Summary document of available facts and figures on key subjects discussed by the Scientific Committee

(Submitted by the French Government)

The work of the International Whaling Commission (IWC) Scientific Committee is internationally renowned and forms the benchmark in this area. It also forms the basis for the Commission's decisions.

Yet this work is dense and covers several years, making it hard to draw up a summary of the data available in any given year. Given that it is not infrequent for new countries to join the IWC, it is vital for new delegates to have a clear picture of the Scientific Committee's work on a certain number of key subjects.

Furthermore, one of the points raised by current discussions on the future of the IWC concerns easier access to scientific knowledge for the delegations of developing countries, which, although not the only countries in this situation, do not have any scientists on the IWC's Scientific Committee.

So the need is felt for the Scientific Committee's work to be more broadly publicised so that delegates to the plenary meeting can take it on board. One way of doing this is to publish a summary document on certain particular points.

Consequently, and by way of illustration, France is presenting a summary document to the Commission based on the scientific publications and data submitted to the IWC Scientific Committee and information drawn from the international scientific literature. This document provides a species-by-species summary of available knowledge of stock distributions, stock numbers and the conservation of the thirteen species of whales covered by the convention.

The document presented is in French at this point. A partial English version is enclosed to facilitate discussion (introduction, conclusion and a factsheet on the humpback whale as a example). This work should be seen as a starting point, a proposal of the type of summary document that could help inform all delegations of the scientific findings discussed by the Scientific Committee. It is in no way intended to replace the Committee's work, but to complement it. This approach could concern other key subjects in the future.

France would like to have the Commission's opinion on:
(a) The expediency and principle of such an initiative;
(b) The next possible steps to be taken before the IWC 61 in Madeira;
(c) The status of such a document: collective document endorsed by the IWC or national contribution on a voluntary basis?

Whale populations: World review of the stock structure, abundance and conservation status of great whales

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INTRODUCTION

The management and conservation of whales is the main area of study of the International Whaling Commission (IWC). A long-standing climate of opposition between highly divergent scientific, socio-economic and ethical arguments has set the scene for debate in this arena and has determined, on a more general level, the opinions of the general public on the issue in the various countries impacted by it. However, one point that everyone agrees on is that reflection must be based on the best scientific data available. The mission of the Scientific Committee (SC) is to continually generate, enrich and evaluate the body of uncontested scientific and technical knowledge necessary for the Commission's debates.

To ensure this mission, the Scientific Committee is composed of a variable number of sub-committees and work groups whose terms of reference correspond to the priorities of the Commission. Within each of the groups, a given scientific theme is handled over several successive years until the objective set by the Commission is reached. The annual report of the Scientific Committee then takes the form of an interdisciplinary information status report on each work group for the given year; however it does not supply overall summary reports covering several years for any of them. This situation is not really a problem for the scientists closely involved in these discussions since, thanks to their regular contact with the Scientific Committee, they naturally incorporate the historical and longitudinal aspects of the themes they deal with. However, for an outside observer or user of Scientific Committee information, often present only occasionally, acquiring an overall understanding of one or the other of the themes developed requires great effort in order to comprehend documents that have been presented and analyzed over several years' time.

The most direct users of this information are of course the commissioners and other members of the government delegations participating in the Commission. The small delegations which are the overwhelming majority at the IWC are not necessarily able to assimilate the key information provided by the Scientific Committee debates. Other users of this information include journalists and the media in general; among them, the most mainstream media, which reaches the widest public in each of the IWC member states, is generally incapable of drawing the necessary information from Scientific Committee minutes. This situation is detrimental to the quality of public debate on whale management and conservation issues because it encourages the dissemination of clichés, often caricatural, as well as false information.

It is therefore necessary to produce and to regularly update summaries and non-specialist documents on the key questions central to the debate on whale management and conservation. Among these recurrent questions, the most frequently asked is certainly "How many whales are there?" Underlying this simple, almost trivial, question lies the most important challenge that the Scientific Committee is faced with.

It is essential to be able to assess the numbers of whales, represented by N, on a spatial scale appropriate to their management. This scale is that of the stocks, which for each species are defined as groups of individuals making up homogeneous demographic units. And so the issue of whale numbers is inextricably linked to those of stock structure, in other words an evaluation of the number of stocks in a given ocean basin and the geographical boundaries that separate them. In addition, not all whale species are equally easy to count, which strongly affects the precision of abundance estimates and the frequency with which such measurements can be taken. In general, species which live in coastal habitats at least at certain periods of their yearly cycle, such as migration or breeding, are more accessible, so their numbers can be estimated more effectively and more often than species which live offshore all year round.

Determining the size of a stock is not sufficient for evaluating the stock's conservation status; for this, population sizes must be compared to those which would be observed if the stock had never been exploited. This benchmark figure is the maximum number of whales that the ecosystem is capable of maintaining, also known as its carrying capacity, represented by K. The closer the observed number is to the carrying capacity, the healthier the stock status. The relationship between observed population sizes and carrying capacity is not only a theoretical indicator of stock status, but also a decisional criterion and management tool. In fact, the

Revised Management Procedure, (RMP) adopted in 1994, stipulates that stocks with a population size representing less than 54% of its carrying capacity cannot be exploited and that, for the healthiest stocks, potential quotas must be calculated to ensure that actual population sizes tend towards a percentage of the carrying capacity no lower than a given level, known as the *Tuning Level* (generally 72%).

Thus, the stocks of each species, the current population size and the carrying capacity in the sectors containing each stock are three types of closely related information that are all needed to evaluate whale population status. Yet, despite the great importance of this information, there is no easily accessible summary document that could be used as a general indicator of current knowledge about world great whale populations. The IWC has a highly stringent and detailed procedure for evaluating the statuses of populations likely to be commercially exploited in the future or currently exploited through aboriginal whaling. This procedure is indispensable before performing simulations which then enable the calculation of quotas. We have no intention of interfering in any way here with this procedure performed by specialists. This summary report, which provides a panorama of great whale population statuses, is intended for non-specialist users who may either participate in the creation of a management and conservation policy for these species or whose role is the wide-scale diffusion of scientific information on these species to the general public.

ORIGINS OF DATA

General

This summary is essentially based on a bibliographical analysis and aims to compile all currently available knowledge on the stocks, abundance and carrying capacity of the thirteen great whale species. Most of the data collected is taken from reports published by the Whaling Commission, in addition to documents taken from the NOAA (*National Oceanic and Atmospheric Administration*), the NAMMCO (*North Atlantic Marine Mammal Commission*) and other scientific articles published in peer-reviewed international journals. To facilitate comprehension of geographical references, distribution maps are provided. Likewise, when several estimates exist for a given stock, only the most significant (i.e. most recent or most comprehensive) one has been provided. Finally, in order to reduce document size, since it is not meant to be an exhaustive technical report but rather a general-public document, we have chosen to include neither the list nor the bibliographical references.

While the figures compiled in the following sections are drawn from often complex scientific protocols that we do not intend to describe in detail here, it is useful to understand the main points of these methodologies in order to better seize the meaning of the results obtained. Stock structure, abundance and carrying capacity have been evaluated using a variety of methods in keeping with methodological developments and field constraints.

Stock structure

In an ocean basin, not all the individuals of a given species have equal opportunities to meet and reproduce. The geographical discontinuity of reproductive habitats and the animals' degree of loyalty to the region where they were born determine the groups of individuals that have a higher chance of reproducing with each other than with those from other groups. They constitute demographical units known as "populations" in an ecological context, and "stocks" in a living resource management context. In order to describe the structure of populations or stocks of a species of whale in the ocean basin, these demographic units must be identified and their probable boundaries ascertained.

Many parameters are useful for establishing the nature of great whale stock structures. These parameters may be traits that determine known examples of spatial discontinuity affecting access to mating partners (distribution area of the species during the mating season, migrations, etc.), or indirect biological indicators that, through their expression of resource exploitation or discrete habitats, suggest the existence of such discontinuity (contaminants and stable isotopes in slowly-renewing tissues, growth and demographic parameters, etc). Such traits may also result from a similar discontinuity in access to mating partners and express themselves through a heterogeneous distribution of genetic material (mitochondrial or nuclear DNA) which can sometimes bring about measurable phenotypic variations (morphometric, acoustic [partially]), or may result from cultural differences inherited through imitation (acoustic [partially]).

There is no clear, recognised threshold for each of these parameters that makes it possible to conclude that there exists a separation of a group of individuals into two stocks, or indicating their fusion into a single demographic unit. Because of the variety of possible indicators, apparently contradictory conclusions are frequently reached. Consequently, evaluating the available information and uncertainties concerning whale stock structure is a lengthy process whose final conclusions often include a high level of uncertainty, especially as concerns oceanic species for which the actual distribution of breeding populations is poorly understood.

Along with these efforts to scientifically study population structure, most species of whale were divided very early into geographical entities, sometimes called "stocks" – an obvious source of confusion with the concepts defined above – but more generally known as "management units", and which were based on operational criteria taken, for example, from the spatial organisation of whaling operations, logistical constraints based on abundance estimation campaigns or political and administrative considerations. It is therefore necessary to ensure that the information obtained from catches or census taking operations – often acquired within the framework of this spatial mode of organisation consisting of units based on operational criteria – coincides with the population structures based on biological facts. This problem is exacerbated by the fact that whaling, as well as many census operations, is most often performed on feeding grounds, while it is the spatial organisation of populations during breeding and the loyalty of individual whales to their region of birth that determines the demographic structure of populations. It is particularly common for a given feeding ground to be exploited by individuals belonging to separate breeding populations or, on the other hand, for individuals from the same breeding population to spread out over different feeding grounds; individual loyalty to feeding grounds should therefore be an important point to consider in terms of management.

Abundance (N)
The current abundance of a great whale stock and its monitoring over time are the principal data in any sustainable management strategy. Absolute abundance is the total number of individuals belonging to a stock or population or, if this data is not available, present in a given sector. It can only be approximated if the estimate made has a low enough bias. If estimate biases are considered to be too high, the term "relative abundance" can be used, but only if this value is proportionate to absolute abundance. The main techniques for evaluating absolute or relative whale abundance are based on sighting density estimates, the probability of sighting marked individuals and counting operations performed along migration routes.

The main method for evaluating the density of a great whale species in an oceanic region is known as the line-transect method. This method is especially recommended for species that live dispersed over vast sectors. A series of lines – or transects – is randomly or systematically spread over a predetermined area in order to sample the space during operations conducted from boats or planes. Several constraints must be adhered to: the probability of sighting an individual on the transect line at the moment of the observers' arrival must be known; either the animal must not react (either positively or negatively) when the observers approach or the speed at which it is moving after their reaction must be well under the speed of the observers; it must be possible to estimate with precision the perpendicular distance from the observation to the transect as well as the size of the groups observed. The number of sightings decreases when the distance of the observations to the transect decreases. By modelling this decrease, the width of the observation band can be established, and then, by multiplying this by the length of the transect, the observed surface area can be determined. Modelling the probability of detecting a group that is present through measurement of the distance to the transect makes it possible to determine the density of groups within the observation surface. Finally, an evaluation of group size makes it possible to convert group density into individual density. In conclusion, the relationship between the observation surface and the total surface of the area being studied makes it possible to extrapolate the total number of individuals likely to be present in the entire sampled area. Uncertainty concerning abundance estimates is in itself essential information because it is often the lower limit of the confidence interval surrounding the estimated mean that, as a precautionary measure, will be used for management purposes. Rorquals are the main species for which this approach is used, but it is also applied to the southern right whale and the humpback whale on their feeding grounds.

Another series of methods, known as capture-mark-recapture (CMR), consists of determining the probability of sighting marked individuals in a population; these methods are especially suited to species that gather together temporarily in limited sectors, for mating in particular. In short, this involves marking a known number of individuals, then (re)capturing individuals randomly within the population in order to determine the proportion of marked individuals in the sample, and thus the size of the total population. In the case of great whales, the main approach used today is one in which photographs are taken (photographic "capture and recapture") enabling individuals to be identified through their natural markings (pigmentation, tail shape, external parasites, etc.). Several methodological constraints must be adhered to in order to achieve an acceptable evaluation of abundance: during the study period, there must be no immigration or emigration and the marks enabling identification must not change. Similarly, all individuals must be equally identifiable and (re)captured randomly. Finally, to obtain abundance estimates with acceptable uncertainty levels, a large enough proportion of the population must be marked. This method is only cost-effective for smaller, localised populations, such as humpback whales, right whales and blue whales on a local level, in their breeding grounds or other restricted areas.

Finally, a last category of methods involves counting population sizes using fixed points located on their migration routes. Individuals travelling off a section of shore are counted during the migration season. Figures are then corrected to account for the proportion of individuals that migrate beyond the observation areas or outside observation periods, or that were missed during the observation periods. This census method provides abundance estimates that are more precise and less costly than the other methods, making it possible to repeat census operations with annual resolution. However, few great whale species have migration routes close enough to the shore to allow implementation of these methods. The main populations monitored in this way are the grey whale along the North American Pacific coast and the bowhead whale in Alaska.

Depending on the methods used and the whale species monitored using them, uncertainty levels of abundance estimates can vary widely. In the sections comprising the body of this report, in which each great whale species is examined separately, abundance uncertainty presentation methods have been given in their original form – either as a coefficient of variation (standard deviation expressed as a percentage or a fraction of the mean) or as the upper and lower bounds of a 95% confidence interval (range of values within which the real abundance value has a 95% chance of falling). It is useful to remember that for a given uncertainty, a 95% confidence interval provides an expression of the dispersion of possible values approximately twice as wide as the coefficient of variation. An example is provided on the first line of Table 1. Alaskan bowhead whale stock is estimated at 10,350 individuals. In this example, the estimated uncertainty using the coefficient of variation calculation method comes to ±13%, or approximately 1,300 individuals more or less than the mean value (the full range of uncertainty is therefore 2,600 individuals). For the same example, the uncertainty level expressed using the upper and lower bounds of the 95% confidence interval comes to 5,300 individuals (from 8,200 to 13,500 whales).

Carrying capacity (K)

The carrying capacity of a population is the maximum population size that a given environment can support while maintaining its equilibrium, without exploitation. This value is not directly measurable in nature. It is a theoretical concept and an essential parameter in the mathematical model of the logistic growth of populations, experimentally demonstrated initially using paramecium and applied since then to a large number of living beings. For great whales, the relationship between population size and carrying capacity also becomes a management criterion since it measures the population's conservation status; it is therefore necessary to estimate the carrying capacity for each stock or population.

This estimate is based on hypotheses stating that all great whale stocks were at carrying capacity before they began to be exploited and that the food potentials of marine ecosystems have not significantly changed. The principal method used for determining the carrying capacity of a stock is to analyse the full history of individual catches of the stock under examination and, taking into account the species' productivity (its capacity to produce calves), to calculate a probable initial stock level so that the series of known, documented catches might explain currently observed levels. The application of this method is heavily dependent on the quality and thoroughness of catch archives, the correct assignment of these historical catches to biologically established stocks and the validity of productivity parameters.

A recently developed genetic approach could help avoid these constraints. Since the number of mutations on non-coding sections of mitochondrial DNA increases proportionately to population size, it is possible to model historical population levels of great whales based on currently observed genetic diversity. However, for reasons that are still being debated, the population sizes obtained through these calculations are incompatible with traditionally obtained results using the analysis of historical catch records. Consequently, it is not sure that this genetic method for estimating pre-exploitation whale population sizes can be used for the evaluation and management of populations of great whales.

Conservation status

Determining the conservation status of a population of great whales is done by evaluating the current situation in light of a prior benchmark situation and then modelling its demographic trajectory in order to evaluate the probability of extinction or the probability of reaching a certain percentage of carrying capacity within a given period of time. The aim of this summary report is to simply examine the relationship between current sizes of each population and their carrying capacity. Whenever possible, and except as otherwise specified, carrying capacities will be estimated based on pre-exploitation population sizes reconstructed using historical catch records.

In addition, the conservation categories established by the International Union for the Conservation of Nature (IUCN) will also be provided. These categories are established based on a series of criteria including abundance, depletion rates and population fragmentation.

Humpback whale *(Megaptera novaeangliae, Borowski 1781)*

Distribution and stocks

The humpback whale is found throughout the world and the boundaries of its numerous stocks are established based on breeding grounds which are all near to the shore and well-defined (Figure 6).

- **North Atlantic**

In the North Atlantic, humpback whales are distributed over numerous feeding grounds spanning from western Greenland and the White Sea in the north to Massachusetts and the British Isles in the south. They migrate towards two main wintering and breeding grounds: in the Caribbean around the island of Hispaniola and the Lesser Antilles in the west, and near the Cape Verde archipelago in the east. Genetic analyses have established the existence of at least two breeding populations in the North Atlantic. Individuals from the western North Atlantic gather in the Caribbean to reproduce. However, the location of the breeding grounds of individuals that feed in the Barents Sea remains uncertain. The Cape Verde archipelago is a second breeding ground, but little is known about the location of this stock's feeding grounds. In addition, humpback whales presumed to originate in the Southern Hemisphere have been observed off the coast of Western Africa through November, suggesting that mixing might occur between whales from the northern and southern basins of the Atlantic Ocean.

- **North Pacific**

In the North Pacific, humpback whales are found in the summer from the Chukchi Sea to north-eastern Japan and from the Bering Strait to Southern California. They migrate to three distinct wintering and breeding grounds: (1) the Western Pacific region, between Southern China, the Philippines and Micronesia; (2) the Central Pacific around Hawaii; (3) the Eastern Pacific off the coast of Mexico and its islands. Limited trans-oceanic movement between these regions has been observed. It appears that individuals from each of the three breeding stocks have a certain preference for separate feeding grounds.

- **Arabian Sea**

In the northern Indian Ocean, humpback whales are present all year long (stock X), suggesting that this population is separate from those of the Southern Hemisphere. They can be found from the Gulf of Aden to Sri Lanka, and even in the Bay of Bengal. This population is the only one that does not migrate, thanks to the nutritional intake provided by the Monsoon.

- **Southern Hemisphere**

During the summer, *Megaptera* populations in the Southern Hemisphere are found over the entire Antarctic region from the Antarctic Convergence to the Antarctic Ice Sheet. Wintering and breeding grounds can be grouped into seven geographical sectors: the Western Atlantic, including the Brazilian coastline and the Abrolhos, Trinidad and Fernando de Noronha Islands (stock A); the Gulf of Guinea region from Nigeria to Angola, including St. Helena Island (stock B); the South-western Indian Ocean, including the coast and islands of the Mozambique Channel and Madagascar (stock C); the South-eastern Indian Ocean, including mainly the Western Australian coast (stock D); the Coral Sea, mainly around the Great Barrier Reef (Queensland, Australia) and the Chesterfield Islands, New Caledonia and the islands of Vanuatu, Loyalty and Fiji, (Eastern Melanesia) (stock E); the Western Pacific, including Polynesia (stock F); the Eastern Pacific, including the western coast of the South American continent from the Gulf of Panama to the equator and the Galápagos archipelago (stock G).

Abundance levels and conservation statuses

The various stock abundance levels and conservation statuses are highly uneven, including within a given ocean basin (Table 6).

In the North Atlantic, conservation status for the Caribbean stock, with an estimated abundance of approximately 11,000 individuals, is difficult to evaluate because the estimate of initial population size made using the genetic approach (approximately 240,000 whales) is controversial and contradicts results obtained through catch record analysis (approximately 10 to 20,000 whales). As for the Cape Verde stock, its numbers are probably very low. The rate of increase in population size was estimated to be approximately 3% in the Gulf of Maine over the period of 1979-1993.

In the North Pacific, the total of all abundance estimates by sector comes to approximately 30% of carrying capacity, determined by backward projection of the effect of catches on the initial stock.

In the Northern Indian Ocean, there are no estimates of overall abundance or carrying capacity; therefore the stock status in that region is unknown. Seven per cent increase rates have been estimated in the Pacific Northwest over the 1990-2002 period.

In the Southern Hemisphere, situations are also highly divergent, as shown by the percentages representing current population sizes as compared to the carrying capacities for stocks A (29%), B (8%), C (78%), D (36%), E (36%), F (unknown) and G (30%). It should be noted that the total estimate for the breeding grounds (40,314 individuals) is relatively close to the total estimate obtained on the Antarctic feeding grounds (54,460 individuals), and the deviation between the two estimates is consistent with the hypothesis that non-reproductive individuals would not all migrate all the way to the breeding grounds. The rates of increase in the number of whales have been estimated at 11 -12% per year in Australia.

The IUCN presents an overall rather than a by-stock evaluation for this species. On a global level, the humpback whale has been classified as vulnerable (VU) because its population size has shrunk by over 50% over the last three generations. However, this reduction seems to be reversible, because the causes are known and have for the most part been eradicated thanks to the cessation of commercial whaling of this species. Still, a stock by stock evaluation would probably show great disparities in classification.

Table no. 6. Stocks, carrying capacity (K) and current abundance levels (N) for the humpback whale. Note: the sign § represents an estimate validated by the IWC.

Stocks or areas	Subdivisions	K	N	Census year
Eastern North Atlantic	Iceland	-	1816 (CV=0.18)	1987
	Norwegian and Barents Seas	-	889 (CV=0.32)	1995
Gulf of Maine		-	902 (CV=0.41)	1999
Western North Atlantic	Newfoundland / Labrador	-	2509 (CV=0.077)	
	Western Greenland	-	406 (CV=0.11)	1992
North Atlantic		240,000 (CI95%: 156,000 – 401,000) genetic 10,000-20,000 catch records	11,570 § (CV=0.068; CI95%: 10,100-13,200) for the Atlantic basin, including 10,572 (CV=0.068) for the Antilles	1992-93 1992
North Pacific	Washington / Oregon / California / Mexico	15,000	1,391 (CV=0.22)	2002
	Central North Pacific		2,648 (CV=0.16)	2001-03
	Western North Pacific		394 (CV=0.084)	1991-93
	Total		>10,000 §	2007
X : Arabian Sea		-	56 individuals identified by mark-recapture	2000-03
Southern Hemisphere			42,000 § (CI95%: 34,000-	1997-98

			52,000)	
A: Western South Atlantic		21,913 (CI95%: 21,575 – 23.586)	6,251 (CV=0.16)	2005
B: Eastern South Atlantic		16,455 (CI95%= 16,105 – 23,586)	1,259 (CV=0.32)	2002
C: Western Indian Ocean	C1: Mozambique and Tanzania C2: Islands of the Mozambique Channel and the Seychelles C3: Madagascar	15,373 (CI95%: 15,160 – 16,293)	11,983 (CV=0.20) of which C_1: 5,811 (CV=0.15) C_3: 1,746 (CV=0.19)	2003 2003 1996-99
D: Eastern Indian Ocean		28,230 (CI95%: 20,494 – 36,837)	8,000-14,000	1999
E: Western South Pacific	E1: Eastern coast of Australia	21,825 (CI95%: 15,043 – 31,716)	6,555 (CI95%: ±389)	2004
	E2: New Caledonia		327 (CV=0.11) 533 (CV=0,15)	1995 – 2001
	E2: Tonga Archipelago		730 (SE=0.15)	1991 – 2000
F: Central South Pacific	F1: Cook Islands F2: French Polynesia	-	232 individuals catalogued	2002
G: Eastern South Pacific		9,704 (CI95%: 9,410 – 10.883)	1,922 (CV=0.43) for Ecuador 1,655 (CI95%: 1,120 – 2,190) for Colombia 2,917 (CV=0.19)	1996-97 1994-95
Antarctic	I: Strait of Magellan, Drake Passage	-	3,337 (CV=0.21)	1996-97
	II: Weddell and Scotia Seas	-	168 (CV=0.61)	1997-98
	III-IIIE: off the coast of Queen Maud Land	-	7,889 (CV=0.10)	2003-04
	IV: Davis Sea, Wilkes Land	-	31,750 (CV=0.11)	2003-04
	V: Ross Sea	-	9,765 (CV=0.33)	2004-05
	VI-W: Amundsen Sea, Marie Byrd Land	-	1,551 (CV=0.24)	2002-03
	Total	-	54,460	

Figure no. 6. Global humpback whale distribution and stocks (key: WNP – Western North Pacific; CNP – Central North Pacific; ENP – Eastern North Pacific; Car – Caribbean; CV – Cape Verde; A to G and X – see text and table no. 6. The stocks are clearly separated into distinct, generally coastal breeding grounds, but may overlap in feeding grounds, in particular as concerns A to G in the Southern Ocean.

Identification and evaluation of stocks

Evolutionary mechanisms are at work within each species: over time, genetic variations and local adaptive traits accumulate in each stock. A stock, which is a reservoir of genetic and phenotypic biodiversity, increases a species' ability to survive despite changes in the environment that may be extreme on a local level. Thus, one of the main objectives of conservation is the preservation of the adaptive and evolutionary potential of species by maintaining them as functional elements within their ecosystems as well as by preserving biodiversity.

The most serious threats to the survival of cetaceans are mainly anthropogenic ones. In order to better understand the direct and indirect impact of human activity on biological populations, stocks must be precisely identified, their boundaries ascertained, and the permeability of these boundaries to genetic mixing with other stocks determined. This information will also influence the manner in which the biological data needed for the evaluation of stocks is collected and interpreted, which in certain cases may help to establish conservation plans.

The notion of "stock" has two meanings, both a biological one and a conservation-based one.

- A **management unit** (MU) is a group of conspecific individuals managed as a discrete unit. This definition is highly dependent on political and or commercial interests, and as a result is not based exclusively on biological discontinuity. Nonetheless, these units are useful for species lacking the biological data necessary to define stocks based on biological criteria.

- A **biological stock** or **population** is a group of individuals that make up an independent demographic entity. Gene flow is random within this entity and limited to inexistent between it and neighbouring groups. However, this concept is highly controversial because of the subjective nature of methods used for determining the limits beyond which a population ceases to be considered as a single unit and vice-versa.

In order to evaluate the conservation status of a stock, one must possess the most precise information possible concerning the situation and dynamics of the population in question. The productivity or potential of the stock must be assessed and a forecast made of its evolution (natural growth balanced against events such as incidental catches, direct take and natural phenomena). This analysis also aims to measure the ability of a stock to recuperate from such losses.

The status of a stock as compared to a benchmark level (such as its initial, pre-exploitation population size) is a valid stock evaluation parameter, as is an estimation of the consequences of diverse management operations. The IWC and the US government (*US Marine Mammal Protection Act*, 1992) have based their stock evaluation method on an estimate of the shrinkage of the currently observed rate of population (N) as compared to initial population size (K).

Conservation status of cetacean populations

Using the N/K ratio (Table 14), the current state of a population can be compared to its original (pre-exploitation) abundance level. This figure is an indication of the stock's current conservation status, and facilitates decision-making geared to the sustainable management of this resource. However, it should be mentioned that confidence intervals are often very high (especially for K) and that certain abundance levels have not been re-evaluated for a long time. As a result, the summary table provided must be considered as an evaluation tool of the overall great whale situation and not as a management tool. For all actual management decisions, a detailed evaluation of the stocks under consideration must be undertaken, including an inventory of all available data, an evaluation of their quality, and the generation of new data, in order to reach the best understanding possible of the real situation of these populations. These tasks are carried out by the Scientific Committee prior to the issuing of any opinions or recommendations by the Commission.

A colour code (red: N/K < 25%; orange: N/K < 54%; yellow N/K < 72%; green: N/K > 72%), has been used for these estimates. It is essential to recall here the goals set by the IWC through implementation of the RMP (*Revised Management Procedure*). This procedure aims to ensure the maintenance of all the world's great whale stocks while examining the possibility of sustainably exploiting populations that are above 54% of their initial size. In addition, the RMP has been created in order to establish quotas enabling potentially exploitable populations to reach sizes in the long term (100 years) above a pre-established level (generally 72% of carrying capacity).

It appears that very few stocks or populations are sufficiently well understood to provide both estimates of their carrying capacity and current population sizes based on concrete biological criteria. It is not surprising that the most coastal species are also the ones for which the most data is available, since they are the most easily accessible. They are also the species for which management-based stock definitions most effectively incorporate biological criteria (morphology, acoustics, migration, genetics, biometrics, life history traits). Inversely, species with mainly deep-sea or oceanic life styles remain poorly understood, and this includes understanding of their taxonomic status. The Antarctic minke whale was only recently recognised as a separate species and the status of different varieties of Bryde’s whale, blue whale and fin whale is still under debate. On a smaller scale, notions of stock are difficult to apply to these off-shore species for which the spatial structure of feeding grounds – often also corresponding to whaling grounds – is quite well known, but for which the geographical organisation and individual loyalty to breeding grounds – an essential element in the determination of distinct stocks – is very poorly understood. Moreover, distinct reproductive stocks can also mix on feeding grounds while remaining loyal to their respective breeding sites (ex. humpback whales in the Southern Ocean).

As a result, it is not surprising to observe that for these off-shore species, the definition of geographical entities used for management purposes is widely guided by practical, political or administrative considerations rather than by biological ones. Thus population sizes and carrying capacities are determined in areas which do not often coincide with actual stocks. Consequently, only partial estimates of natural populations are obtained (ex. minke whales and fin whales in West Greenland) or estimates corresponding to mixed populations (ex. minke whales near Japan) or even mixed groups of distinct species or sub-species that are virtually indistinguishable from each other in the high sea (ex. minke whales in the Southern Ocean and Bryde’s whales in the Indo-Pacific).

And last, while there is no easy answer to the question "How many whales are there?", it is clear that stocks for which estimates of both carrying capacity and abundance exist conjointly, are for the most part in precarious states of conservation (Table 14). It is also interesting to note that the stock structure of rorquals for which K and N are both known, is most often inadequately defined. In other words, the population sizes and carrying capacities are estimated for regions which presumably do not correspond to biological stocks, but rather to a mix of several stocks or only to just a fraction of a given stock.