacity varied as the result of competitive interactions or climatic changes.\(^{381}\)

Despite a mounting criticism of MSY, and the development of alternative objectives, this criterion, sometimes in a slightly modified form, is still politically popular, especially outside the United States. For example, a modified MSY goal is contained in the definition of "conservation and management" in the most recent negotiating text for the ongoing U.N. Law of the Sea Conference.\(^{382}\)

\(b\). The Marine Mammal Protection Act and "Optimum Sustainable Populations"

An early attempt to define management goals which would incorporate relevant ecological considerations was made in the United States Marine Mammal Protection Act of 1972.\(^{383}\) The act establishes two minimum levels or floors below which managed populations cannot be depleted. The first floor is that population level at which the managed stock "cease[s] to be a significant functioning element in the ecosystem" of which it is a part.\(^{384}\)

\(^{379}\) Deterministic models exaggerate the predictability of population phenomena. In contrast, stochastic models deliberately attempt to incorporate the probabilistic nature of population phenomena. For example, if a hundred married couples average 0.5 children/couple/year, a deterministic model would predict that the population would have exactly 50 children each year. A stochastic model might predict that this population would have 42, 57, or 53 children in any given year.

\(^{380}\) "Carrying capacity" has been defined in several different ways. See Dasmann, supra note 32, at 181-82. As used in this article it refers to the number of animals of a given species that would occur in the habitat under the current and immediately foreseeable ecological condition of the habitat if all human harvesting were stopped.

\(^{381}\) For a discussion of the role of changing climate in the distribution and abundance of cetaceans, see Vibe, Artic Animals in Relation to Climatic Fluctuations, 170 The Danish Zoogeographical Investigations in Greenland No. 5, at 73-76 (narwhals & belugas), 81-99 (bowheads), 195-97 (1967), also reprinted as Doc. FAO/ACMRR/MM/SC/55 (May 1976).

\(^{382}\) Revised Single Negotiating Text of the Second Committee, 3rd United Nations Conference on the Law of the Sea, May 6, 1976, U.N. Doc. A/Conf.62/WP.8/Rev.1/Part II (1976). This text states that conservation measures shall be designed to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors, including the economic needs of coastal fishing communities and the special requirements of developing countries, and taking into account fishing patterns, the interdependence of stocks and any generally recommended subregional, regional or global minimum standards.

I d. art. 50 para. 3. The negotiating text also imposes a duty on the state promulgating conservation regulations to take into consideration the effects on species associated with or dependent on harvested species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened.

I d. art. 50 para. 4. For an informative history of the concepts of "full utilization" and MSY in the Law of the Sea negotiations, see O'Sy in Fisheries Management, supra note 367, at 82-85.


second floor, which supplements the first one, is the "optimum sustainable population" (OSP). The OSP is defined as the MSY stock level, qualified by a mandatory consideration of "the optimum carrying capacity of the habitat and the health of the [relevant] ecosystem." The Act allows harvesting of a stock only if such harvesting will not lower the stock size below either of the minimum levels.

OSP represents an improvement over the simplistic MSY because it recognizes that marine mammals live within, and are significant elements of, ecosystems. The Act also attempts to define the optimal population size of the managed stock in terms of characteristics of the ecosystem in which it lives. Unfortunately, the terminology of the Act is ambiguous, imprecise, and nearly impossible to apply in particular management situations. Terms such as "significant functioning element in the ecosystem," "carrying capacity," and "health of the ecosystem" are rarely quantifiable given our present level of knowledge of marine ecosystems.

For the above reasons, and because the definition of OSP drastically limits the amount of allowable harvesting, no other nations have adopted OSP as defined in the MMPA as a management goal.

c. The New Management Procedure and MSY

The next development in the evolution of management goals was made by the IWC with the adoption of the New Management Procedure. At its 1974 meeting, the Commission declared in the preamble to the Procedure that it recognized:

in negotiating international agreements, reference to the MMPA (Marine Mammal Protection Act of 1972) or insistence upon the inclusion of the term OSP (Optimum Sustainable Population) is not always necessary. Rather, the U.S. goal should be international acceptance of the management principles embodied in the MMPA. This includes acceptance of the fact that consideration should be given to the entire ecosystem, rather than a single species, and to values other than the total yield.


[T]he need to preserve and enhance whale stocks as a resource . . . for future use when food needs of the world will be greater because of increased human population and . . . the need to maintain marine ecosystems in a well-balanced condition capable of high productivity.\footnote{Quoted in full in Christol, supra note 4, at 157-58.}

Acting pursuant to this recognized need, the Commission stated that henceforth:

[T]he management of whale stocks should be based not only on the concepts of maximum sustainable yield in numbers by species, but should also include such considerations as total weight of whales and interactions between species in the marine ecosystem.\footnote{\textit{Id}.}

Although these statements emphasize the importance of recognizing whales as integral parts of marine ecosystems, the definition of optimum levels remains ambiguous. Despite this newly-professed ecological sensitivity, the Commission decided at its 1974 meeting that optimum levels would continue to be defined as MSY\footnote{1975 Amendments to the Schedule, supra note 263, para. 6.} stock levels until “optimum levels are . . . determined.” The Scientific Committee of the IWC recognizes the development of a more ecologically-oriented definition of optimum level as one of its major tasks of the next several years.

d. \textit{Optimum Ecological Resource Management}

During the spring of 1975, several members of the IWC Scientific Committee who had been most critical of MSY as a management goal organized a series of workshops on “The Conservation of Wild Living Resources.” Experts on both the theoretical and practical aspects of resource management were invited from around the world. These meetings, also known as the “Airlie House Workshops”, were convened to make recommendations and to draft a model provision for living marine resource conservation to be included in treaties being drafted by the U.N. Law of the Sea Conference. Although the workshops’ recommendations were directed mainly toward fin fisheries, the scientists’ experience with whaling regulation strongly influenced the workshops’ recommendations, and it was at the 1975 IWC meeting that some of these principles were first incorporated into international law.\footnote{See note 545 infra and accompanying text.}

1. The ecosystem should be maintained in a desirable state such that
   (a) consumptive and non-consumptive values can be max-
       imized on a continuing basis
   (b) present and future options are ensured
   (c) risk of irreversible change [or] of long-term adverse
       effects as a result of use is minimized.

2. Management decisions should include a safety factor to allow for
   the facts that knowledge is limited and institutions are imperfect.

3. Measures to conserve a wild living resource should be formulated
   and applied so as to avoid wasteful use of other resources.

4. Survey or monitoring, analysis and assessment should precede
   planned use and accompany actual use of wild living resources.
   The results should be made available promptly for critical public
   review.394

These guidelines, often called "Optimum Ecological Resource Manage-
ment" (OERM), are an important development because they stress the need
to manage ecosystems rather than single resources. OERM recognizes the
dynamic nature of ecosystems, their fragility when mismanaged, and the need
to be conservative when estimating the resiliency of exploited ecosystems.

Since many of the world's foremost experts on fishery management had
participated in the Airlie House Workshops, the principles that emerged from
those meetings received remarkably rapid publicity and acceptance. For
example, in September of 1975, the General Assembly of the International
Union for the Conservation of Nature and Natural Resources, probably the
most influential conservation organization in the world, formally adopted the
recommendations stated above.395 The United States Congress incorporated

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394. Airlie House Draft Report, supra note 393, at 6-7. The members of the workshop
drafted a proposed article for inclusion in international treaties concerning living marine
resources. The first two of the articles' three sections are quoted below; the third section is
quoted at note 654, Part Two infra.

A. Conservation of the living resources of the sea is that aggregate of measures
   required to maintain those resources and their environment in a state such that
   1) a maximum and stable supply of food and other marine products may be taken
      from them on a continuing basis;
   2) there is minimal likelihood of irreversible or long-term adverse effects of
      exploitation on particular resources or on the marine ecosystem as a whole;
   3) a wide diversity of options for future use is ensured.

B. Conservation measures shall be formulated with a view to
   1) avoiding wasteful use of other natural resources expended to secure the supply
      of food and other marine products;
   2) providing a margin of safety to allow for unpredicted variations and charac-
      teristics of marine resources and their environment, and for the fact that the applica-
      tion of measures may be subject to delay or be otherwise imperfect;
   3) securing in the first place a supply of food for human consumption.

Id. at 8; also quoted in Report of the Workshop, App. 2, supra note 393, at 14, with notes at 15-18.

395. Resolution 8, Resolutions of the 12th General Assembly of I.U.C.N., Sept. 18, 1975,
N'Sele, Kinshasa, Zaire, quoted in Holt, Scientific Advice Concerning Management of Marine
Mammals—Recent IUCN Actions, Doc. FAO/ACMRR/MM/SC/60 Annex, at 3 (June 1976). This
nearly all of these principles into the Fishery Conservation and Management Act of 1976.\textsuperscript{396} Details of how these principles are affecting, and may in the future affect, the practice of whaling are discussed in later sections.\textsuperscript{397}

3. Approaching the Optimum Level

No matter which of the above population goals is chosen as the optimum population level (OPL) for whale stocks, management organizations must still face the difficult strategic question of the means by which the OPL can be reached. This is necessary for almost all stocks, because by any of the various definitions discussed above, many stocks would be considerably below OPL and a few stocks would likely be above that level. For these stocks, the critical decisions will involve management strategies rather than precise determinations of optimum population levels. Despite the meager theoretical consideration that has been given to this problem, the choice of strategies is of tremendous practical importance.

If the whaling industry could easily adjust its harvesting effort over a wide range of quotas, then a stock which was above the optimum population level, however defined, should be reduced as rapidly as possible to that level in order to maximize economic benefits.\textsuperscript{398} Conversely, a stock below OPL should be completely protected until it has recovered to OPL. Unfortunately, as the previous historical section has shown, the whaling industry is not economically flexible and it has a strong tendency to overcapitalize. In order to discourage such overcapitalization, strategies for reducing populations to OPL should be designed without sudden planned reductions in whaling effort.

Caution is advisable from a biological perspective as well. For stocks above OPL, most of the critical biological parameters such as stock identification, existing population size, OPL, and local ecological patterns are unknown or poorly known. Since it is less costly to be wrong in a conservative direction than in an overly optimistic one, and since it may take several years to obtain more accurate estimates of these parameters, caution should be employed in setting the initial quotas.

The New Management Procedure of the IWC states that Initial Management Stocks will be managed to bring them to MSY (or optimum) stock level "in an efficient manner and without risk of reducing them below this level."\textsuperscript{399} Quotas are to be set at or below approximately 90 percent of the...
estimated MSY. Under this scheme, quotas should remain relatively constant during the transition of the stock from Initial Management Stock status to Sustained Management Stock status. If, during the period of initial exploitation, it becomes apparent that the initial estimate of MSY was too high, then quotas would have to be reduced to 90 percent of the new estimate. This scheme represents a considerable improvement over past policies of the IWC in which stocks received no protection until they fell below OPL.

Recently, J.A. Gulland, a biologist for the Food and Agriculture Organization of the United Nations, has proposed an alternate scheme for reaching the optimum level which would balance economic and biological considerations more effectively than does the New Management Procedure. First, he argues that the quotas for Initial Management Stocks should be set in a manner that reflects the quality of the existing scientific data concerning the stock. If knowledge about the stock is relatively poor, and if current estimates are not likely to be improved rapidly, then lower quotas should be set initially. If the knowledge of the stock is quite good, initial quotas could be set high, even above the estimated MSY, to achieve economic goals.

The second feature of Gulland's plan calls for step-like increments in quota adjustments. He argues that the strategy should be such that large changes in quotas and the resulting economic problems for the industry be avoided. This consideration would apply whether quota changes were reductions or increases.

The third principle of his program is that quota changes be an automatic result of new scientific information once an original management plan is agreed to. At its inception, the management program would have to contain "explicit and detailed prediction[s]" of what will happen to the stocks as a
result of the planned management. If subsequent data do not confirm these predictions, the quota would be adjusted by an increment which had been previously agreed upon. This procedure for automatic adjustments would minimize the danger of depleting a stock below OPL while allowing for initial quotas which may exceed the estimated MSY.

4. The Questionable Existence of a Single Optimum Population Level

The preceding discussion has generally assumed that there exists one relatively constant optimum population level for each cetacean stock and that the task of management is to bring the stock to that level and maintain it there. By definition, this static population level generates the maximum yield consistent with ecological and social constraints. However, scientists do not have adequate data or knowledge to identify this optimum level assuming a static ecosystem, let alone to identify accurately changes in this level resulting from changes in the ecosystem. Therefore, one goal of management must be to acquire more and better knowledge about whale ecology and population dynamics. For purely utilitarian reasons such research would allow for the more precise determination of the optimum population levels. However, the acquisition of greater scientific knowledge is at least partly in conflict with the concept and practice of maintaining the managed stock at a constant population size.

Scientists gain information about the population dynamics of managed species by observing biological parameters during changes in the size of the stocks. Most knowledge concerning whale population dynamics has come from the study of those species and stocks which were most recently and heavily depleted. The New Management Procedure calls for the maintenance of stocks at a constant level—the MSY or "optimum" level—but observation of a stock at a constant level yields little information concerning either the dynamics of that population or possible higher productivity at other stock levels.

In recognition of this problem, several whale population experts have proposed that whale stocks be carefully managed as part of a large controlled experiment designed to generate as much scientific information as possible. Such management need not reduce the overall harvest, the overall

405. Id. at 6.

406. An essential element of a dynamic strategy is that these changes—particularly those related to additional knowledge of the resource—should be automatic. That is, the programme set out in previous years (specifically the levels of catch quotas) would only remain unaltered if there was positive evidence that the estimates of population size, etc., on which they were based were still reasonable. This implies . . . that the scientific advice on management (e.g., catch quotas) contains an explicit and detailed prediction of what would happen. . . . Further, this prediction should include a note on the precision with which changes in abundance can be detected, from catches per unit effort or otherwise.

Id. at 6. See also Larkin, A Confidential Memorandum on Fisheries Science, WORLD FISHERIES POLICY 189 (B. Rotschild ed. 1972).

biomass, or the productivity of the resource, but it would probably require managing apparently similar stocks in dissimilar ways. Some stocks would be reduced to levels below the estimated optimum population level. Others currently protected because of past over-exploitation would become subject to renewed exploitation before they recovered to optimum population levels. Such a scheme would create a greater short-term risk of over-exploitation of certain stocks than currently exists under the New Management Procedure, but care could be taken to minimize long-term adverse consequences of any over-exploitation, and the resulting knowledge could lead to a substantial long-term reduction of risks concerning extinction or depletion.

B. Cetacean Management in Practice

1. Endangered Species

a. The bowhead problem

The most endangered whale species is unquestionably the bowhead (*Balaena mysticetus*). Once abundant in the arctic waters of both the North Atlantic and North Pacific, this species long supported large and wasteful whaling industries. The harvesting was so thorough that by the beginning of this century, over thirty years before the establishment of the IWC, commercial whaling on bowheads had ceased. The bowhead has received protection from commercial whaling in all international whaling agreements signed since 1931. Commercial whaling for bowheads is now also prohibited by both the United States' Endangered Species Act of 1973 and the Marine Mammal Protection Act.

All of these treaties and statutes exempt "aboriginal" or Eskimo whaling from the general protective regulations. Canadian and Alaskan...
Eskimos have hunted bowhead whales for subsistence food throughout their recorded history. Unfortunately the current bowhead population in the eastern North Atlantic is so desperately low that Canadian Eskimo whalers can rarely find a whale to chase.\textsuperscript{416} Hunting the last sizable population of bowheads, Alaskan Eskimos averaged a catch of 12 whales per year during the first half of the century.\textsuperscript{417} Recently, a growing Alaskan Eskimo population has increased the intensity of its whaling effort and over the last four years the catch has averaged 30 whales per year.\textsuperscript{418} In 1976, a record 48 whales were killed and landed.\textsuperscript{419} The number of whales killed and landed does not accurately represent the Eskimos' effect on the stock. Many whales are struck with harpoons, but cannot be landed. Estimates of the ratio of whales struck-but-lost to whales landed vary from 1.4:1 to 15:1.\textsuperscript{420} An unknown percentage of the struck-but-lost whales later die.\textsuperscript{421}

When bowheads were plentiful, even this wasteful catch probably had little effect on the stocks. However, because the North Pacific stock of bowheads now offers the last major hope for the species' survival, the loss of as few as 40 whales per year may be unacceptable.\textsuperscript{422} The situation is especially horrifying because the Eskimo whaling effort is increasing.\textsuperscript{423}

\textsuperscript{416} See Mitchell, The Status of the World’s Whales, 2 Nature Canada 9, 17 (Dec. 1973); Canadian Bowheads, supra note 44.


\textsuperscript{420} 1974 Bowhead Studies, supra note 411, at 20 (1.4:1); 1975 Bowhead Studies, supra note 418, at 22 (1.7:1); North Pacific Whale Research supra note 417, at 189 (3-4:1); McVay, Stalking the Arctic Whale, 61 Amer. Scient. 24, 26 (1973) (5:1) [hereinafter cited as Arctic Whale]; Dr. Donald Patten, Los Angeles County Museum of Natural History, personal communication, July 16, 1976, (15:1). For a description of the primitive technology used by the Eskimos, see 1974 Bowhead Studies, supra note 411, at 7-12.

\textsuperscript{421} The struck but lost whales usually disappear. A few are subsequently found days after they were harpooned, but many presumably die far from shore or under the pack so their bodies never reach the surface.

\textsuperscript{422} Although Eskimo whalers can only operate a short distance away from the shore-bound ice, the particular migratory behavior of the bowheads causes an apparently high, but unknown, percentage of the whales to pass very close to the Eskimo whaling camps on the northwest coast of Alaska. Most bowheads appear to migrate in spring north through the Bering Straits, then east to the Beaufort Sea. At this time of year the pack ice breaks into narrow channels close to the shore ice, and the bowheads follow these opening channels. A lesser amount of whaling is done during the return fall migration. See 1974 Bowhead Studies, supra note 411 and note 427 infra.

\textsuperscript{423} 1975 Bowhead Studies, supra note 418, at 11.
while both the percentage of struck whales landed\textsuperscript{424} and the utilization of whale carcasses\textsuperscript{425} are decreasing. The combination of no trustworthy estimate of bowhead stock sizes,\textsuperscript{426} almost no scientific knowledge concerning the biology of bowheads, and no significant past experience in managing species at critically low levels, has created a very real possibility that current management inaction will result in the bowhead's extinction.\textsuperscript{427}

The International Whaling Commission apparently has the legal authority to regulate Eskimo whaling.\textsuperscript{428} Until recently, however, the IWC has

\textsuperscript{424} Patten & Durham, Eskimo Whaling of Bowhead Whales in the Western Arctic (paper presented at the Conference on the Biology and Conservation of Marine Mammals, Univ. of Calif., Santa Cruz, Dec. 4-7, 1975) [hereinafter cited as Eskimo Whaling]; The information in this paper is presented in more detail in Durham, The Catch of Bowhead Whales (Balaena mysticetus) by Eskimos in the Western Arctic, Part I, Catch Statistics (submitted for publication, NAT. HIST. MUS. LOS ANGELES CO. CONTRIB. IN SCIENCE); Patten & Durham, The Catch of Bowhead Whales Part II, Recent Trends and Developments (manuscript in preparation).

\textsuperscript{425} Historically, the whale hunt played a major role in both the survival and culture of the Eskimo. Today, it is still perceived by Eskimos as one cultural ritual little affected by contact with western culture. However, Eskimo technology and the reasons for whaling have changed drastically since the encroachment of white men. Whaling camps are now supplied by snowmobiles rather than dogteams; the camps are in communication with each other by means of walkie-talkies; whales are spotted with binoculars and shot with a harpoon made in Pennsylvania. The replacement of dogsleds by snowmobiles and the availability of alternate food and energy supplies has lessened the need for whale products. It also appears that the cultural role of the whale hunter is changing; the hunt is becoming more and more a competition for the most whales killed, or the largest killed. Eskimo Whaling, supra note 424; 1974 Bowhead Studies, supra note 411; Carroll, Utilization of the Bowhead Whale, Appendix I to 1975 Bowhead Studies, supra note 418; see also Rau, Black Water, Red Death, 45 SPORTS ILLUSTRATED 74 (Nov. 1, 1976).

\textsuperscript{426} The first systematic attempts to census bowhead whales did not begin until 1976, when National Marine Fisheries Service observers made a serious effort to count bowheads from shore points and airplanes as the whales migrated. It is still too early to estimate population size with much precision, but the data suggest that it is in the order of 1,500-3,000 animals. Personal communication from Dr. Bruce McAllister, NWFC, Nat'l Marine Fish. Serv., Seattle, Wash., Nov. 20, 1976. Earlier estimates of bowhead numbers were little more than guesses: McVay (1,000), Artic Whale, supra note 420, at 30; Rice (4,000+), North Pacific Whale Research, supra note 417, at 189; Floyd Durham (1,000-3,000), personal communication, Dec. 4, 1975.

\textsuperscript{427} If there are only 1,000 whales left, and if their net recruitment rate is approximately the same as for other baleen whales (4-7%), then only 40-70 whales would be recruited per year. If the Eskimos land 25 whales a year and strike but lose 2 mortally wounded whales for each they land, the total impact of this small amount of whaling would exceed recruitment. Furthermore, the concentration of whaling effort on immature animals means that natural mortality is additive to human caused mortality rather than compensatory to it. Our ignorance of the "critical minimum population size" for bowheads, plus our general ignorance of population dynamics of very small populations, combine to make any "theoretically available" sustained yields pure conjecture. See note 40 supra.

\textsuperscript{428} This conclusion is based on the fact that in 1946 the member nations of the IWC felt the need to explicitly exempt "aboriginal whaling" from the regulations contained in the Schedule.
ignored the bowhead issue both in order to avoid delicate political and ethical questions and as a result of its concentration upon regulating commercial whaling.\textsuperscript{429} At its 1976 meeting, the Scientific Committee issued its strongest warning of possible extinction to date, "strongly recommending" that the expansion of Eskimo whaling effort for bowheads be stopped and the loss rate of struck whales be reduced.\textsuperscript{430} The Committee also recommended increased research on bowheads.\textsuperscript{431}

Because Alaskan Eskimos are within United States jurisdiction, the necessary protective measures could be adopted through unilateral action by the American Government. The legal authority to regulate the catch already exists. Notwithstanding the general exemptions for Eskimos under both the Marine Mammal Protection Act and the Endangered Species Act of 1973, the Secretary of Commerce has the power under these acts to limit or prohibit the taking of bowheads upon his determination that the stock is "depleted"\textsuperscript{432} or that the native hunting "materially and negatively affects" the bowhead.\textsuperscript{433} Despite this authority, the Secretary of Commerce has done virtually nothing to regulate the catch.\textsuperscript{434} The failure to adopt more stringent conservation measures seems to be in clear violation of the Marine Mammal Protection Act,\textsuperscript{435} the Endangered Species Act of 1973,\textsuperscript{436} and the 1931 Convention for

\textsuperscript{1949 Amendments to the Schedule, supra note 174, para. 2, currently para. 7 (amended 1975). An argument can, however, be made that the IWC does not have jurisdiction over Eskimo whaling, since art. II(2) of the Convention states that the treaty applies to "factory ships, land stations, and whale catchers . . . ." "Land station" is defined as "a factory on the land" where whales are processed, id. art. II(2), and "whale catcher" is defined as "a ship" used for hunting whales. Id. art. II(3). If Eskimo whaling camps do not constitute "land stations," and if the small skin boats are not "whale catchers," then the IWC arguably has no jurisdiction over Eskimo whaling.

\textsuperscript{429. It should be noted that Eskimos are not the only group of people who catch whales under the "aboriginal whaling" provision and that bowheads are not the only whales so caught. Russian catcher boats catch approximately 160 gray whales each year in the North Pacific "to be used exclusively for local consumption by the [Siberian] aborigines." 1975 Amendments to the Schedule, supra note 263, para. 7; Rice, Status of the Eastern Pacific (California) Stock of the Gray Whale, Doc. FAO/ACMRR/MM/SC/14, at 3 (Dec. 1975) [hereinafter cited as Status of the Gray Whale].

\textsuperscript{430. INT'L WHALING COMM'N, 28TH REPORT (to be published 1978) (Scientific Comm. Rep. para. 11.5.1).

\textsuperscript{431. The Committee recommended a thorough examination of early whaling logbooks, marking studies, and increased efforts at determining current stock size and other biological parameters. Id.


\textsuperscript{433. Endangered Species Act of 1973, 16 U.S.C. § 1539(e)(4); the bowhead is currently listed as an endangered species under this statute, 50 C.F.R. § 17.11 (1975).

\textsuperscript{434. See 50 C.F.R. §§ 17.5, 216.23, 351.2 (1975). The Bergen working group on aboriginal hunting recommended that when a species was endangered, "no export, cash sale or other 'commercial' use of the products" be allowed and that "at no time should the harvest exceed local needs." Report on Aboriginal Hunting, supra note 419, at 1. The Endangered Species Act of 1973 allows the taking of bowheads if such taking is "primarily for subsistence purposes." It also permits the selling of edible portions of the animal in native villages for native consumption and the selling of non-edible portions in interstate commerce, 16 U.S.C. § 1539(e)(1)-(e)(3) (Supp. V 1975).

\textsuperscript{435. The continued taking of bowheads is completely inconsistent with the stated policy of the Act, which is to restore marine mammal populations to levels at which they are not endangered. 16 U.S.C. §§ 1361(2), 1362(1), 1371 (Supp. V 1975). More particularly, Alaskan
the Regulation of Whaling.\textsuperscript{437}

In order to safeguard the remaining bowhead whales, three actions must be taken immediately. First, much more research must be done on the biology and population status of bowheads.\textsuperscript{438} Second, the number of whales killed must be reduced. Either a complete ban on bowhead whaling should be imposed, or village quotas based on historical catches or current need should be established.\textsuperscript{439} Third, if Eskimo whaling is allowed to continue, technology must be developed and regulations enforced to reduce waste.\textsuperscript{440} Eskimo leaders must be involved in the design of any regulations, for without their support, regulations would be largely unenforceable.

natives are only exempted from the protective regulations concerning bowheads if the whaling “is not accomplished in a wasteful manner.” \textit{Id.} § 1371(b)(3). As discussed above, see note 420 \textit{supra} and accompanying text, current Eskimo whaling involves an intolerable amount of waste, and this waste is increasing both in terms of whales struck but not landed and utilization of the whale carcasses.

436. The Endangered Species Act of 1973 also exempts Eskimo whaling only if it is not done in a wasteful manner. 16 U.S.C. § 1539(e)(2) (Supp. V 1975); see also note 435 \textit{supra}.

437. The 1931 Convention for the Regulation of Whaling, \textit{supra} note 115, completely prohibits whaling for bowheads (art. 4) (described in the treaty as Greenland right whales), except for “aboriginal whaling” which is allowed (art. 3) if, and only if, the Eskimos “(1) . . . only use canoes, pirogues or other exclusively native craft propelled by oars or sails; and (2) They do not carry firearms.” However, a considerable amount of Eskimo whaling done in the fall is accomplished from motorized launches. Eskimo Whaling, \textit{supra} note 424. Further, one of the main instruments used to kill the whales is a shotgun-like harpoon gun which surely qualifies as a “firearm.” 1974 Bowhead Studies, \textit{supra} note 411, at 7-12.

438. The need for increased research on bowhead whales was explicitly recognized by Congress in its passage of the Whale Conservation and Protection Study Act, Pub. L. No. 94-532, 90 Stat. 2491 (1976), 16 U.S.C. § 917, which authorizes one million dollars for research on whales over the next two years. The original bill reported out of the House Merchant Marine and Fisheries Committee was titled “Save the Gray and Bowhead Whales Act” and allocated research funds for studies concerning only those two species, H.R. REP. No. 1574, 94th Cong., 2d Sess. 4 (1976) \textit{reprinted in} [1976] U.S. CODE CONG. & AD. NEWS 5983, 5985.

439. Historical quotas could be based on the average catch of each village over the last 25 years. Quotas based upon each village’s need might be preferable, since each village has different access to alternate food and energy supplies, and the relative efficiency of recovering struck whales varies between villages. 1974 Bowhead Studies, \textit{supra} note 411, at 10. The Bergen working group on aboriginal hunting discussed establishing overall stock quotas to be divided among the villages based on population and limits on the number of boats and crews that would be allowed to operate out of each village. \textit{See Report on Aboriginal Hunting, supra} note 419, at 2; 1974 Bowhead Studies, \textit{supra} note 411.

The appropriate management agencies in all the involved nations (the United States, the Soviet Union and Canada) must make much greater efforts to explain to the Eskimo villagers the need for a reduction in the catch, demonstrating how such a reduction is in their own long-range interest. Every effort should be made to get the Eskimos to regulate their own catch. To the extent that quotas or a moratorium would result in economic hardship for Eskimo villages without readily available alternate food supplies, national governments must act to provide food for these villages.

440. The Bergen working group on aboriginal hunting suggested that efficiency might be increased by requiring each crew to have a minimal amount of equipment, by requiring the use of radio transmitters to help locate wounded whales, and by requiring the use of the most efficient techniques. \textit{See Report on Aboriginal Hunting, supra} note 419, at 2.
b. Other endangered cetaceans

While the bowhead is clearly the most endangered whale species and perhaps the only whale for which the entire species is endangered, several stocks of other whale species are at seriously low levels. Right whales in the Antarctic number only around 3,000 animals, and stocks in the North Atlantic and North Pacific probably number a few hundred animals at most. Both humpback and blue whales are at low levels in all oceans, but especially in the North Atlantic and North Pacific.

Humpback and blue whales were depleted during the period the IWC was managing the stocks. Although all of these stocks are currently protected by the IWC, this protection came only after long and inexcusable delays. During the 1950's and early 1960's, the IWC acted as if the phenomenon of critical minimum sizes did not exist; it acted as if a stock would automatically recover if a handful of animals were left. Whaling went on even though scientists could not determine such elemental facts as the age of sexual maturity of the harvested species. The declaration of quotas in blue whale units allowed whalers to exceed legally the catch of favorite species on which the b.w.u. quota was based. Finally, the lack of any international observer scheme made illegal catches easily disguisable.

The belated protection of blue, humpback and fin whales, the adoption of species and stock quotas, the safety margins incorporated in the New Management Procedure, and the implementation of an international observer scheme finally give some credibility to the IWC's conservation claims.

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442. Draft Report on Large Cetaceans, Supp. 1, supra note 14, § 5.1; Chapman, Status of Antarctic Rorqual Stocks, in The Whale Problem 226-29 (W. Schevill ed. 1974); see also Table 2 in text accompanying note 14 supra.

443. Draft Report on Large Cetaceans, supra note 14, §§ 2.1(b), 2.2, 2.3; see also Table 2 in text accompanying note 14 supra.

444. 1976 Amendments to the Schedule, supra note 273, para. 6(c).

445. See text accompanying notes 189-222 supra.


447. If one takes the first reliable records of the blue whale catch in 1909 as the beginning of its commercial life and 1965 as its end, the specific knowledge of age at sexual maturity was attained when its commercial life was 95.2 percent over. In other words, . . . 95.2 percent of all blue whales taken in the history of Antarctic whaling had already been killed.

Small, supra note 5, at 31.

448. This occurs whenever whalers concentrate on large whale species more than the IWC planned.

449. See text accompanying notes 539-50 infra.
and some hope for preserving the whales. Still, our ignorance of whale ecology may cause us to miss opportunities to manage the whales' ecosystems in a way that will ensure or speed the recovery of endangered stocks, and the continued whaling by nine non-IWC nations continues to threaten these stocks.

The situation for the smaller cetaceans, though less publicized, may be even more serious than that of the large whales. Mitchell, in his 1975 study of small cetacean fisheries, listed two species of fresh water dolphins as "endangered." Three other species, including the Dall's porpoise and northern bottlenose whale, were listed as "vulnerable" to extinction due to excessive catches in direct and incidental fisheries. So little is known about an additional 33 species of small cetaceans that their status could only be listed as "indeterminate."

Since the two endangered species are freshwater mammals and are consequently confined to internal waters, their conservation is going to depend largely upon the commitment of the nations within whose borders they are found to adopt adequate conservation measures.

450. For example, it has been suggested that the failure of southern right whales to recover has been due to competition with sei whales which have increased in numbers with the reduction in other baleen whale species. Gambell, The Unendangered Whale, 250 Nature 454 (1974) [hereinafter cited as The Unendangered Whale]. If this is true, a reduction in the number of southern sei whales might be necessary to bring about a recovery of right whales. The evidence for such a competitive interaction is weak and is criticized by Holt, Whales: Conserving a Resource, 251 Nature 366, 367 (1974) [hereinafter cited as Whales: Conserving a Resource].


452. The third vulnerable species listed was the Ganges Susu (Platanista gangetica), another freshwater dolphin. Mitchell, supra note 283, at 12. The term "vulnerable" is used as in 1 H. Goodwin & C. Holloway, IUCN Red Data Book preamble § 5.2 (1972) (mammals) [hereinafter cited as Goodwin & Holloway]. This section, as amended in 1974, reads:

Taxa believed likely to move into the endangered category in the near future if the causal factors now at work continue operating. Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are under threat from serious adverse factors throughout their range.


453. Indeterminate species and other taxa are defined as:

Taxa that are suspected of belonging to one of the first three categories [endangered, vulnerable, or rare] but for which insufficient information is currently available.

Goodwin & Holloway, supra note 452, preamble § 5.5.

454. See note 451, supra. An additional species, the cochito (Phocoena sinus) may also be protected by unilateral action by only one nation—Mexico. The only known range of this species...
conservation of most of the vulnerable and status-indeterminate species will probably depend on international conservation measures. However, the lack of any existing international conservation agency with authority over small cetaceans makes the adoption of effective conservation measures all the more difficult. The future role of the IWC and alternate international agencies in small cetacean conservation is discussed in more detail in the legal assessment section.\textsuperscript{455}

2. Whales and the Practice of MSY

a. The Calculation of MSY

Under the provisions of the New Management Procedure, whale stocks are managed for the goal of MSY until "optimum levels" are quantitatively defined.\textsuperscript{456} As mentioned previously, MSY is a politically acceptable goal because it appears to maximize the yield from the resource, and because it is assumed to be easily calculated.\textsuperscript{457} However, close examination of the methodologies by which maximum sustainable yields are calculated reveals the extremely tenuous relationship between the mathematical calculations and the biological reality they attempt to quantify.\textsuperscript{458}

Dr. Sidney Holt, fisheries biologist for the FAO and expert on population biology, has written, "The term 'MSY' describes a property, not of an animal population, but of a mathematical model which is applied to data from a population."\textsuperscript{459} This point, explicated below, is vital to an understanding of the problems involved in any practical application of MSY principles. Too often, whaling apologists have mistaken sophisticated mathematical models for a profound understanding of whale ecology.

In order to design harvest quotas which will achieve MSY for each stock, a population biologist generally needs three pieces of information: the net recruitment rate of the stock expressed as a function of the stock size, the current size of the stock (including age and sex ratios), and the initial abundance of the stock before exploitation.\textsuperscript{460} Given this information, the population biologist can construct a model to predict the stock level and yield at MSY. By comparing the predicted stock level and yield at MSY with

\textsuperscript{455} See text accompanying notes 660-873, Part Two infra.

\textsuperscript{456} 1975 Amendments to the Schedule, supra note 263, para. 6.

\textsuperscript{457} See text accompanying notes 362-75 supra.

\textsuperscript{458} For examples of techniques for determining and modeling whale population parameters, see Chapman, Estimation of Population Parameters of Antarctic Baleen Whales, in The Whale Problem 336 (W. Schevill ed. 1974).

\textsuperscript{459} The Concept of MSY, supra note 375, at 5.

\textsuperscript{460} Id. at 5-6; Draft Report on Large Cetaceans, supra note 14, at 13-30; Mackintosh, supra note 7, at 184-98.
estimates of current abundance of the stock and data describing the number of whales harvested from that stock annually, the biologist can decide whether quotas need to be reduced or increased.

Theoretically, biologists can determine the MSY directly from the net recruitment rates of stocks. As was explained earlier, recruitment rates of most stocks of wild animals show an inverse density-dependent response, i.e. the recruitment rate increases as the stock level decreases. As a result of a great deal of scientific research on the exact mathematical description of this relationship in cetaceans, scientists have concluded that the precise relationship between stock size and net recruitment rate differs for each stock of each species. Although the recruitment rates of some stocks of several species are known over relatively narrow ranges of abundance, this data is not available for all stocks or even all species. Stocks for which data is unavailable have been assumed to act the same as the one or two stocks for which data is available.

Ideally, the MSY stock level could be calculated directly and solely from the recruitment rate curve of each stock. However, in practice, whaling data do not allow sufficiently precise estimation of the net recruitment rate as a function of stock size to make such a method feasible. Therefore, estimates of the present and initial stock sizes must also be used in determining the MSY stock level.

Whale biologists have equal difficulty in estimating the second necessary piece of information—the current population of the stocks. The data on stock sizes comes from three main sources—sighting cruises, the "mark-

461. See The Unendangered Whale, supra note 450, at 454; Changes in Pregnancy Rate, supra note 36.

462. Even when stock separation is fairly clear, practically never has it been possible to estimate the vital parameters of each stock of a species separately; most if not all of the parameters are assumed to have the same value in all stocks, or in a group of stocks, the only variable being the number of animals in the stock. . . . Practical application of the management policy is really then to presumed stocks on the basis, at best, of knowledge about the population biology of the species.

Whale Management Policy, supra note 407, at 1.

463. The recruitment rate curve is the graphical representation of the net recruitment rate as a function of stock size.

464. Starting from the fact that it is impossible to discriminate between several plausible mathematical models of the net recruitment rate expressed as a function of stock density, Dr. Holt has shown that depending upon which model was chosen, the MSY stock level would vary from 0.22 to 0.66 of the initial population level. He concluded that:

It seems unlikely that the MSY [stock] level could be deduced from excellent data for a reproduction curve with less than 20% error, and, I suspect, not even within 30% error in practice.

Holt, Aspects of Determining the Stock Level for Maximum Sustainable Yield, Doc. FAO/AC-MRR/MM/SC/29 (Dec. 1975); much of this same argument is contained in The Concept of MSY, supra note 375, app. 4; see also The Optimization of Management, supra note 388, at 5-8; Note on Strategy, supra note 401, at 5; Holt, A Comment on the Assessments for So. Hemisphere Sei Whales, 1976 REPORT AND PAPERS OF THE SCIENTIFIC COMM. (to be submitted to the June 1977 meeting).

465. Sighting is usually done from catcher boats, or boats on whale marking cruises, although it has also been done from shore for gray whales and from airplanes for certain local stocks. For discussion of the theory behind this form of population estimation, see Doi, Further Development of Whale Sighting Theory, in THE WHALE PROBLEM 359 (W. Schevill ed. 1974).
ing" of whales, and the catch data of whalers (the catch per unit effort or CPUE data). The main use of sighting data has been to estimate the population abundance and trends of protected stocks. Marking data has primarily been used to identify biological stocks and to verify the accuracy of ageing techniques. The most important and useful source of data for estimation of the population size of harvested stocks has come from CPUE data. Unfortunately, as a result of technological innovations and changes in whaling operations, CPUE data is necessarily biased. Although the raw

466. Whale "marking" consists of firing a metal cylinder into the blubber of a live whale. The cylinder, or "discovery mark," provides information only when the whale is later killed. Even then the efficiency of mark recovery is quite low. Attempts are being made to develop markers that will be visible on live whales. See Mitchell & Kozicki, Prototype Visual Mark for Large Whales Modified from "Discovery" Tag, INT'L WHALING COMM'N, 25TH REPORT 236 (1975). Markers are also being developed which will chemically stain certain organs so that ageing techniques can be further refined. See FOE, supra note 65, at 121-22. For a discussion of the shortcomings of whale marking for population estimation see note 469 infra.

Smaller cetaceans have also been marked with "Discovery" marks, see Brown, Marking of Small Cetaceans Using "Discovery" Type Whale Marks, 32 J. FISH. RES. BOARD CANADA 1237 (1975), but recently considerable attention has been directed towards developing radio-telemetry tags for small cetaceans. See Evans, Radio-telemetric Studies of Two Species of Small Odontocete Cetaceans, in THE WHALE PROBLEM 385 (W. Schevill ed., 1974); Norris, Evans, & Ray, New Tagging and Tracking Methods for the Study of Marine Mammal Biology and Migration, in THE WHALE PROBLEM 395 (W. Schevill ed., 1974); Report of the Meeting on Smaller Cetaceans, supra note 285, at 960-62.

467. Data concerning the number of whaling ships in operation, the number and size of the catcher boats, the number of days spent hunting on the whaling grounds, and the geographic area of the catches is reported by the whaling nations to the Bureau of International Whaling Statistics in Sandefjord, Norway. If CPUE figures remain constant over several years, it is fairly safe to assume that the stock is stable; if they decrease, the stock is probably decreasing. See SMALL, supra note 5, at 67 (Fig. 8); The Last of the Great Whales, supra note 211, at 18. For a discussion of some of the methodological problems with interpretation of this data, see note 471 infra.

468. The major problems of translating sighting data into density or abundance estimates are the result of the non-random nature of the searching, the infrequency of the expeditions, and the variability of the search area due to such factors as weather. See Draft Report on Large Cetaceans, supra note 14, at 13-15.

469. Marking data has not been widely used for population estimation because of the relatively small number of whales that have been marked and the variability of recovery rates among whaling expeditions. See Draft Report on Large Cetaceans, supra note 14, at 15-18. The development of a marker that is visible on live whales would enable the use of this technique for estimating populations of protected species.


471. Untreated CPUE data from different years is comparable only if the searching and catching efficiency remain constant over the period of years in question, if whalers proportion their effort between species similarly over the years, and if each whaling fleet operates at the same efficiency. None of these assumptions are justified. Searching efficiency has increased as a result of the increase in size of catcher boats and as a result of the installation of variable tilt ASDIC (sonar) apparatus on catcher boats. This last innovation alone has increased whaling efficiency an estimated 230%. In addition, the change in whaling grounds, the mix of species sought, and the national composition of the whaling fleets has altered the average efficiency of the whaling fleets. See Draft Report on Large Cetaceans, supra note 14, at 18-21.

Increases in the efficiency of whaling effort tend to mask decreases in stock sizes. The shifting of the proportion of total effort initially toward a species when it is unexploited and then away as it becomes depleted causes the estimates of population size to be low during both periods when relatively little effort is being directed toward that species. Thus, CPUE-derived estimates
data can be adjusted to correct for the biases involved, due to the imprecision of our knowledge of the biological parameters of whale stocks it is scientifically impossible to determine exactly which adjustments will increase the accuracy of the estimates. Often, different scientists, each making plausible adjustments to identical data, have arrived at radically different population estimates for the same stock.\textsuperscript{472}

Finally, the initial population level of stocks is also difficult to estimate.\textsuperscript{473} For stocks which were severely depleted before this century, it is rarely possible to estimate initial abundance. Even for stocks recently exploited, this figure is hard to calculate and has questionable value for calculations of MSY stock levels.\textsuperscript{474}

b. **MSY-Weight vs. MSY-Numbers**

MSY for whales has traditionally been calculated to yield the maximum *number* of whales that could be taken (MSY-number).\textsuperscript{475} An alternate strategy would be to maximize the total biomass or *weight* of the whales harvested (MSY-weight). Note that using this latter goal, scientists can still set quotas in numbers of harvested animals.

In terms of both MSY stock level and yield (in weight and numbers), there is virtually no difference between MSY-number and MSY-weight strategies *if* the average size of the whales caught does not substantially change as a result of exploitation.\textsuperscript{476} However, all species of whales, especially sperm whales, have shown significant decreases in the mean size of captured individuals as the result of whaling.\textsuperscript{477} When this happens, the sustainable yield obtainable at an MSY-weight stock level exceeds in weight that obtainable at an MSY-number stock level.\textsuperscript{478} Since the industry is interested in the volume of whale products, which is a direct function of the

\textsuperscript{472} of blue whale populations during the mid-1960's overestimated the extent of stock depletion. For an excellent discussion of this last example and problems of CPUE data in general, see *A Note On Blue Whales*, supra note 14.

\textsuperscript{473} See Talbot, *supra* note 1, at 28-29.

\textsuperscript{474} See *Draft Report on Large Cetaceans*, *supra* note 14, at 29-30.

\textsuperscript{475} The value of a figure for the initial population size is that it allows an estimation of the recruitment curve, because it is generally assumed that the population was stable (*i.e.* net recruitment = 0) at this level. However, recent studies of populations have tended to show that wild populations are rarely constant, and it is more likely that whale populations were changing in size at the time of their initial exploitation. This makes determination of the recruitment curve more difficult. See *The Concept of MSY*, *supra* note 375, at 11; *Draft Report on Large Cetaceans*, *supra* note 14, at 29-30.

\textsuperscript{476} It could be argued that the blue whale unit was an attempt to manage whales by weight, but MSY levels were always calculated for number for each species.

\textsuperscript{477} S. Holt, Memorandum to K. R. Allen, Chairman of the IWC Scientific Committee, on the maximum sustainable yield in weight and related matters, at 3 (Aug. 26, 1974) (on file with the author) [hereinafter cited as Holt Memo].

\textsuperscript{478} The average weight of male sperm whales caught in the Antarctic has decreased from 47 tons to 28 tons. The average size of the females caught has decreased from 16 to 12 tons. *Id.* app. 1.

\textsuperscript{478} *Id.* at 9.
weight rather than the number of whales taken, logically the industry should prefer an MSY-weight criterion. Dr. Holt of the FAO argues further that under an MSY-weight criterion the desired harvest volume could be taken with less effort than would be necessary under an MSY-number policy, again a change that seemingly would benefit the industry.

The industry’s objection to the MSY-weight criterion results from the fact that the stock levels which must exist to generate MSY-weight are higher than those which generate MSY-number. Therefore, stocks below MSY-weight stock level have to be protected in order to allow them to increase in size. The differences in calculated MSY population levels under these two plans are on the order of 5 percent of the current MSY-number stock level for baleen whales and 7-18 percent for sperm whales.

From the point of view of conservationists, MSY-weight is clearly preferable since it allows a high yield while maintaining the stock level higher and closer to its pre-exploitation level. From the industry’s point of view, any transition from MSY-number to MSY-weight for stocks that are already at or below MSY-number levels would require that harvests be temporarily reduced or suspended to allow the stock to increase to the MSY-weight level. For the economic reasons detailed below, the industry is far more concerned about present catch levels than any anticipated gains from future catches, and has opposed the MSY-weight criteria.

The position of the IWC Scientific Committee on this matter reveals the political pressure on that body. In June of 1974 the full Commission adopted the policy that “scientific advice for management of whale stocks should be based not only on the concepts of maximum sustained yield in number by species, but should also include such considerations as total weight of whales.” At its meeting in La Jolla in December of 1974, however, the Scientific Committee considered the problem again and concluded that the differences between MSY-weight and MSY-number were not significant.

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479. Because of variations in prices of products, and in the degree and mode of utilization of whales caught, and the international nature of the industry, it is not practicable to put forward, at this time, a strictly value criterion for MSY. The total weight of a whale catch is, however, a good index of the value of products that can be obtained from it; this is generally true even for different species of baleen whales, notwithstanding the fact that there are inter-specific differences in meat and oil yield, etc., and also seasonal and area differences. Even if the weight and value are not exactly or invariably proportional, they are certainly much more closely related than are number and value.

Holt Memo, supra note 476, at 4.

480. “[B]y maintaining a number criterion, rather than changing to a weight criterion, the industry is encouraged to exert 50% more whaling effort (catchers’ days work) than is necessary to take the same yield.” Holt, Criteria for Management—Weight or Numbers? 1975 REPORT AND PAPERS OF THE SCIENTIFIC COMMITTEE 409, 411 (1976) [hereinafter cited as Criteria for Management].

481. See id; Holt Memo, supra note 476, at 9-11; Whales: Conserving a Resource, supra note 450, at 367.

from a management point of view since the differences are in the same order of magnitude as the statistical confidence intervals for stock size estimates.\footnote{483}{A "confidence interval" represents the range of possible size of the population being estimated with a given degree of probability, \textit{i.e.}, the best estimates of the population size of a given stock may be 100,000 with a 95\% chance that the actual population size is between 90,000-110,000. This latter range would be the 95\% confidence interval for that particular estimate. \textit{Scientific Comm., Report of the Dec. 1974 Special Meeting La Jolla, 1975 REPORT AND PAPERS OF THE SCIENTIFIC COMMITTEE OF THE IWC 88 (1976); see also Criteria for Management, supra note 480, at 409.}}

The Committee's argument is specious. Because the direction of difference between MSY-number and MSY-weight is known, management decisions can and should be adjusted accordingly regardless of the width of the confidence interval for stock size estimation. The Committee's action can only be understood if one notes that the MSY-weight issue was the less important of two issues that had to be resolved at the December meeting. The potentially more explosive issue was the numerical definition of "near MSY" in the stock classification scheme. Consequently, conservation interests were compelled to surrender the MSY-weight issue despite the lack of contrary scientific evidence in order to persuade a large majority of the Scientific Committee to agree to the 10 percent figure as a definition of the lower boundary of "near MSY".\footnote{484}{See text accompanying notes 257-64 supra.}

3. \textit{The IWC and Ecosystem Management}

The need for cetacean management based on ecological principles has been stressed earlier in this article. It should be reiterated that the call for more ecological management is not merely an idealistic refrain, but a matter of immediate and practical necessity. This section will briefly outline the major ecological problems facing both whales and small cetaceans and suggest actions the IWC should take to deal with these problems.

The brevity of the following discussion reflects the current knowledge of marine ecosystems generally and cetacean ecology in particular. In general, ecological research is difficult to carry out because of the number of interrelated factors that must be analyzed. When such research must be conducted over vast areas of ocean with virtually no experimental control over any of the factors involved, the difficulty and expense of conducting it increases. As a result, little ecological research has been done on cetaceans.

The research that has been done suggests four main classes of ecological interactions of special concern for cetacean management. These classes are 1) interactions among cetacean species, 2) the effects of human exploitation on cetaceans and their food supply, 3) the effects of human pollution of the seas, and 4) the effects of human alteration of critical cetacean habitats.

Ecological relations among whale species may have been altered by whaling. For example, an alteration of ecological relations may occur whenever several species of baleen whales are found in the same area feeding
on the same prey and only some of these species are hunted, or different species are hunted with different intensity. Historically, whalers selectively hunted certain species while ignoring sympatric species that they were technologically incapable of harvesting or that were less valuable economically. In the Southern Hemisphere, early whalers drastically reduced the population of right whales and the larger rorquals. As a possible ecological consequence, sei whale stocks apparently increased. When commercial whaling of right whales ceased, their populations increased in response to this protection much more slowly than had been expected. Some scientists have suggested that the increase in number of sei whales altered the right whale’s ecology in a manner which prevented the latter’s rapid recovery. Similar inter-specific competitive interactions may be occurring among other baleen whale species in other areas.

Similarly, ecological relations among small cetaceans existing in schools of mixed species may have been altered by harvesting of one or more species. Some of the best known mixed species groups are large schools of delphinids in the eastern Pacific composed of three or more species. The reasons for these inter-specific groupings are unknown. The intentional harvest of one of the represented species is likely to have a profound effect on the other species involved.

The second class of significant ecological interactions involves the effects of human exploitation on cetaceans and their food supply. As mentioned above, human harvesting of whale species may affect the ecological relations among whale species. It may also have very critical effects upon the relative and absolute abundance of non-cetacean species. Human exploitation of food species of cetaceans has created problems of two types. First, in several fisheries the combined cetacean and human fishing effort is beginning to exceed the sustainable yield of the resource; one or the other will have to be reduced. Second, certain small cetacean species hinder human fishing efforts and steal fish from the nets or hooks of the fishermen.

The best example of the effect of harvesting cetaceans on the abundance of non-cetaceans has occurred in the Antarctic. It was earlier noted that whaling in the Antarctic has reduced the original baleen whale biomass of the area to approximately one-seventh its original weight. The resulting reduction in whale predation on krill has created an estimated annual “surplus” of 153 million metric tons of krill. In contrast, the total world fisheries catch for all species in 1972 was only 56.2 million metric tons.
Intensive commercial exploitation of krill in the Antarctic has not yet begun, but the technological and marketing aspects of such an operation have been investigated and appear feasible. Populations of other krill eaters (crabeater seals, fish, penguins, and other pelagic birds) have apparently increased as a consequence of the greater abundance of krill. The ecosystem may be stabilizing at a new equilibrium point, and if substantial human fishing for krill is added to this system, baleen whales may not recover to their former abundance.

Whales and humans also fully exploit (or over exploit) common prey on a smaller, but less hypothetical, scale in other parts of the world. North Atlantic baleen whales, especially fin whales, take considerable amounts of capelin, herring, and cod which are also the targets of human fisheries. Baleen whales and fisheries also compete for mackerel and anchovies in the North Pacific and horse mackerel, anchovies, and pilchard around South Africa. Small cetaceans also compete for species sought by fishermen. Common dolphins off the California coast annually consume an estimated 300,000 short tons of anchovies, or three times the quota allowed commercial fishermen. Belugas feed heavily on spawning salmon at the mouths of rivers in the North American Arctic.

Small cetaceans are polyphagous, opportunistic feeders that can survive drastic reductions in the populations of fish species currently sought commercially. However, there is an increasing interest in developing large-scale fisheries for non-traditional species, notably squid. Since different species of squid form the major part of the diet of many cetacean species either seasonally or during the whole year, such fisheries could have drastic effects on local or regional populations of small cetaceans. A much better knowledge of small cetacean ecology is necessary before the precise effects can be predicted, and the fisheries can be regulated to minimize their impact on small cetaceans.

The problem of small cetaceans directly stealing fish from fishermen’s nets and hooks and damaging equipment has received more publicity in recent years. During the 1950’s, the United States Navy attacked killer whales off Iceland with machine guns, rockets, and depth charges because of the whales’

492. See Bondar & Bobey, Should We Eat Krill? 4 ECOLOGIST 256 (1974) and contained references; Moiseev, Some Aspects of the Commercial Use of the Krill Resources of the Antarctic Seas, in 1 ANTARCTIC ECOLOGY 213 (M. Holdgate ed. 1970).
494. Id.
interference with herring fisheries. Off the Florida coast, bottlenose dolphins actively interfere with fishing operations for Spanish mackerel, bluefish, pots, pompano, and king mackerel. As a result, fishermen have incurred annual costs of approximately $440,000 from damaged gear, lost fishing time, and decreased fishing efficiency in the presence of dolphins. Interference by common dolphins with fishing operations is reportedly a widespread problem in the Mediterranean. Problems have also been reported with false killer whale (Pseudorca crassidens) interference with long-line fisheries for tuna and billfish in the Indian and Pacific Oceans.

A third ecological problem is pollution. Three types of pollution are of immediate concern: chemical pollution, increased maritime traffic, and noise pollution. Most of the studies that have been done on the effects of chemical pollution on cetaceans have focused on organochlorine pesticides. Research is greatly needed on the effects of pollution from heavy metals such as mercury, cadmium, lead, arsenic, and chromium. The expanding use of supertankers and the increasing number of off-shore oil wells pose a serious threat to many species of cetaceans. Preliminary studies suggest that chemical pollution has caused significant loss or changes in distribution of small cetacean faunas near areas of industrial development. Areas of current concern include the Baltic, the North Sea, and the Mediterranean.

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504. The U.S. Marine Mammal Commission recently recommended delaying a Bureau of Land Management sale of oil and gas leases near the Georges Bank due to the unknown impacts of such development on marine mammals, in particular the right and humpback whales. 2 Marine Mammal News 3-4 (Dec. 1976).
Heavy ship traffic near busy harbors has apparently altered the migration patterns of gray whales, minke whales, and finless porpoises (Neophocaena phocaenoides).\textsuperscript{509} The noise from ship traffic may also affect cetacean behavior over greater distances. It has been suggested that certain large whale species communicate over ranges of several hundred miles of sea.\textsuperscript{510} The increase in ocean noise over the last hundred years as the result of steam transportation and greatly expanded maritime traffic may have significantly lessened the ability of these animals to maintain their communication system.\textsuperscript{511}

The final class of ecological problems involves the protection of critical habitats for cetaceans. The major difference between this problem and pollution is scale. Critical habitats are areas of relatively small size which are particularly important in the life history of the species and which are often hypersensitive to a wide range of environmental disturbance. The coastal lagoons of Baja California and Peninsula Valdes, Argentina are areas which need special protection to assure that gray and right whales will continue to use them as calving areas.\textsuperscript{512} Critical habitats for other whale species and small cetaceans are less well identified but probably exist and will also require special conservation measures.

The IWC does not have the legal authority to manage all aspects of the whales’ ecosystems, and it is unrealistic to imagine that it will gain this authority in the future. However, the IWC should be aware of the problems mentioned, and should ensure that adequate research is done, coordinate its activities with the activities of other appropriate international and national environmental agencies, and formulate its own policies in a manner which acknowledges the ecological nature of the resources it is managing.

There are four specific actions the IWC should take to deal with the ecological problems discussed above. First, the Commission should establish management goals that recognize the interaction among cetacean species. This recognition must be one of the elements distinguishing "optimum population levels" from MSY levels. Second, the IWC must more actively encourage and, if necessary, conduct research on ecological problems related to direct and indirect cetacean competition with human fisheries. This may initially involve collection of more data by regional fishery commissions and/or the Food and Agriculture Organization. Third, the IWC must continue to monitor levels of pollution, and communicate its concern to the appropriate international and national agencies. Finally, the IWC must identify critical habitats for cetaceans, and strive to protect these habitats. It may be necessary and appropriate in the case of migratory stocks for the state within whose

\begin{footnotes}
\item[509.] Id. at 7; see also Draft Report on Ecological and General Problems Supp. 3, supra note 495, at 11.
\item[510.] Payne, supra note 82, at 148-58.
\item[511.] Id. at 151; Draft Report on Ecological and General Problems, supra note 506, at 7.
\end{footnotes}
boundaries these critical habitats exist to receive some compensation from other nations which benefit from the protection the coastal state provides. The IWC might play a role in the development of such a plan.

C. The Institutional Response to Biological Uncertainty

1. The Problem of Biological Uncertainty

Previous sections have discussed the tremendous gaps and uncertainties in our knowledge of cetacean biology and ecology. One of the most important consequences of these gaps is that scientists are unable to estimate population sizes and sustainable yields of whale stocks except within broad ranges. Yet, quotas have been based on single number estimates. The IWC has often given the impression that the selection by the Scientific Committee of a single population estimate out of the range of estimates developed by the scientists is a purely scientific process. This is inaccurate. The selection process is in part scientific, in part guesswork, and in large part political. By carefully choosing input parameters for the population models, whaling nations have dramatically "increased" on paper the sustainable yield of various stocks in attempts to justify "scientifically" quotas that were predetermined by economic needs.

The problems arising from the imprecision of scientific estimates were exacerbated by the adoption of the New Management Procedure. The Procedure requires significantly greater informational input, especially concerning the identification of stocks, the determination of the biological parameters of individual stocks, the estimation of "initial stock levels," and the calculation of "optimum population levels." If MSY yields are speculative when based on species biology, estimated yields for individual stocks are even more speculative. Notwithstanding the imprecision of estimates of present and MSY stock levels, the Scientific Committee must use these estimates to determine into which of the three management categories each stock will be classified.

Imprecise knowledge is a common feature of most managed fisheries, although it does not pose as great a problem for fisheries management as it does for whale management. The greater short-term resilience of most fish

513. For example, at the 1973 meeting of the IWC, the estimates of the humpback population in the North Pacific varied from 2,000-8,500, fin whale stocks in the Southern Hemisphere from 84,000-97,000, and the sustainable yield from southern minke whales from 5,000-12,230. Scheffer, The Case for a World Moratorium on Whaling, in MIND IN THE WATERS 231 (J. McIntyre 1974). These variances are smaller than they have been in the past: in 1970 the sustainable yield of Antarctic fin whales was variously estimated at between 600-6,000 whales. Allen, Recruitment to Whale Stocks, in THE WHALE PROBLEM 352, 356-57 (W. Schevill ed. 1974). These variances have continued to decrease, but they are still substantial. See Table 2 in text and references contained in note 14 supra. The ranges of estimates are much larger for small cetaceans and are summarized in Report of the Meeting on Smaller Cetaceans, supra note 285; Draft Report on Small Cetaceans and Sirenians, supra note 286.

514. See Talbot, supra note 1, at 28-29.

515. See text accompanying notes 257-64 supra.
populations and the shorter time lag before mistakes become detectable make mistakes less costly in fisheries management. Also, the economic and legal environment of whaling probably creates a stronger incentive to deplete stocks than occurs in most fisheries. As a consequence, the design of institutional procedures for cetacean regulation that will deal routinely with biological ambiguity in a manner safeguarding management goals is one of the major challenges facing international lawyers and resource managers today.

2. "Best Estimates"

Current attempts to deal with the problem can best be understood within a historical context. During the 1950's, and to a slightly lesser extent during the 1960's, one of the primary goals of the Scientific Committee was unanimity in its recommendations. Basic reforms were sought, such as the abolition of the blue whale unit, and a united scientific front on all issues was thought to be necessary in order to achieve influence on any issue. In view of the unwillingness of the full Commission and of certain whaling nations to accept any scientific advice contrary to the whaling nations' economic interests, this drive for consensus may have been wise, but the cost was often a masking of the extent of stock depletion, especially of blue and humpback stocks.

The following process of resolving ambiguity was used until the 1975 meeting of the IWC. The Scientific Committee would review the catch statistics, CPUE data, sighting records, and the population estimates derived from this data. Often there would be two or more estimates of population size and sustainable yield for the same stock presented by the same or different scientists. The Committee would debate the merits of the various population estimates and come up with its own "best estimate." The criteria used to

516. See text accompanying notes 591-97, Part Two infra.
517. As recently as 1975 the Scientific Committee said "the Committee's normal procedure should be to reach a consensus on scientific and management matters." 1975 REPORT AND PAPERS OF THE SCIENTIFIC COMM. OF THE IWC 2 (1976).
518. Another factor has been that scientists have seen that differences among them, made public, have been exploited in order to justify higher, rather than lower, quotas, or the deferment of restraining regulations until such time as there is a consensus. This attitude on the part of the "managers" has practically forced scientists to seek agreement among themselves at almost any cost, and to place a holy aura on "best" estimates—better, it is said, to act on a best estimate than not to act at all.
S. Holt, A Ten Year Moratorium on All Commercial Whaling 3 (1974) (International Ocean Institute, Royal University of Malta, Msida, Malta); see also MACKINTOSH, supra note 7, at 180; NORRIS, supra note 303, at 246.
519. (If) we make a criticism, it is that the Scientific Committee, whether or not by intent, but certainly by the manner in which it has, under pressure, communicated its conclusions, tended to obscure the uncertainties of its deductions and calculations. This has an understandable origin—too often in the past honest uncertainty has been taken as a sign of weakness and management decisions—or non-decisions—have been inappropriate to the situation. We believe that ignorance must be honestly faced, and appropriate decision procedures developed which take account of it.
520. The practical problems of assessing the magnitude of stocks and yields frequently
determine this "best estimate" were rarely articulated either in print or verbally, and often the figure chosen represented a political compromise designed to achieve unanimity or to avoid the withdrawal of one or more members from the Commission. The labeling of the chosen estimate as the "best estimate" implied both a preference which was scientifically unjustifiable and a degree of certainty which never existed.

result in the Scientific Committee being faced with an array of possible values which cannot be subjected to proper statistical analysis. In this situation, the best procedure will be for the Scientific Committee to advise the Commission of the "best estimate."

1975 REPORT AND PAPERS OF THE SCIENTIFIC COMM. OF THE IWC 40 (1976). The Committee did add the admonition that:

The margins to be allowed in establishing both the boundaries between stock categories and the permitted levels of catch should therefore take into account the fact that there will be reasonably likely estimates which are somewhat below the best estimate.

Id.

521. [Flow of the calculations on which the Scientific Committee has based its advice to the Commission have been published in full, and they are often not described in detail in the Commission's internal documents. Thus even those scientists who have participated in the discussions are not necessarily able to check the results, and the results are certainly not open to critical scrutiny by a broader community of scientists, even those especially knowledgeable about whale biology, population dynamics or marine ecology. In particular it is difficult, if not impossible in some cases, to see exactly what assumptions, and what adjustments to data, have been made.


522. While the scientific subcommittee (as it then [1955] was) believed, (or most of it believed) that the quota should be, if the stocks were to be maintained, no more than 12,000 B.W.U., they also recognized that an immediate reduction from 15,500 B.W.U. would be highly unpopular with the whaling industries. Rather than leave the decision on the balance between long and short-term interests to the Commission or even better describing the long and short-term results of possible courses of action, the scientists themselves suggested a compromise, of 14,500 B.W.U. for the 1955/56 season.

Not surprisingly, the Commission took advantage of this suggestion, but in general treated the figure as an ultimate objective rather than an interim measure.


523. If there is only one estimate available, and the procedure of determining it is not such that a statistically valid measure of error can be attached to it (which is practically always the case), then it is not appropriate to call it the "best" one, certainly not in any scientific sense. Any statement concerning the likelihood of it being within a certain distance of the "true" value must be purely subjective. If several estimates are available, they are normally obtained by a variety of methods and combinations of methods. There is no "scientific" way of combining these to give a "best" estimate, although we may assume that the group of estimates is a sample from a probability distribution and treat them accordingly to obtain, as central value, a median, mode, arithmetic mean or some other kind of average. We may assume further that the probability distribution is peaked, having a maximum somewhere between the observed extreme values, and try to estimate the location of this maximum to obtain a most probable ("best") value. But even then we have no idea of how flat-topped the distribution is, and certainly have no reason to suppose it is like a normal curve. Thus it is entirely possible that the most probable ("best") value is hardly more probable ("better") than other quite different values; indeed, it might be a defensible procedure to assume that all values within an observed range (perhaps even somewhat beyond it) are equally probable ("equally good"). I suggest that on present evidence, estimates differing from the central values (which the Scientific Committee is in process of determining) by 50% or more either way may, for practical purposes, be equally as good as each other and as the central values.


The "best estimates" of the population size and sustainable yields of the various stocks made by the Scientific Committee were forwarded to the full Commission along with the Scientific Committee's quota recommendations. The full Commission would then review all the data and produce the quotas actually written into the Schedule. In the debate before the full Commission, economic and political interests had a second arena in which to exert their influence, an arena in which biological considerations were poorly comprehended and poorly represented. The need for a three-fourths majority of the full Commission to adopt any quota, the ability of any nation to unilaterally veto any quota, and the threat of a nation's withdrawal from the Commission all must have been in the minds of the Commissioners as they reviewed the Scientific Committee's recommendations. The result was that the once compromised quotas of the scientists became compromised again, or even worse, the full Commission would delay taking any action until the results of further research became available.

3. Minimizing Uncertainty

The objections outlined above were recognized by several of the scientists on the Scientific Committee and pressure was brought within the Committee to reform the process. The first reform was a gradually greater and more public admission by the Scientific Committee of the weakness of much of the biological data. Majority and minority estimates were included in the Scientific Committee Report, allowing the Commissioners and the public in general to be better advised of the wide range in most of the stock estimates. In articles addressed to the general or scientific public, IWC scientists admitted their models were dependent upon poorly investigated assumptions.

Second, the Scientific Committee also acted to increase the information flow between itself and outside scientists. At the 1976 meeting, the Scientific Committee agreed that all papers which formed the basis for specific management decisions would have to be either published or otherwise made available for public review. Communication among IWC and non-IWC scientists was further increased as a result of the FAO Advisory Committee on Marine Resources Research (FAO/ACMRR) study groups on marine mammal conservation.

A third reform was the increase in the size of the IWC Secretariat and the appointment of Dr. Ray Gambell as Executive Secretary. Dr. Gambell's experience with whale biology and the adoption by the IWC of international whale research priorities (the program of the "International Decade of Cetacean Research") 532 promise a more rapid and efficient accumulation of knowledge of cetacean biology and ecology.

A fourth reform was the more precise articulation of management guidelines in the New Management Procedure and the resulting minimization of input by the full Commission. In 1975 nearly all the quota recommendations of the Scientific Committee were adopted, 533 and in 1976, for the first time, all of them were adopted.

4. Coping With Uncertainty

The increasingly widespread recognition of the need for more scientific research and for a greater commitment to fund that research offers hope that the gaps in our knowledge of cetacean population dynamics and ecology will be reduced. However, for the next several decades, the IWC will still be confronted with the problem of managing many stocks of whales and smaller cetaceans with only highly conjectural predictions of the consequences of alternative management schemes.

The decision to manage the stocks according to biological criteria has had the beneficial effect of rapidly reducing quotas to levels the populations should be able to withstand, but it has also increased the amount of political and economic pressure that is brought to bear on the scientists in their deliberations. These pressures have led to calls for an independent scientific advisory and research agency. 534

The pressures on the Scientific Committee are a result of the millions of dollars involved in each IWC decision, and the Scientific Committee's new, more significant role in that decision-making process. Whereas during the 1950's the Scientific Committee clearly had too little influence on the IWC's

531. The 1976 conference, entitled "Mammals in the Seas, A Scientific Consultation on the Conservation and Management of Marine Mammals and Their Environment", was held between August 31 and September 9, 1976. The background papers and working group reports of this conference provided most of the scientific information used in this article. See Mammals in the Seas Prospectus, Doc. FAO/ACMRR/MM/SC/INF. 1 (1976); see also note 14 supra.


533. The major deviation from the Scientific Committee's recommendations in 1975 involved southern sei whale stocks, which were estimated to be slightly below MSY stock levels. The modification still allowed the stocks to recover, but allowed the catch of an additional 650 whales worth several million dollars. See 1975 Amendments to the Schedule, supra note 263, para. 6(a).

534. See text accompanying notes 843 et seq., Part Two infra.
actions, some observers feel the Committee has too much influence under the New Management Procedure. The determination by the Scientific Committee on weak and ambiguous data that a stock is more or less than 10 percent below its theoretical MSY level determines whether any exploitation of that stock will be allowed. Even if only a few hundred whales are involved, this decision may involve many millions of dollars in gross revenue.

Total management responsibility should not be given to the scientists, but the division of responsibility for management between scientists and the Commission needs to be clearly articulated. In the past, when the Commission ignored the Scientific Committee recommendations, it did so on the pretense that the scientific conclusions were not clear enough. In reality, the Commissioners apparently believed that the scientists had not adequately considered industrial or political problems. Having no particular expertise in economic or political areas, the scientists were not in a position to consider these aspects of the problem. In contrast, under the present scheme, the whaling nations have been backed into the position of declaring that economic and political criteria are irrelevant to the management decisions.

An alternative approach has been incorporated into the structure of the United States Marine Mammal Commission.535 The MMC is advised by a Committee of Scientific Advisors and in turn advises other federal agencies. When the MMC chooses not to adopt a recommendation made by its Committee of Scientific Advisers, the MMC is required to forward those recommendations on to the appropriate federal agency and to Congress "with a detailed explanation of the MMC's reasons for not accepting such recommendations."536 Likewise, should another federal agency choose not to adopt the MMC's recommendations, the former must notify the MMC and give "a detailed explanation" of its reasons.537 Analogously, the IWC might require that the Commission explain fully to its member nations any deviation from the Scientific Committee's recommendations. Such a procedure would certainly be an innovation for an international commission, but it would allow for the inclusion of socioeconomic criteria in management decisions, take much of the political and economic pressure off of the Scientific Committee, and still assign responsibility for decisions. Undoubtedly, many conservationists will argue that economic and political forces are so consistently and strongly antagonistic to whale conservation that allowing them such influence would negate the accomplishments of the last twenty years. The willingness of countries to state candidly their political and economic motivations is also questionable. Although the MMC scheme may be impractical on the international level, the need to develop some scheme to balance the role of biologists, economists and politicians is clear. The nations' divergent views as to how the IWC should act absent such an accommodation reflect major differences in philosophies of resource management.

536. Id. § 1403(c).
537. Id. § 1402(d).
Safeguards of the New Management Procedure

Most, if not all, nations share a desire to return over-exploited stocks to at least MSY levels. Most nations also agree that care should be taken so that stocks not yet heavily exploited (Initial Management Stocks) do not become over-exploited in the future. Most nations further agree with the participants of the Airlie House workshops that: "Management decisions should include a safety factor to allow for the facts that knowledge is limited and institutions are imperfect." 538

The IWC's responses to these principles appear in several provisions of the New Management Procedure. A first safety factor is the commitment to set maximum harvest quotas no higher than 90 percent of the estimated maximum sustainable yield. This maximum applies to both Sustained Management Stocks and Initial Management Stocks. 540 Harvesting a stock at a rate below its actual MSY should cause the population to stabilize at a level considerably above its MSY stock level. For example, if the MSY stock level is estimated to be about 50 percent of the initial population size, a harvest of 90 percent of MSY should cause the population to stabilize at approximately 66 percent of its initial population level. If the estimated MSY level is 60

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<th>Size of Confidence Interval (%)</th>
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The proposal was apparently simple, flexibly scaled to the magnitude of the ambiguity, and designed to generate conservative yield figures. However, as noted above, the calculation of population estimates involves a series of assumptions the accuracy of which cannot be stated probabilistically. As a result, statistical confidence intervals cannot be established for most population estimates. The Scientific Committee in reviewing the problem recognized the need for safety factors and agreed that the approach outlined above had many advantages but it thought such an approach was at present infeasible. 1975 REPORT AND PAPERS OF THE SCIENTIFIC COMM. OF THE IWC 40 (1976). See also Holt, A Possible Basis for Determining Limits to the Allowable Catch, 1976 REPORT AND PAPERS OF THE SCIENTIFIC COMM. OF THE IWC (to be published 1977).

538. Airlie House Draft Report, supra note 389, at 6; see also note 394 supra, model conservation article § B(2).

The members of this workshop wrote that "the margin of safety provided [should be] . . . based on reasonable assessments of the degree of uncertainty and the magnitude of the risk." Report of the Workshop App. 2, supra note 393, at 11. The same call for safety factors had been made in an early draft of one of the FAO/ACMRR reports. See 1974 FAO/ACMRR Progress Report, supra note 521, at 7. In response to this latter report, a special subcommittee of the Scientific Committee proposed that population estimates be reduced according to a somewhat arbitrary schedule as a function of the confidence levels applicable to the particular population estimate:

539. 1975 Amendments to the Schedule, supra note 263, para. 6(a).

540. Id. para. 6(b).
percent of initial population size, a harvest of 90 percent of MSY should cause the population to stabilize at 74 percent of initial population size.\(^{541}\)

A second safeguard in the New Management Procedure is the adoption of a minimum stock level—90 percent of the MSY stock level—below which commercial exploitation will not be allowed.\(^{542}\) This dividing line at 90 percent of the MSY stock level is fairly arbitrary from an ecological point of view and was the subject of tremendous controversy between scientists from whaling and non-whaling nations.\(^{543}\) Scientists from whaling nations argued for continued or resumed harvest of stocks below 90 percent of MSY stock level. Under the New Management Procedure, this is what occurs at stock levels between 90-100 percent of MSY stock level.\(^{544}\)

A third safety factor in the New Management Procedure is built into the management of Initial Management Stocks. Under the strong urging of the United States delegation, the IWC agreed that "Exploitation [of Initial Management Stocks] should not commence until an estimate of stock size has been obtained which is satisfactory in the view of the Scientific Committee."\(^{545}\) This rule has already been invoked to prevent full-scale commercial

543. I cannot accept the scientific ground of 10% of MSY stock level below MSY level, but I interpret that this guideline was *temporarily* established to maintain the level of a valuable marine resource as high as possible. If the MSY stock level, or MSY level which is estimated from the present knowledge varies in the future, or if the range of MSY level exceeds 10%, such a guideline will be meaningless.

T. Ichihara, *Fisheries Biology of Whales and Whaling with Special Reference to the Fin Whale* 17 (paper delivered at the conference on The Whaling Issue in United States—Japanese Relations, University of Southern California, July 14-16, 1976) (emphasis added) [hereinafter cited as Ichihara].

I contend here that the proper function of the Scientific Committee is, as it has been, to provide the Commission with biologically allowable ranges of catch quotas upon the best available data and analyses and not to pre-empt the Commission's or the Technical Committee's business [of setting the precise quotas adopted].

In other words, however small it may be estimated, the Scientific Committee should not recommend zero quota, venturing to pre-empt the function and the responsibility of the Commission . . . or the Technical Committee . . . .

544. 1975 Amendments to the Schedule, *supra* note 263, para. 6(a).
545. *Id.* para. 6(B). This action was a direct consequence of the Airlie House meetings held just a few months previously. Letter from Dr. Lee Talbot, Assistant to the Chairman for International and Scientific Affairs, Council on Environmental Quality, Washington, D.C. to Dr. Tom Lovejoy, World Wildlife Fund, Washington, D.C. (July 22, 1975); see also *text accompanying notes 391-96 supra*. A conservative approach is also mandated by the Marine Mammal Protection Act of 1972. Before permits may be issued for the taking of marine mammals, the Secretary of Commerce must make findings concerning:

the estimated existing levels of the species and population stocks of the marine mammals concerned; . . . [and] the expected impact of the proposed regulation on the optimum sustainable population of such species or population stock.

16 U.S.C. § 1373(d) (Supp. V 1975). Failure to make such findings has been held to be sufficient
exploitation of Bryde’s whales in the Southern Hemisphere.\textsuperscript{546}

Japanese commentators believe such conservation-oriented caution to be both unscientific and a distortion of the management goals embodied in the Preamble to the Convention.\textsuperscript{547} They argue with some justification that exploitation of Initial Management Stocks and Protection Stocks is necessary to obtain the data required for satisfactory estimates of stock sizes. Without exploitation, estimates of stock size can only be made from sighting data, but sighting data estimates in successive years often differ by as much as 100 percent, when in reality the stock level cannot be changing by much more than 5 percent per year.\textsuperscript{548} Sighting data also does not allow scientists to determine

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  \item In the teeth of this lack of knowledge of specific causes [for declines in marine mammal populations], and of the certain knowledge that these animals are almost all threatened in some way, it seems elementary common sense to the Committee that legislation should be adopted to require that we act conservatively—that no steps should be taken regarding these animals that might prove to be adverse or even irreversible in their effects until more is known.\textsuperscript{549}
  \item Southern stocks of Bryde’s whales had never been heavily exploited due to their small size and the fact that their range was north of the main Antarctic whaling grounds. With the drastic reductions in quotas between 1974 and 1976 for southern fin whales (from 1000 to 220 to 0), the whaling countries sought a quota on Bryde’s whales that would allow the ships to catch them on the voyage to and from the Antarctic whaling grounds. The Scientific Committee in 1975 concluded that not enough was known about the stocks to justify increased exploitation, and the full Commission did not act to allow increased exploitation.
  \item Although Bryde’s whales were included in a combined sei and Bryde’s whale quota of 2,230 whales for the 1975-76 season, 1975 Amendments to the Schedule, supra note 263, para. 11, the continued prohibition of whaling by Antarctic factory ships north of 40°S latitude, Schedule para. 4 (amended 1974), resulted in the overwhelming majority of this catch consisting of sei whales. It is noteworthy that when this principle was applied to the management of southern hemisphere Bryde’s whales, the latter were being managed as Sustained Management Stocks, 1975 Amendments to the Schedule, supra note 263, para. 6(a), and the requirement of adequate population assessments prior to increased exploitation technically only applied to Initial Management Stocks, id. para. 6(b).
  \item At the 1976 meeting of the IWC southern hemisphere Bryde’s and sei whales were classified separately—Bryde’s whales being classified as Initial Management Stocks. 1976 Amendments to the Schedule, supra note 273, para. 6(b). But see also note 157 supra.
  \item See S. Sugiyama, Japanese View Toward the Law of the Sea and Whaling 6-7 (paper presented at the conference on The Whaling Issue in United States—Japanese Relations, University of Southern California, July 14-16, 1976). In discussion at the conference, Prof. Sugiyama argued more explicitly that the IWC was guilty of deviating from scientific principles and the management goals of the Convention by demanding too much protection for whales. This opinion was seconded by Yoshinori Hayashi, a member of the editorial staff of a large Japanese newspaper, who stated: Frankly speaking, many Japanese do not believe that the decisions of the IWC are always based on fair scientific criteria. Just as with many other international conferences, the IWC is greatly influenced by the United States; and the opinions of the scientists become distorted by the United States and its sympathizers.
  \item Masaki, Japanese Pelagic Whaling and Sighting in the Antarctic 1975/76, INT’L WHALING COMM’N, 28TH REPORT (to be published 1978), quoted in part in Ichihara, supra note 543, at 10, 23; see also note 468 supra.
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whether or not the environment has changed and whether or not the MSY is occurring at a different stock size than was previously calculated.

As of 1976, all stocks of blue, humpback, right, and bowhead whales, all Southern Hemisphere fin whale stocks, and many sei whale stocks were classified as Protection Stocks. Protection was granted to these stocks in fairly rapid succession and the blow to the whaling industry was severe. The industry is now waiting until some of these latter stocks are sufficiently recovered to allow exploitation. Under the New Management Procedure, this exploitation cannot recommence until the stock has reached 90 percent of its MSY stock level. Japanese biologists have called for continued, small-scale whaling on depleted stocks in order to monitor changes in stock levels and ecological parameters and to support the whaling industry.

b. New stock classifications

The conflict between the need for data and the need for caution in whale management cannot be resolved by scientists alone, since basic attitudes towards resource exploitation and economic concerns are so heavily involved. This problem is even more severe for small cetacean management because stock identity, stock size, and recruitment parameters are literally unknown for many species. The information is so poor that it would be impossible to classify many species into any of the three existing management categories. For this reason, the Scientific Committee at its 1976 meeting recommended consideration of two new stock categories for possible application to small cetaceans and whales.

Stocks which have apparently been severely affected by direct fishing, and/or incidental take, or environmental changes, and for which adequate stock assessment information does not exist, would be classified as Vulnerable Stocks. Catch limits would be no greater than the catch at the time of classification or in the recent history of the fishery. National governments whose fisheries were affecting the stocks would have to provide annual reports of catch data and other biological information to the IWC. If the nations failed to provide annual reports, or if in spite of the annual reports, adequate information did not exist after five years, the stock would automatically become a Protection Stock "unless the Commission ha[d] reason to specifically continue the annual classification of the stock as vulnerable." If circumstantial evidence gave no indication that a stock was being over-exploited, but the inability to estimate initial stock size made calculation of the MSY stock size impossible, then the stock would be classified as an Indeterminate Stock. Catch limits would be set at a level no higher than 5

549. See Japan Whaling Ass'n, Whaling Controversy: Japan's Position 2, 6-17 (June 1976).
percent of the estimated present stock size. If no scientific estimates of present stock size could be made, catch limits would be set at the present catch levels if that catch had been constant over a long period of time. Both of these new stock categories will be considered in more detail at the 1977 meeting of the IWC.

This section has stressed the importance of reducing biological uncertainty by acquiring new and better knowledge of cetacean ecology and population dynamics, and of proceeding with caution until such knowledge is obtained. Only after more knowledge has been acquired will there be justification for decreasing the safety margins finally being incorporated into management decisions at the cost of considerable diplomatic strain. It was stated above that several scientists have advocated the idea that stock population levels be varied on an experimental basis to yield more information about the productivity of stocks at different population sizes. The same approach could be used to improve population assessment techniques while simultaneously reducing the risk of major management errors resulting from inaccurate population estimates.

In summary, the provisions of the New Management Procedure which deal with the IWC's response to biological uncertainty represent a significant improvement over past policies. However, the new policies have not been permanently accepted, and they do not go far enough in dealing with the problem. The IWC must start developing a second-generation set of management policies which effectively and conservatively accommodate gaps in existing knowledge and shortcomings of current techniques.

[The second part of this article will appear in the next issue of *Ecology Law Quarterly*.]

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552. *Id.*
553. See text accompanying notes 407-09 *supra*.
554. Dr. Sidney Holt has suggested that instead of managing all whale stocks on the basis of "best estimates" all of which are based on the same methodological assumptions, one set of stocks might be managed accepting "optimistic" scientific estimates of their status while another set of stocks would be managed on the basis of "pessimistic" scientific estimates. After a few years when trends in population size of each stock became detectable, adjustments could be made to the quotas accordingly. In contrast to the present system, biases in the population assessment methods and population models would operate in different directions for different stocks, rather than operating on all stocks in the same manner (towards depletion or increase). These biases should also be detectable more quickly and with less cost since they will be operating on only one or a few stocks per model. *Whale Management Policy*, supra note 407, at 3-4.