Conservation Units of Managed Fish, Threatened or Endangered Species, and Marine Mammals

Report of a Workshop: February 14-16, 2006
Silver Spring, Maryland

Steering Committee:
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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-37
January 2008

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Executive Summary

The National Marine Fisheries Service (NMFS) is responsible for the conservation of living marine resources and their habitats with primary authority from three Federal statutes: the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). The MSA governs the exploitation of fish stocks for the maximum net benefit of the Nation, while preventing overfishing and rebuilding overfished stocks of fish to biomass levels capable of producing Maximum Sustainable Yield (MSY). The ESA governs the taking of species that have an elevated risk of extinction to ensure that effects of human activity are restricted to levels that would allow recovery of the species to the point it is no longer threatened or endangered. The MMPA governs the taking of marine mammals so that the total of such taking is sustainable, that is, it would allow populations of marine mammals to recover to or to be maintained within their Optimum Sustainable Populations (OSP). Meeting the different objectives mandated by each law requires potentially different definition of biological stocks and management units.

NMFS convened a workshop of scientists, managers, and policy advisors to discuss issues related to conservation units, exchange information about the biological basis for stock structure, learn about case studies in which particular aspects of population structure are important, discuss strengths and weaknesses of NMFS' identification of conservation units under the three statutes, and to recommend alternative approaches or revisions for identifying conservation units under the three statutes. Presentations and discussions at the workshop provided a basis to address two pressing questions for the agency:

> (1) Why are our conservation units different under MSA, ESA, and MMPA?
>
> (2) Is there a biological paradigm that may be used to explain differences noted in conservation units?

Much, but not all, of the answer to the first question can be found in the objectives of these laws. A major motivating factor for the ESA was a desire to preserve genetic variability, between and within species. Accordingly, conservation units under the ESA should be substantially reproductively isolated from one another to be listed under this act. On the other hand, objectives of the MMPA include keeping populations or stocks of animals above their Optimum Sustainable Populations OSP levels. The MSA allows for management units that may contain multiple species as members of a complex, but the concept of demographically independent stocks within a species is commonly used to determine the status of fishery resources. Thus, demographic independence is an appropriate basis for identifying conservation units (distinguishing among populations or stocks) for the MSA and MMPA.

A low amount of exchange among groups for breeding may be sufficient to prevent development of important genetic differences; however, these groups may remain demographically independent from one another. Therefore, it is generally expected that conservation units identified on the basis of reproductive isolation would be larger than those identified on the basis of demographic independence. Thus, discrete groups under the DPS policy would generally be larger than discrete groups identified for management under the MSA or MMPA. Furthermore, marine mammal biology includes internal fertilization, live birth, parental care, and maintenance of family groups; these features act as barriers to mixing among groups and help produce fine-scale population structure.

Demographic Independent Populations (DIP) represent a paradigm that may be used to explain differences in conservation units identified under the ESA versus the MSA or MMPA. A single DIP would be an appropriate conservation unit of managed fish or marine mammals due to the demographic nature of the objectives of the MSA and MMPA. However, although DIPs are discrete from one another demographically, they may be genetically similar. Therefore, a discrete group under the DPS policy formulated for implementation of the ESA may contain individuals from two or more DIPs.

Participants at the workshop agreed that guidance used to identify conservation units under the three statutes is generally acceptable and has worked well for a number of years. Despite this general acceptance, discussions at the workshop revealed a number of places where each set of guidance could be improved and noted two specific challenges for identifying conservation units common under all three statutes: (1) seasonal mixing of individuals from various stocks and (2) clines or continuously-distributed species. The steering committee recommends that NMFS, along with appropriate partner agencies or organizations, revise the statute-specific guidance to incorporate necessary improvements.

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Introduction

Natural populations are seldom homogeneous and typically consist of intra-specific groups. Individuals within these groups may move or migrate to other groups. As exchange between groups is diminished, structuring occurs, and this structuring may affect the management or conservation of the groups. These groups are usually recognized and conserved as separate populations. Different degrees of inter-group exchange of individuals occur within species, resulting in sub-specific structuring. Such structuring is recognized in the ecological and conservation literature as subspecies, populations, or other such groups. An important question, therefore, arises for conservation agencies regarding how little exchange (or how much separation) is necessary of individuals among groups to result in recognizing these groups as separate conservation units. The answer to this question depends in large part upon the purposes or goals of conservation programs.

The National Marine Fisheries Service (NMFS) is responsible for the conservation and stewardship of living marine resources and their habitats with primary authority from three Federal statutes: the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). The MSA governs the exploitation of fish stocks for the maximum net benefit of the Nation, while preventing overfishing and rebuilding, as necessary, stocks to biomass levels capable of producing Maximum Sustainable Yield (MSY). The ESA governs the taking of species that have an elevated risk of extinction to ensure that effects of human activity is restricted to levels that would allow recovery of the species to the point it is no longer threatened or endangered. The MMPA governs the taking of marine mammals so that the total of such taking is sustainable, that is, it would allow populations of marine mammals to recover to or to be maintained within their Optimum Sustainable Populations (OSP). Meeting the different objectives mandated by each law requires potentially different definition of intra-specific groups. These differences may be difficult to explain to many of the agency's constituents and may be confusing for NMFS staff and managers.

To alleviate confusion related to the identification of conservation or management units under the three statutes, NMFS convened a workshop of scientists, managers, and policy advisors to discuss issues related to management units, exchange information about the biological basis for stock structure, learn about case studies in which particular aspects of population structure are important, discuss strengths and weaknesses of NMFS' identification of conservation units under the three statutes, and to recommend alternative approaches or revisions for identifying conservation units under the three statutes. Three major questions may represent the major underlying issues for the agency:

1. What conservation units make sense for NMFS to fulfill its stewardship responsibilities?

2. Can we draw on similarities and differences in our three major acts to describe different perceptions in identifying conservation units?

3. What, if any, are the practical limitations in identifying more conservation units within a species?

The workshop consisted of the following sessions:

- Introduction of problems associated with identifying management units from the perspective of NMFS' Leadership Council
- The biology of population structure
- The legal frameworks for conservation under the MSA, ESA, and MMPA
- Approaches used to identify conservation units under the three statutes
- Case studies of the implementation of conservation programs for conservation units under the three statutes
- Breakout sessions to discuss
    - Strengths and weaknesses of identifying conservation units under each statute
    - Similarities and differences among the three statutes regarding conservation objectives and identifying conservation units

This report includes a summary of the introductory remarks describing the problem; abstracts of the presentations on population biology, legal frameworks, existing guidance for identifying conservation units, and case studies; summaries of the breakout sessions; and conclusions and recommendations from the steering committee. The steering committee recognized that the discussions at the workshop could indicate the need for change to established policies for identifying conservation units. The scope of this workshop was limited, however, because responsibilities under the MSA, ESA and MMPA are shared with other organizations (Regional Fishery Management Councils, U.S. Fish and Wildlife Service, and Marine Mammal Commission). Accordingly, changes to policies for identifying conservation units were not addressed in this workshop. Rather, this workshop identified strengths and weaknesses of the approaches used under each statute to allow statute-specific guidance to be reviewed and, as needed, changed in partnership with the other affected agencies.

Guidance from the Leadership Council

Dr. William Fox, Director of the Southwest Fisheries Science Center, Dr. Douglas DeMaster, Director of the Alaska Fisheries Science Center, and James Lecky, Director of the Office of Protected Resources, presented aspects of the Leadership Council's concerns related to the identification of conservation units. The major problem is that constituents often do not understand the bases upon which NMFS identifies conservation units and perceive that these units are identified inconsistently among the three major statutes. The Assistant Administrator often encounters such views from constituents and has no concise summary of NMFS' policies for identifying conservation units.

The primary question is, "Why are our conservation units different under MSA, ESA, and MMPA?" To some extent, this question arises because the objectives of the statutes are different; thus, conservation units under each statute may be different and designed to meet the objectives of the specific statute. The purpose of the MSA is to provide maximum net benefit to the Nation by preventing overfishing, rebuilding overfished stocks, and ensuring optimal harvest of fish stocks. The ESA is designed to promote the recovery of threatened or endangered species and the habitats upon which these species depend. The MMPA protects all marine mammals, regardless of the status of the population stock to which they belong, with a major objective of maintaining each stock within its OSP, keeping in mind the carrying capacity of the environment. These differences in policies for identifying conservation units are confusing. Because the selection of a unit to conserve has cultural and economic implications, unexplained differences and their resulting confusion lead to a lack of understanding of our policies by constituencies, with particular sensitivities by regulated communities.

Most members of the Leadership Council have experience and expertise in fishery management and are familiar with the identification of fishery stocks. They understand that the conservation units in fishery management assume some sort of genetic basis for dividing fish into stocks and use various measures (e.g., tagging, use of different spawning ground, exposure to different mortality rates, or other biological parameters) in identifying stocks. Many of our fish stocks, however, were identified long ago, before the widespread use of technologies now used in identifying conservation units (e.g., molecular genetics).

In contrast, most senior managers are less experienced in the ESA and MMPA and see conflict in structure of conservation units defined under these laws. In particular, there is a perception that conservation units under these statutes are smaller than under the MSA, particularly for marine mammals; further, social structure within populations, combined with little genetic information, makes the identification of conservation units more complicated. Such perception and ongoing re-evaluations of marine mammal population stocks, which result in small conservation units, leads to a concern that population stocks could become too small for practical aspects of management. To explain the rationale behind different approaches under the three statutes, it would be helpful to find a common paradigm that may be used as a starting point for identifying conservation units under the different laws.

The Leadership Council representatives noted that a clear, concise description of our guidance for identifying conservation units under the MSA, ESA, and MMPA would help agency officials explain the apparent differences perceived for managed fish, threatened and endangered species, and marine mammals. The description should be in the form of a “white paper” or “primer” that agency officials could distribute to interested constituents when questions arise.

Presentations

To provide a broad scope of information, which would serve as the basis for discussions later in the workshop, scientists and managers from various offices with NMFS were invited to make presentations to the workshop. Presentations were grouped into the following aggregations to ensure participants heard biological, legal, and policy perspectives on identifying conservation units and examples of the application of existing guidance to identifying conservation units under the three statutes:

- Biology of Population Structure
- Legal Requirements and Guidance
- Current Guidelines for Identifying Conservation Units
- Case Studies

Biology of Population Structure

Presentations in this section described the biological basis for identifying populations, biological characteristics that result in population structure, and the consequences of alternatives for identifying conservation units or populations.

What Is a Population?

Robin S. Waples
Northwest Fisheries Science Center
(much of this material is covered in more detail in Waples and Gaggiotti, 2006)

Among the most important and vexing questions in marine conservation and management is, "How many stocks or populations of a given species are there?" No single scientifically "correct" answer exists for this question; instead, the answer depends on several factors that involve a combination of science and policy. First, it is important to clearly articulate the objectives one is trying to achieve because that can influence the way populations are defined. Examples of possible objectives include: 1) We want to maximize sustainable harvest; 2) We need to manage "stocks" or "populations" separately because of a legal mandate; 3) We want to minimize impacts on "weak" stocks. Second, it is important to articulate what a population is conceptually. Again, no single approach is "correct." Two commonly used frameworks for considering populations are the ecological paradigm (which emphasizes demographic cohesion) and the evolutionary paradigm (which emphasizes reproductive cohesion). It is important to match the appropriate population paradigm with the management or conservation objectives. For example, with respect to Objective 3 above, we might want to minimize impacts on weak stocks for either (or both) of two reasons: 3A) Locally depleted stocks take a long time to rebuild; or 3B) Local extirpation might represent an irreversible loss of biodiversity. If we are primarily concerned with 3A, the ecological paradigm is more suitable because the key factor is the degree of demographic exchange among subunits. In contrast, if the primary concern is loss of biodiversity, the evolutionary paradigm is more appropriate.

Given the central importance of the population/stock concept, one might expect to be able to find definitions of "population" that are objective and quantitative enough that independent researchers could apply them to a common problem and achieve the same results. In fact, however, a review of the literature indicates that few of the commonly used definitions of 'population' are operational in this sense; instead, they typically rely on qualitative descriptions such as "a group of organisms of the same species occupying a particular space at a particular time" (Krebs 1994). This illustrates the need for a third key step in defining populations: one must identify quantitative criteria for how different units must be before they are considered separate "populations." Population differentiation occurs along a continuum, and no single point on the continuum captures all reasonable concepts of "population" (Figure 1). Choice of the quantitative criteria is necessarily somewhat arbitrary but can be made more objective by relating them directly to the management/conservation goals. It is important to realize that standard statistical tests generally evaluate the null hypothesis of a single, randomly mating population—a scenario that lies at one extreme end of the population differentiation continuum. Rejection of that hypothesis, therefore, does not directly address the issue as to whether the differences among units are large enough to warrant separate population status. Perhaps the best, published example of a quantitative population definition is that of a demographically independent population (DIP) in the Viable Salmonid Populations

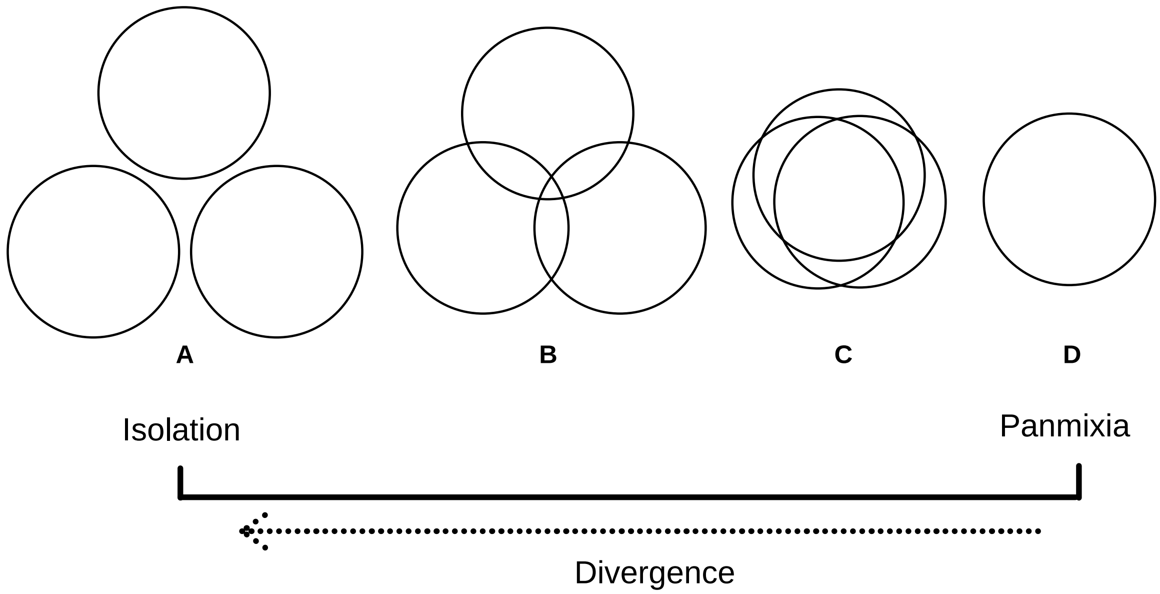

Figure 1. The continuum of population differentiation. Each group of circles represents a group of subpopulations with varying degrees of connectivity (geographic overlap and/or migration). A) Complete independence. B) Modest connectivity. C) Substantial connectivity. D) Panmixia; "subpopulations" are completely congruent (Waples and Gaggiotti, 2006).

(VSP) report (McElhany et al. 2000). The focus of that document is describing the characteristics of healthy salmon populations and Evolutionarily Significant Units (ESU), and DIPs are natural units upon which to base viability analyses. The VSP definition of a population is one in which demographic exchanges with other populations occur at a low enough level that they do not substantially affect extinction risk over a 100-year time frame.

Many marine species are particularly challenging for stock/population identification because high levels of gene flow ensure that the genetic signal from population differentiation is weak, and various errors associated with estimating population genetic parameters that might normally be safely ignored assume a relatively greater importance. Insights into stock identification in marine species can best be obtained by using a combination of methods that provide information on both ecological and evolutionary time scales. Experimental design and data analysis and interpretation should be conducted in the context of detailed information on the ecology and life history of the species in question.

The Biology of Marine Population Structure

Barbara Taylor
Southwest Fisheries Science Center

Population structure is the end product of complex biological processes whereby animals maximize their fitness to adapt to variation in their physical and biological environment. For even a single species the complex interaction of the changing biotic and abiotic environment results in complex population structure that evolves with time. Humpback whales illustrate this complexity by exhibiting very different structures in different ocean basins. The North Atlantic is primarily composed of a single breeding area with multiple feeding areas maintained by maternally learned migration patterns. As such, each feeding area is a DIP (demographically independent population) but would not qualify as a DPS (distinct population segment) because the heritable nuclear markers are mixed on an ocean-basin level. In contrast, the larger North Pacific has several breeding grounds and several feeding grounds. Some feeding grounds have individuals only from a single breeding ground, while other feeding grounds have individuals from multiple breeding grounds. Successful management of such a complex structure requires a deep understanding of management objectives.

Biological structure, from the population level to the species level, exists on a continuum, yet, management rules are simple and discrete. In simple terms, the objective of the MMPA is to maintain “population stocks” as functioning elements of their ecosystem, whereas the goal of the ESA is to maintain the evolutionary potential of the “species.” Clear quantitative objectives facilitate management that accounts for complex biology. Figure 2 illustrates a way to conceptualize one type of population structure that is common for coastal marine species. The “water bottles” represent groups of individuals with random mating within the group. These groups are connected to neighboring groups by dispersal. Human removals are symbolized by the spigots. If removals are small and evenly distributed across the range then detailed understanding of population structure is not needed (see A). However, if human caused removals are concentrated (see B) then the level of connectivity becomes important. The needed level of dispersal (external recruitment) depends on the specific management objectives, the pattern of human-caused removals and the ability of the groups to grow (internal recruitment). An example of quantitative management objectives needed to “solve” the problem in B would be: 1) maintain the range, and 2) no part of the range should be reduced to less than X% of historical numbers.

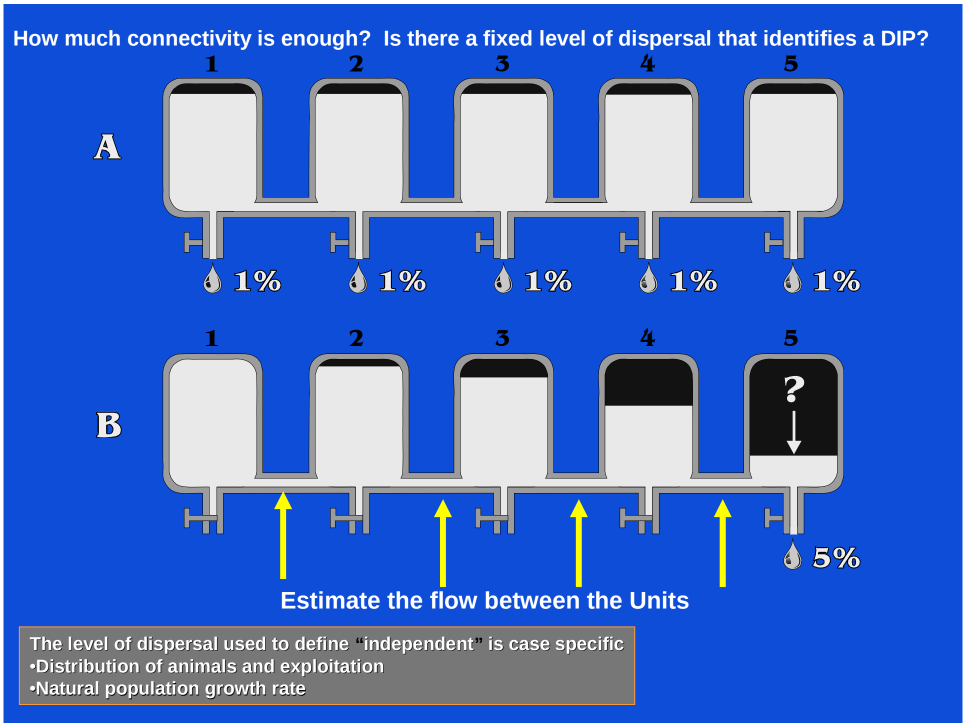

Figure 2. Conceptual model of population structure for coastal marine species.

Management of Biological Stocks under the MSFCMA, ESA, and MMPA

Richard Methot
Office of Science and Technology

The major legislative mandates for NOAA Fisheries: MMPA, ESA, and MSA provide guidance for addressing the conservation and management of biological stock units. For the MMPA and ESA, conservation of stock units, at some level of aggregation, is the paramount goal. The ESA is designed to prevent extinction and to recover stock units listed as threatened or endangered with extinction. The MMPA seeks healthy ecosystems, with each marine mammal stock as a functioning component of its ecosystem. While MMPA explicitly focuses attention on the finest discernable population scale in order to maintain its role in the local ecosystem, ESA focuses on broader taxonomic units: species, sub-species, or distinct population segments of a (sub)species. For MSA, the paramount goal is achievement of optimum benefits from the fishery while preventing overfishing, rebuilding depleted stocks and protecting the marine ecosystem; conservation of stock units is implicit and necessary to achieve these goals. MSA is not explicit about biological units. In practice, fishery management units range from multi-species complexes down to local aggregations of a species. Marine species exhibit structure along a continuum of scales of aggregation. As scientific methods improve our ability to discern biological units with finer degrees of distinction, the gap between management focused on protection of these fine units and management focused on protection of entire species grows. Such a difference is not irrational. Finer scale units are the scale that interacts with the local ecosystem, including human communities, on the time scale of generations. But units at this spatial scale may be ephemeral on the evolutionary time scale from the species' perspective (Figure 3). Pro-active, preventative management actions may best be focused on the finest scales in order to protect all potential units. But when existing management measures have not been able to keep a species from the brink of extinction, it is rational to step back to a broader scale of aggregation. Good, science-based management on a fine scale is ideal, but fine scale management increases the data requirements and management costs, and limits flexibility for management and constituents to adapt to changing spatial patterns. Recognizing the continuum of spatial scales on which each species functions is fundamental to good management under all 3 mandates.

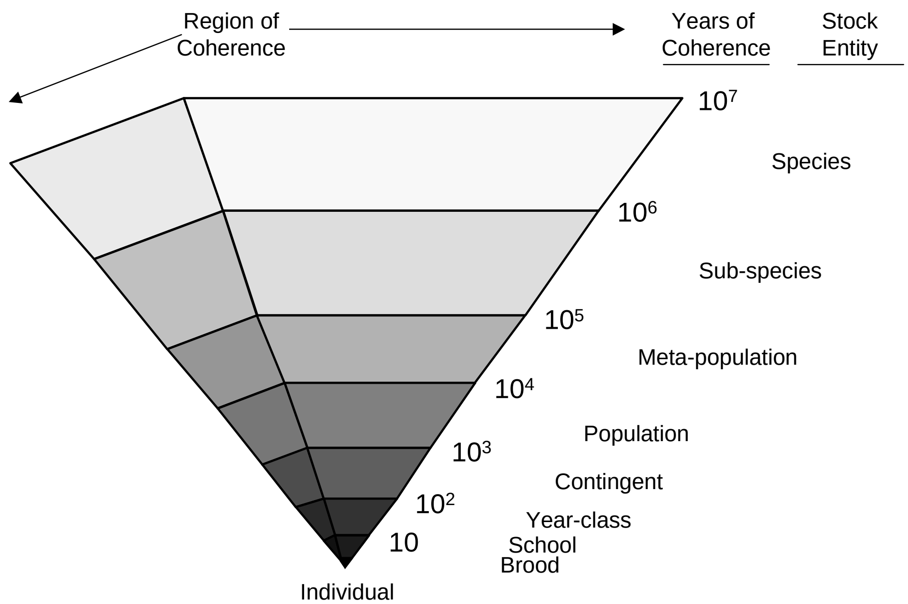

Figure 3. Temporal and spatial domains and levels of biological organization relevant to the unit stock (from Secor 2005).

Legal Requirements and Guidance

The purpose of this session was to summarize the general objectives for the MSA, ESA, and MMPA; explain references to, definitions of, and requirements for conservation or management units; and discuss how issues related to conservation units have been "clarified" by case law or congressional reports.

Determining Management Units Pursuant to the Magnuson-Stevens Act

Stacey Nathanson
General Counsel for Fisheries

The primary goal of the he Magnuson-Stevens Fishery Conservation and Management Act is to ensure sustainable and economically viable fisheries, and is focused on resource extraction rather than resource protection. The purpose of National Standard 3 is to induce a comprehensive approach to fishery management. The geographic scope of the fishery, for planning purposes, should cover the entire range of the stock(s) of fish, and not be overly constrained by political boundaries. Wherever practicable, an FMP should seek to manage interrelated stocks of fish. National Standard 3 states that “to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination” See 16 U.S.C. 1851(a)(3). A “stock of fish” is “a species, subspecies, geographical grouping, or other category of fish capable of management as a unit” See 16 U.S.C. 1802(37). A “fishery” is “(A) one or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics; and (B) any fishing for such stocks” See 16 U.S.C. 1802(13). National Standard 3 promotes unity of management: cooperation and understanding among entities concerned with the fishery (e.g. Councils, States, Federal Government, international commissions, foreign nations)
where management of a fishery involves multiple jurisdictions, coordination among the several entities should be sought in development of the FMP. The term “management unit” is defined in the National Standard 3 guidelines as a fishery or that portion of a fishery identified in an FMP as relevant to the FMP’s management objectives. There is no definition of species in the Magnuson-Stevens Act or its regulations. The Act is focused on flexibility and ease of management. However, tension exists between setting up management units for the fishery and the requirements to undertake research and conservation for the individual stocks.

ESA Management Units

Karl Gleaves
General Counsel for Fisheries

The Endangered Species Act states that the term “species” includes any subspecies of fish or wildlife or plants, and any distinct population segment of any vertebrate fish or wildlife which interbreeds when mature [Section 3 (16) T]. Legislative history indicates an intention to protect populations. The interpretation by NMFS was defined in the 1991 NMFS Pacific salmon Evolutionarily Significant Unit (ESU) policy: the stock must satisfy two criteria to constitute an ESU: 1) it must be substantially reproductively isolated, and 2) it must represent an important component of the evolutionary legacy of the species. The 1996 Joint FWS-NMFS Distinct Population Segment (DPS) policy is that two elements are considered in a decision regarding the status of a possible DPS as endangered or threatened: 1) discreteness of the population segment in relation to the remainder of the species to which it belongs, and 2) the significance of the population segment to the species to which it belongs. Future issues are defining significant portion of range, management units or DPS’s in the context of recovery and dealing with special subunits such as hatchery stock or hybrids.

MMPA Management Units

Karl Gleaves
General Counsel for Fisheries

The Marine Mammal Protection Act defines the term “population stock” or “stock” as a group of marine mammals of the same species or smaller taxa in common spatial arrangement, that interbreed when mature [Section 3 (11)]. The findings and declaration emphasize populations: “The Congress finds that – (1) certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man’s activities; (2) such species and population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem in which they are a part… (3) there is inadequate knowledge of the ecology and population dynamics of such marine mammals… (Section 2). The Legislative history shows that “population stock” involves a new concept, permitting and requiring the Secretaries to discriminate between different groups of animals distinguishable from other populations of the same species [HR 10420 (1971) House Merchant Marine and Fisheries Committee Report]. The Alaskan polar bear, for example, is clearly a population stock within the general worldwide species classification of polar bears. A “population stock” or “stock” refers to a group of marine mammals of the same species that interbreed when mature [S 2871 (1972) Senate Commerce Committee Report]. This concept permits a discrimination between different groups of animals distinguishable from other populations of the same species.

Current Guidelines for Identifying Conservation Units

For this session, presenters were asked to describe existing guidelines for identifying conservation units under the three statutes, with particular reference to the following:

- Identify the intersection of biological principles (population structure) with statutory requirements;
- Describe the development of technical guidelines and criteria; and
- Discuss challenges in applying (or developing) policies

Endangered Species Act: Species, Subspecies, and DPSs

Marta Nammack
Office of Protected Resources

The ESA allows us to list a species, subspecies, or a DPS of a vertebrate species as threatened or endangered. We have two policies for defining DPSs: a NMFS one for Pacific salmon (November 1991), another one with the FWS for all other vertebrate species (February 1996). These policies are consistent with each other. Both include a 2-step process: 1) reproductive isolation, or "discreteness;" and 2) importance to the evolutionary legacy of the species, or "significance." The only real difference is that the joint policy allows us to use international boundaries to satisfy the "discreteness" criterion when management mechanisms or status of the species differs in the two countries. Robin Waples developed the approach for defining "distinct population segments" for Pacific salmon, using the term "evolutionarily significant unit" (ESU). The ESA purpose of preventing extinction and its goal of preserving genetic diversity guided his approach, as did congressional direction to use the provision sparingly. Out of 201 stocks of Pacific salmon identified by Nehlsen et al. (2001), NMFS has identified 52 ESUs and listed 26 of them as threatened or endangered. In addition to these 26 ESUs, we listed 10 DPSs (including 4 populations of marine turtle with FWS) as threatened or endangered, and FWS has listed 45 DPSs. Listing a DPS does not preclude us from managing for population substructure; we can do this through section 7 consultations and recovery planning. I describe a few examples, including Atlantic salmon, of how the policies have been implemented and review some of the challenges facing us in this area.

Although most rivers in Maine historically contained populations of Atlantic salmon, only a portion of these rivers were included in the range of the Gulf of Maine DPS (see Figure 4). Genetic data, life history data (including straying rates), and the international boundary were used to support discreteness between these populations and those in Canada. Because loss of this group of populations would result in a major gap in the range of the species, we determined that it met the DPS policy's "significance" criterion. The State of Maine challenged the listing, claiming that there were no wild salmon left, and, therefore, there was no DPS to list. A National Academy of Sciences report confirmed that salmon in the Gulf of Maine were discrete and significant. Recently, further genetic studies by Tim King of the U.S. Geological Service confirmed our DPS determination, and our decision was also upheld in court. We are currently considering whether to include a few additional populations in this DPS.

Figure 4. Historic range of Atlantic salmon in Maine and range of the Gulf of Maine DPS (rivers shown in green).

Marine Mammal Stock Identity Guidelines

Thomas C. Eagle
Office of Protected Resources

The term, "population stock" or "stock" is the fundamental conservation unit under the MMPA and is defined as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature." The MMPA, however, does not provide additional information to clarify the definition of population stock. The congressional reports accompanying the MMPA in 1972 note that it is a new concept but provide little additional information. The House (House of Representatives, Report 92-707, December 4, 1971) stated that Alaskan polar bears were clearly a population stock within the worldwide species classification for polar bears. Ironically, the FWS identifies two stocks of polar bears in Alaska both of which move beyond the US Exclusive Economic Zone.

To consider the meaning of population stock, one can consider two "eras" under the MMPA, Pre- and Post-1994. Prior to 1994, population identity was not often used outside of determinations whether a stock was depleted or not. The first two stocks designated as depleted were bowhead whales and Hawaiian monk seals. Both of these were designated as depleted throughout the range of the species due to the species listing as Endangered under the ESA. For northern fur seals and bottlenose dolphins, NMFS identified only part of the US range of the species as a stock that was depleted (Pribilof Islands stock of fur seals and the Atlantic coastal migratory stock of bottlenose dolphins) distinguishing them from other individuals in other areas (fur seals breeding on San Miguel Island and bottlenose dolphins inhabiting bays, sounds, and estuaries along the Atlantic coast. Similarly, certain aggregations of spinner and spotted dolphins in the Eastern Tropical Pacific Ocean were designated as depleted, distinguishing them from other aggregations of these dolphins in the Pacific Ocean.

The Post-1994 era of the MMPA is marked primarily by the requirement to prepare stock assessment reports for all stocks of marine mammals that occur in waters under U.S. jurisdiction. These reports contain information necessary to support a data-intensive, stock-specific regime to govern interactions between marine mammals and commercial fishing operations. The MMPA Amendments of 1994 required initial draft stock assessment reports to be prepared within 90 days of enactment. Therefore, NMFS had to act quickly to establish guidelines for preparing the reports, including guidance to identify stocks of marine mammals.

The original draft guidelines were prepared as the result of a workshop held in La Jolla, CA, in June 1994. The draft guidelines were made available for public review and comment prior to final guidelines. The guidelines were subsequently reviewed and revised in workshops in 1997 and 2003. After public review and comment, each of the draft revisions was made final in 1997 or 2005, respectively.

Because the statutory definition of population stock was not clear, NMFS reviewed other parts of the MMPA and its legislative history for guidance and found helpful statements in the purposes and policies of the act, especially in noting that population stocks should not be permitted to diminish below the point at which they cease to be a significant functioning element of the ecosystem of which they are a part. From this indirect guidance and the definition of population stock, NMFS used demographic independence as a primary determinant of stock identity.

The guidelines note that ideally, a stock would be a management unit that identifies a demographically isolated biological population. The guidelines, however, refer to a pragmatic realization that identified stocks may fall short of this ideal due to a lack of evidence or for other reasons. Additional guidance for identifying marine mammal stocks notes that morphological or genetic difference in animals from different geographic regions indicates reproductive isolation, and reproductive isolation is proof of demographic isolations. Evidence that may be used to identify stocks include distribution and movements, differences in population trends, morphology, life history, genetics, contaminant or isotope loads, parasite loads, and oceanographic habitat. The guidelines conclude that separate management is appropriate when such differences are noted.

Failure to detect differences among groups of marine mammals in the types of evidence described above does not necessarily mean that separate stocks are not appropriate due to sample size and statistical power. In particular, the genetic models are sensitive to very small levels of migration among groups.

A major goal of identifying stocks under the guidelines is to avoid potential for localized depletion where marine mammals are subject to human-caused mortality and serious injury. This goal is consistent with the concept of OSP and maintaining marine mammal stocks as functioning elements of their ecosystem, as noted in the purposes and policies of the MMPA. Challenges in the application or interpretation of the guidelines include the following: lack of information, seasonal or periodic mixing of individuals from different stocks (e.g., assigning mortality or abundance to specific aggregations), identifying stock boundaries of continuously distributed species, political influence due to socio-economic considerations, and commitment to constituent processes (e.g., co-management) that move more slowly than the compilation of biological information.

Guidelines for Identifying Conservation Units Under the Magnuson/Stevens Fishery Conservation and Management Act

Steve Cadrin
Northeast Fisheries Science Center

The MSA and associated National Standard 3 guidelines include some direct guidance on identifying conservation units for U.S. fishery management. More precise guidelines on stock identification are implied by the conservation and management mandates of the Act. In order to effectively meet the requirements of the Act, conservation units should be self-sustaining groups of individuals, for which intrinsic population parameters (e.g., growth, recruitment, natural mortality and fishing mortality) are the most important factors determining fishery production, while extrinsic factors (e.g., migration, larval transport) are considered to be negligible.

National Standard 3 states, "*to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination*." The term 'stock of fish' means "*a species, subspecies, geographical grouping, or other category of fish capable of management as a unit*." This definition of 'stock of fish' may appear circular, but a more meaningful and useful interpretation is that 'capable of management as a unit' involves all of the implicit requirements associated with National Standard 1: "*Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimal yield from each fishery for the United States fishing industry*."

National Standard 1 mandates that fishery management is based on a MSY strategy. 'Overfishing' is defined in the Act as "*a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce maximum sustainable yield on a continuing basis*." 'Optimal yield' is defined as : "*maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and in the case of an overfished fishery, provides for rebuilding to a level consistent with producing maximum sustainable yield…*" Estimation of MSY and associated reference points for status determination requires the identification of groups within a species that have independent population dynamics, on an ecological time scale (i.e., years to decades). Furthermore, the Act requires that fishery management plans shall "*specify a time period for ending overfishing and rebuilding the fishery that shall… not exceed ten years…*" This implicitly specifies the ecological time scale of reproductive isolation and medium-term population dynamics that pertain to stock identification for fishery management, as compared to evolutionary time scales (i.e., millennia) typically required for genetic changes and adaptation.

The opening phrase of National Standard 3, "to the extent practicable" allows for practical compromises from ideal stock identification that are typical in fisheries science and management. For fisheries that harvest mixed stocks or the same or even different species, determining stock composition of the catch is often difficult or impossible, and the stock complex is monitored and managed as a unit stock. On the other extreme, geographic portions of a stock may be difficult to monitor or manage, and a subset of a single self-sustaining resource may be considered a unit stock for status determination and management (Figure 5). National Standard 1 guidelines confirm this allowance: "…status determination criteria should generally be specified in terms of the level of stock aggregation for which the best scientific information is available."

National Standard 3 guidelines state that "*the geographic scope of the fishery, for planning purposes, should cover the entire range of the stock(s) of fish, and not be overly constrained by political boundaries.*" This guidance on international management of transboundary stocks is consistent with the practical need to monitor and manage self-sustaining resources as a unit. National Standard 3 guidelines also specify 'management units' for fishery management plans, which are practical subdivisions based on a variety of biological and socioeconomic factors, but do not offer more specific guidance on stock identification.

These direct and indirect guidelines are entirely consistent with current conventions in fishery science related to stock identification. The discipline has developed to be interdisciplinary, considering various information on genetics and life history to attain accurate delineation of stocks. Considering the mandate of National Standard 2, "conservation and management measures shall be based upon the best scientific information available," conservation units for fishery management should apply state-of-the-art technologies and advancements in stock identification to accurately and reliably manage the fishery and conserve the resource.

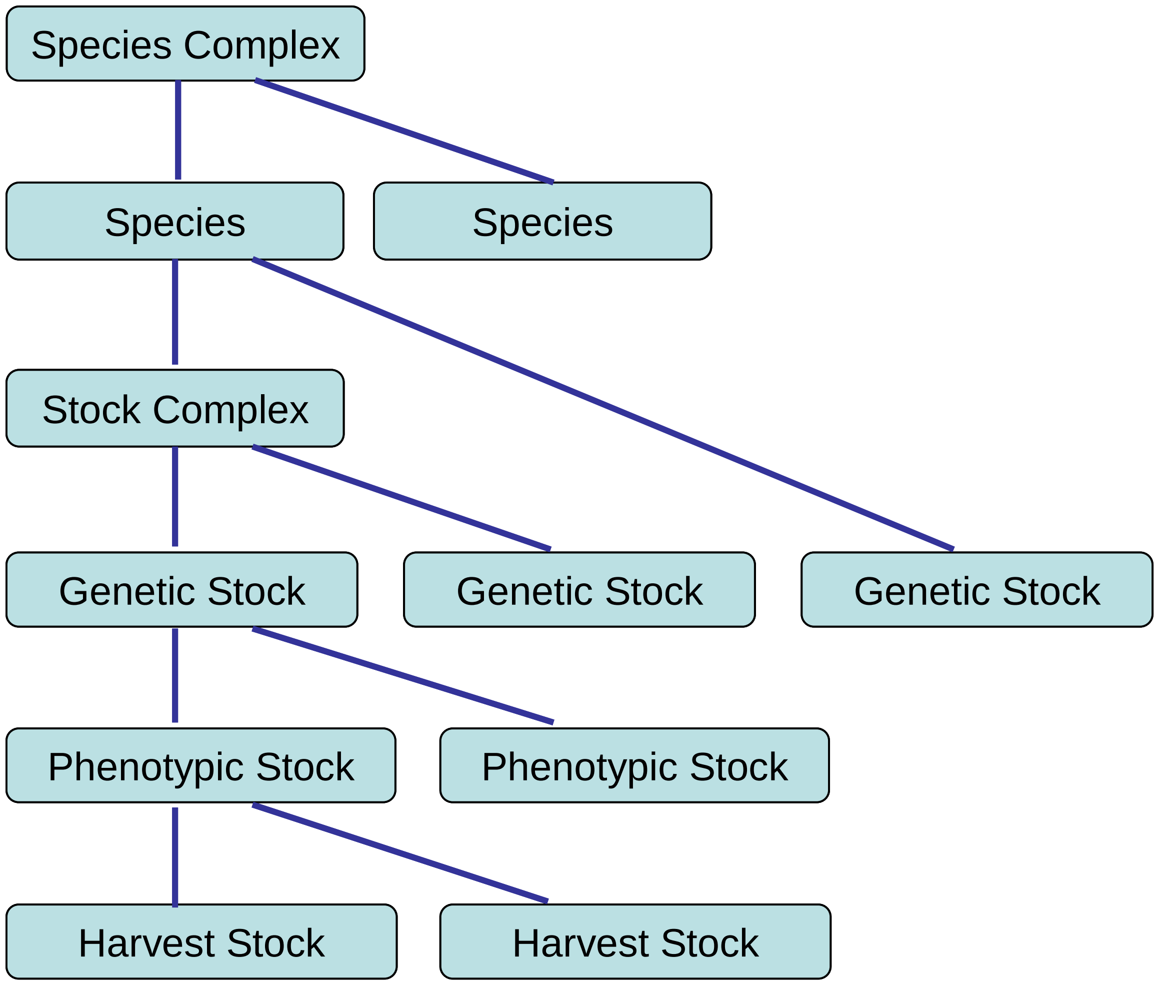

Figure 5. Fishery conservation units expressed as a hierarchy of variation and structure.

Case Studies

The final group of presentations involved the description of examples where conservation units have been identified under NMFS' policy guidelines for such identification. Presenters were asked to address the following points in their case studies:

- Summarize the population's structure
- Identify the intersection of biological principles with statutory requirements
- How has the individual act’s policy guidance been applied?
- What was the basis for the decision made to identify the management unit?
- Describe how stock ID implementation has helped meet agency missions (successes)
- Describe challenges or impediments to implementing (or developing) policies (failures)
- What has not been successful to this point?

Groundfish Stocks in Alaska

Grant Thompson
Alaska Fisheries Science Center

Two general areas (Figure 6) are covered by fishery management plans (FMPs) in Alaska: the Bering Sea/Aleutian Islands (BSAI) and the Gulf of Alaska (GOA). The factors by which management units may be defined are FMP (BSAI or GOA), region (BS, AI, or GOA), area (e.g., Western, Central, or Eastern GOA), management category (e.g., target species, prohibited species, forage species), and species or species complex. However, stock assessments are not always nested within the above management units. For example, BS/AI/GOA sablefish and W/C/E GOA Pacific ocean perch have single assessments, but separate catch limits for individual regions or areas. Some issues are: determining the basis for combining species or splitting complexes, protecting small stocks within complexes, mismatches between management area boundaries and stock ranges, difficult species identification in the field, and recognizing new taxonomy.

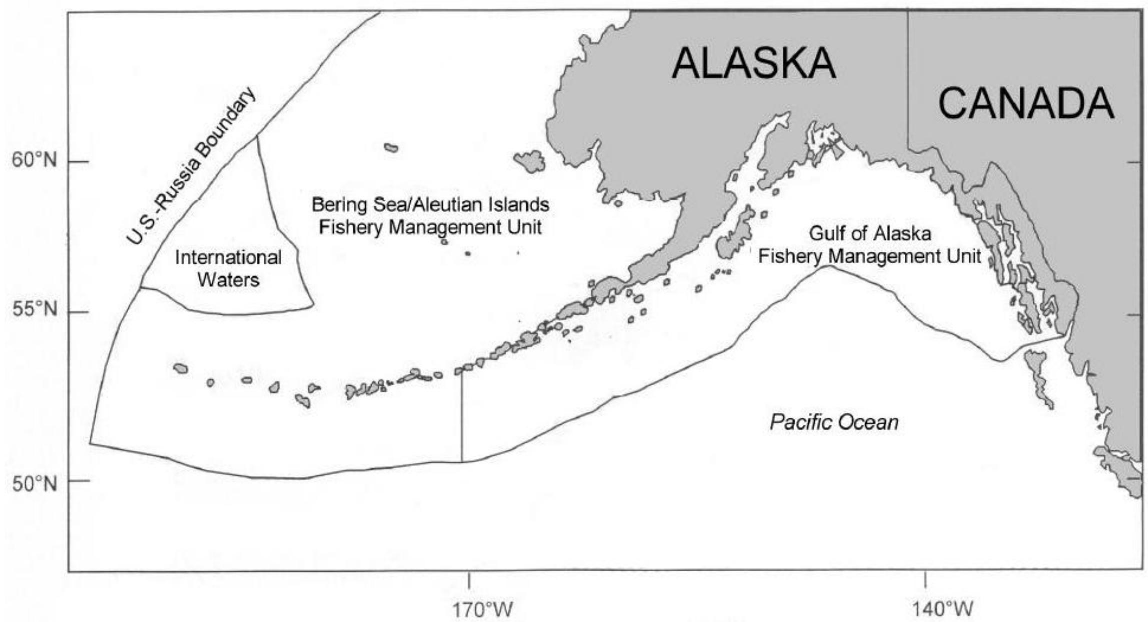

Figure 6. Areas included in the Bering Sea/Aleutian Islands and Gulf of Alaska Fishery Management Units.

Stock Structure and Management Units for West Coast Groundfish

Richard Methot
Office of Science and Technology/Northwest Fisheries Science Center

Many species of groundfish harvested off the coasts of California, Oregon and Washington tend to have relatively sedentary behavior as adults and broad spatial distributions extending through much of the continental shelf of the North Pacific. A slowly growing body of genetic stock structure data tends to find some significant, although not large, differences across large spatial scales such as southern California to Puget Sound or west coast to the Aleutian Islands. Genetic separation on a spatial scale that would be within the CA-OR-WA region is not common and tends to occur for some nearshore rockfish and near faunal breaks like major rocky headlands. Although genetic data do not indicate a multiplicity of separate small stocks along the coast, there still may be only limited mixing of larvae, juveniles and adults along the coast. Most of the demographic analyses (stock assessments) conducted on west coast groundfish have treated the entire west coast as a unit demographic stock. A few have separated the coast into northern and southern sections. Although several of these stocks have distributions that span the US-Canada border, nearly all assessments have truncated at the border due to discontinuities in data and the lack of a full framework for coordination of management. Truncation at the border may not cause bias in the demographic analyses if cross-border movement is very low, but if movement is that slow then greater consideration should be given to structure within the west coast zone. With only slow rates of mixing, there is a risk of localized depletion if the fishery does not freely conform to the stock's spatial distribution and there is a risk of erroneous assessment results if trends and patterns observed in only one area are incorrectly asserted to represent trends in the entire coastwide stock. An example of finer scale geographic patterning is shown for canary rockfish (Figure 7. Arguably, there are 6-8 canary rockfish aggregations along the coast with unknown degrees of demographic connectivity. Although more high-resolution genetic evidence would help discern the boundaries of these aggregations, there seems to be sufficient evidence to warrant an investigation of finer scale demographic analyses and an analysis of the risks of misplaced or missing assessment boundaries.

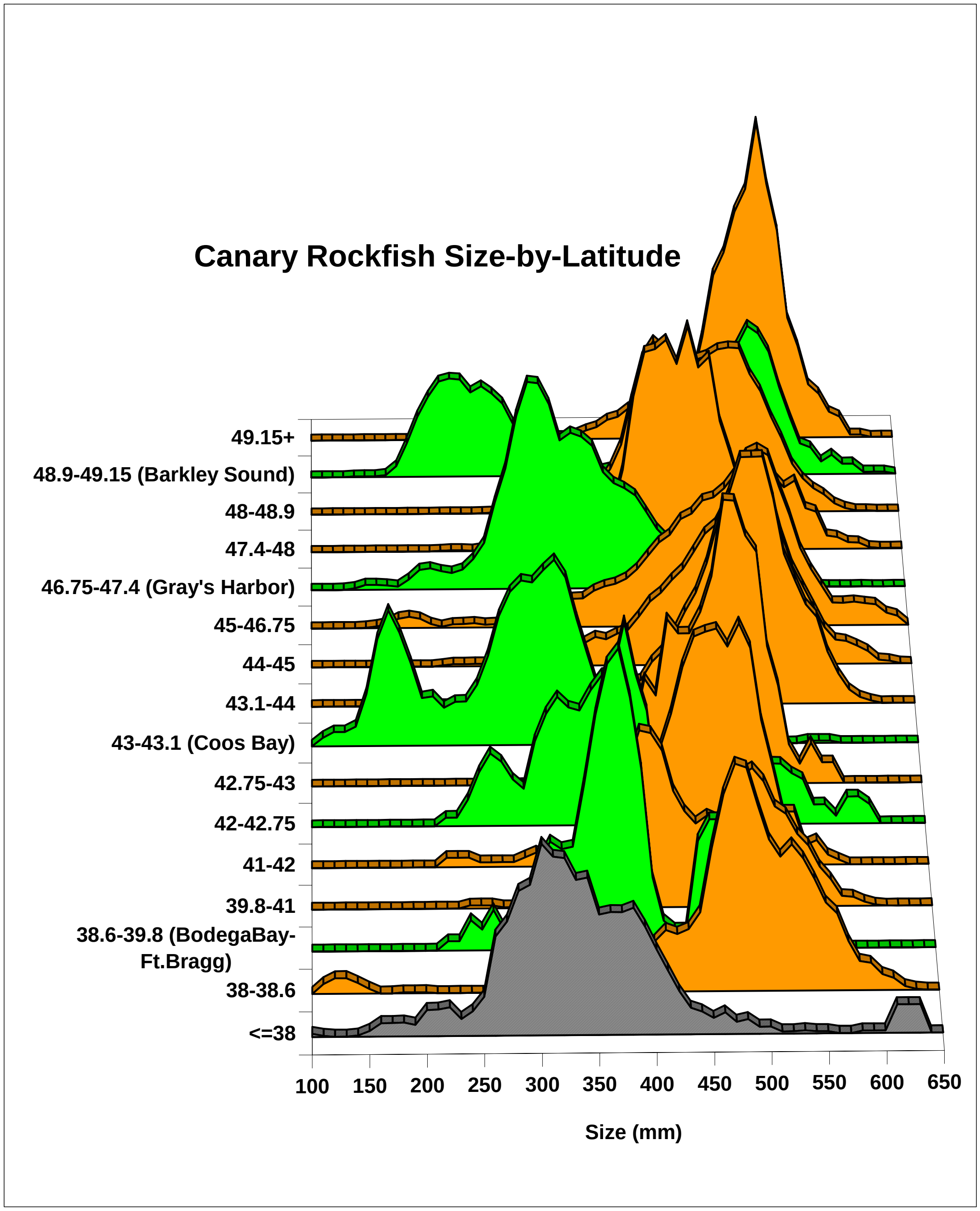

Figure 7. Geographic variation in size of canary rockfish

Stock Identification of New England Groundfish

Steve Cadrin
Northeast Fisheries Science Center

New England groundfish species are typically managed as discrete stocks based on multidisciplinary information that indicates fishery resources within geographic areas that have similar life history dynamics (e.g., growth, maturity, recruitment) and limited movement with adjacent, conspecific resources. Stock definitions and boundaries are occasionally reconsidered when new information is available and revised when the new definition will improve fisheries science and management. The recent revision of yellowtail flounder stock definitions is a typical example.

An interdisciplinary study of yellowtail stocks off the northeast coast of the USA that evaluated geographic patterns of abundance, geographic variation in growth and maturity, larval transport, morphometry, and genetics suggested that yellowtail flounder comprise three separate management stocks despite genetic homogeneity. Two harvest stocks of yellowtail flounder have significantly different patterns of abundance and biomass over time, with a boundary on southwest Georges Bank. Geographic patterns of size and proportion mature at age indicate two phenotypic stocks of yellowtail flounder, with a boundary on northern Georges Bank. Therefore, southern New England yellowtail form a separate harvest stock than Georges Bank yellowtail, and Cape Cod yellowtail are a separate phenotypic stock than those on Georges Bank or off southern New England. However, population dynamics of the Cape Cod-Gulf of Maine stock are sensitive to movements of fish from adjacent yellowtail stocks. In recognition of this, a tagging study was initiated in collaboration with New England fishermen and fishery scientists. To date, over 35,000 yellowtail from the Gulf of Maine to the Mid Atlantic Bight have been tagged using conventional disc tags and data-storage tags. Preliminary results indicate frequent movements within stock areas, and less frequent movements among stocks (Figure 8). Data-storage tags indicate distinct off-bottom behavior, typically in evening hours, lasting an average of about four hours. The frequent off-bottom movements and occasional movements to different depths strongly suggest that yellowtail flounder can move between fishing grounds or stock areas using mid-water currents. Therefore, movements across current stock boundaries (e.g., shallow shoals or deep channels) may occur more frequently than previously thought. The movement information will be considered in the next benchmark stock assessment of yellowtail flounder resources.

A review of the basis of New England groundfish stock definitions shows that a similar approach is used for all species, but the amount of information available varies by species:

- Atlantic cod are managed as two stocks (Gulf of Maine and Georges Bank) based on meristics, spawning seasons, growth rates, maturity, observed movements, parasites, and distribution of eggs and larvae. New information on Atlantic cod stocks from recent tagging and genetic studies will be considered in the next benchmark stock assessment.

- Haddock are managed as two stocks (Gulf of Maine and Georges Bank) based on meristics, ichthyoplankton distribution, growth rates, age at maturity, observed movements and parasites.
- Winter flounder are managed as three stocks (Gulf of Maine, Georges Bank, and southern New England-Mid Atlantic) based on meristics, growth rates, age at maturity, observed movements and distribution.
- Silver hake are managed as two stocks (northern and southern) based on genetics, morphometrics, growth, tagging, spawning seasons, distribution of life stages, and traditional fishing areas.
- Pollock are managed as a single stock (Georges Bank/Gulf of Maine) based on genetics, meristics, morphometrics, growth, maturity, distribution of life stages, and tagging.
- White hake are managed as a single stock (Georges Bank/Gulf of Maine) based on meristics, morphometrics, tagging, spawning season, growth and distribution of larvae and adults.
- Acadian redfish are managed as a single stock (Gulf of Maine/Georges Bank) based on taxonomic studies, meristics, morphometrics, growth, maturity, parasites and larval distribution.
- American plaice are managed as a single stock (Gulf of Maine/Georges Bank) based on growth, spawning seasons and distribution of eggs and adults.
- Witch flounder are managed as a single stock from the Gulf of Maine to the Mid Atlantic based on growth, distribution and larval period.
- Red hake are managed as two stocks (northern and southern) based on meristics, demographics and distribution.
- Windowpane flounder are managed as two stocks (Gulf of Maine/Georges Bank; Southern New England/Mid-Atlantic) based on spawning seasons and growth.
- Atlantic halibut is managed as a single stock in the Gulf of Maine despite extensive movement to other areas in the Northwest Atlantic.
- Ocean pout and offshore hake have little information on stock structure and are managed as single stocks in U.S. waters.

The Northeast Fisheries Science Center continues to conduct research on stock identification, and stock structure is reviewed through regular benchmark stock assessments.

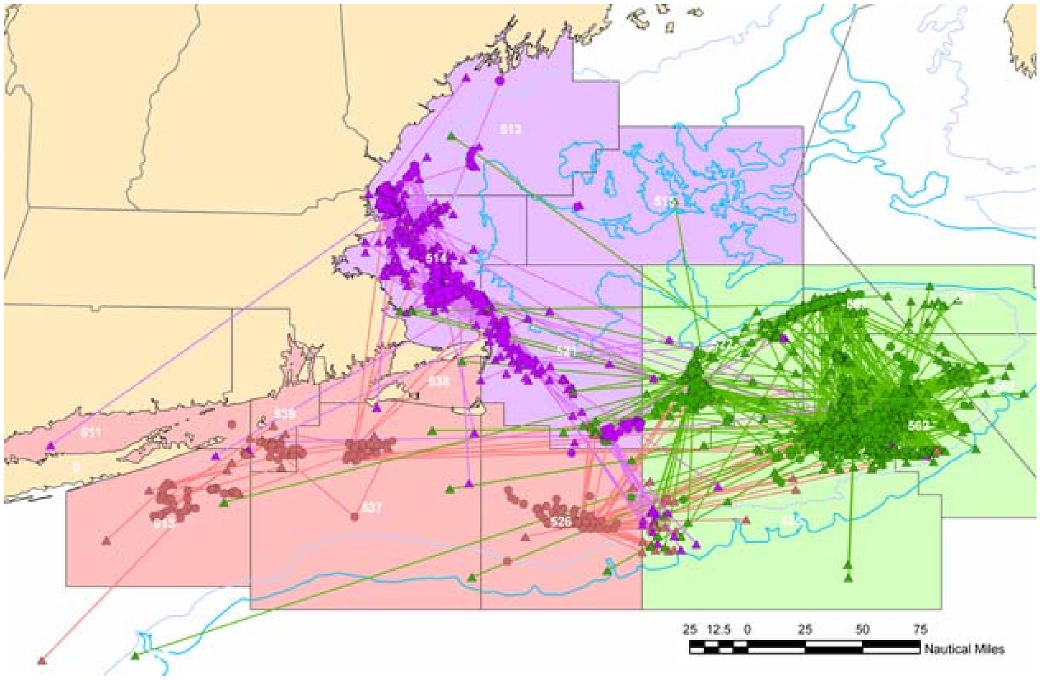

Figure 8. Releases (circles) and recaptures (triangles) of tagged yellowtail flounder and the three U.S. management areas.

Atlantic Bluefin Tuna: Swim Anywhere They Want, Wanted Everywhere They Swim

Clay E. Porch
Southeast Fisheries Science Center

Atlantic bluefin tuna *Thunnus thynnus* are among the largest and fastest of bony fishes, weighing up to 700 kg and able to swim at over 90 km h^{-1}. Their endothermic physiology allows them to maintain a relatively stable body temperature even in waters as cold as 3^{o}C. This combination of size, speed and thermoregulation enables individuals to range widely throughout the Atlantic basin, from the warm shallows of the Caribbean Sea to the frigid waters off Norway.

Atlantic bluefin tuna have long been prized as food fish, particularly in the vicinity of the Mediterranean Sea, where a substantial fishery has existed for more than 4,000 years (Roman records attest to catching thousands of tons). The fishery for bluefin in the western Atlantic dates back only to the early 1900's, when bluefin were occasionally taken by harpoons and traps, but were regarded mostly as a nuisance**.** The advent of Japanese longliners in the late 1950s and U.S. and European purse seiners during the 1960s resulted in a large increase in bluefin landings throughout the Atlantic, but perhaps the single most important development in the fishery was the burgeoning sashimi market in Japan. The high demand and even higher prices (one 200-kg specimen recently sold for almost $174,000) made bluefin so valuable that fishermen could afford to target them even at relatively low densities. Currently it is believed that the total landings of bluefin tuna exceed 50,000 MT and are not sustainable.

The high demand for bluefin tuna coupled with the fact that they routinely swim through multiple jurisdictions (including the high seas) makes them rather difficult to manage. The need for International coordination was formally recognized in 1966 with the signing of the International Convention for the Conservation of Atlantic Tunas (ICCAT), the stated goal of which is "maintaining the populations of tuna and tuna-like fishes at levels which will permit maximum sustainable catch." Currently, ICCAT manages bluefin tuna on the premise that there are two primary stocks, one which spawns in the Gulf of Mexico and another that spawns in the Mediterranean Sea. This premise helps the agency mission by averting the possibility that declines in the smaller western stock will go unnoticed or simply not be acted upon.

The major challenges facing management under the two-stock premise include (1) defining the boundary that best delineates the eastern and western management areas (and stocks); (2) quantifying the nature and degree of intermixing across that boundary; (3) incomplete data, particularly for the eastern stock; and (4) different management schemes applied to each stock with different, perhaps confused, goals. The poor quality of the catch and size statistics for the eastern stock is particularly vexing as it precludes effective modeling of the effect of mixing between the two stocks. If substantial westward mixing exists, then the uncertainty in the east will confound estimates for the west (i.e., the status of the western stock may be inestimable by current methods). The different management schemes also pose a problem. Enforcement in the eastern management zone (eastern Atlantic and Mediterranean Sea) is widely seen as rather lax in comparison to the west. Catches are believed to exceed the imposed TAC and, until recently, size limits were often ignored. This has led to a perception that no matter how much fishing pressure is reduced in the western management zone, the western stock will remain overfished owing to their frequent forays into the eastern management area. One could also argue that there has been some confusion in terms of the basic goal; whether to maintain high catches in each management area or to maintain high catches of each stock. The former can perhaps be achieved by maintaining a healthy eastern stock, whereas the latter presupposes that maintaining population diversity matters.

Recent advances in electronic tagging, genetics, and otolith microconstituent analyses, coupled with satellite imagery and the enhanced scale of ongoing oceanographic measurements, promise to help unveil many of the mysteries relating to the interaction between eastern and western bluefin tuna. To date, the results have tended to support the two-stock premise used by ICCAT, however the nature and degree of mixing remains somewhat unclear.

Management Units for Sedentary Stocks:
The Atlantic Sea Scallop Example

Dvora Hart
Northeast Fisheries Science Center

Fishery stocks are typically idealized as well-mixed, closed populations. The "well-mixed" assumption implies that all (adult) individuals are subject to a similar environment and, thus, have similar life history characteristics and fishing mortality risks. These attributes are rarely correct in those stocks where adults are sedentary or sessile. Sedentary animals are strongly influenced by their local environment. As a result, life history attributes such as growth rates and length-weight relationships can vary strongly within a stock. For example, the growth rate of the Atlantic sea scallop (*Placopecten magellanicus*) depends on depth, so that reference points for deep water sea scallops may be different than those in shallow water. Fishing effort can also vary greatly spatially, as it is influenced by factors such as resource abundance, distance to port, and spatial management measures (e.g., fishery closures). In mobile stocks, individuals can move among areas with different fishing mortality rates, and thus may be approximately subject to the spatially averaged fishing mortality. By contrast, fishing mortality risks can vary greatly in a sedentary stock, with individuals in popular fishing grounds being subject to much higher fishing mortality than those in lightly fished or closed areas.

For these reasons, sedentary stocks are often subject to localized over- and under-fishing, even when the spatially averaged fishing mortality meets the whole-stock target. Localized variation in fishing mortality can reduce yield per recruit compared to that which would be expected if fishing mortality was uniform (Figure 9). Depending on larval transport patterns, localized overfishing may also induce recruitment failure “downstream” of overfished areas. Whole-stock target reference points that may be required under the current national standards can not prevent localized overfishing. In some cases, where a substantial proportion of the stock is not fished either due to management measures (as is the case with sea scallops) or because of toxicity issues (as with ocean quahogs), meeting the whole-stock fishing mortality target necessarily implies localized overfishing in the fished areas.

Area management is typically required for proper management of sedentary stocks. For example, the Canadian Bay of Fundy sea scallop stock is divided into a number of “scallop production areas” (SPAs) based on depth and the fishing fleet that traditionally has exploited the area. Each SPA can be assigned its own target reference points and fishing quota, thereby obtaining near-optimum yield from each area. Rotational fishing, as used in the U.S. sea scallop fishery, is another way of alleviating the effects of spatial variability on yield.

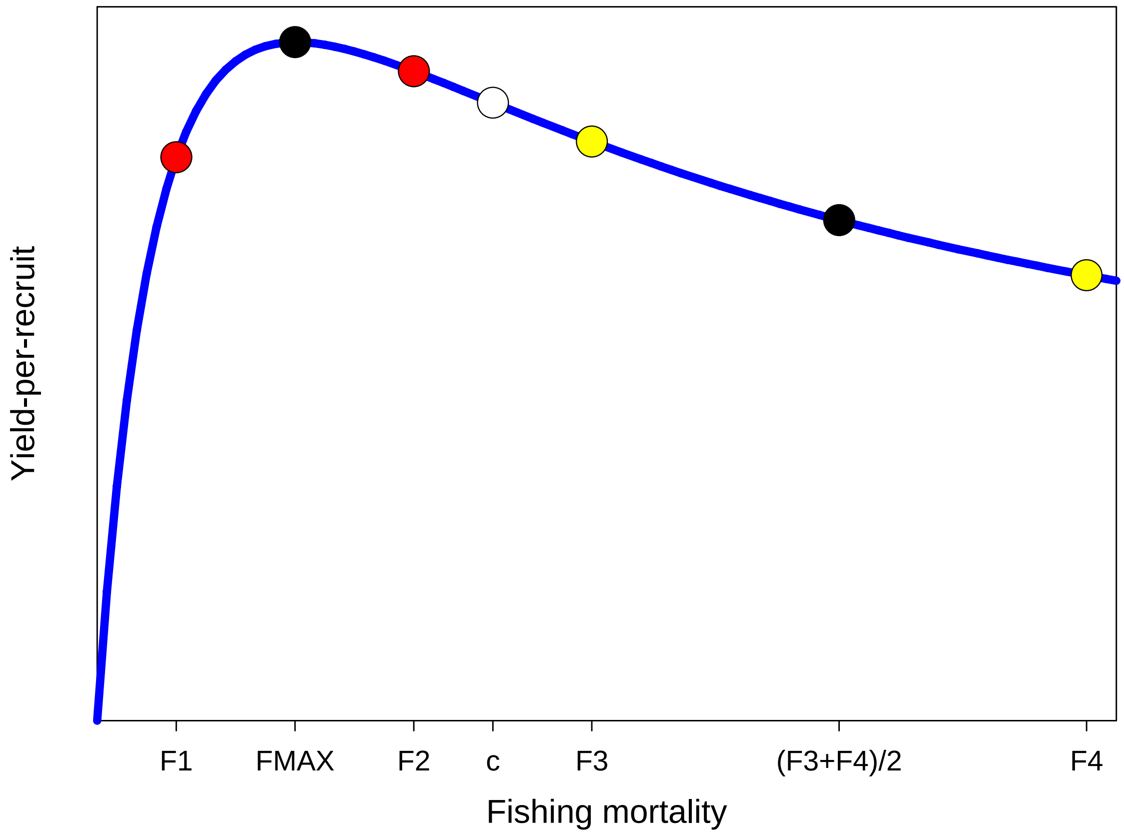

Figure 9. Effect of various levels of fishing mortality on yields of Atlantic sea scallops.

Case Study: Petition to Reclassify Two "Subpopulations" of the Loggerhead Turtle (*Caretta caretta*) as Distinct Population Segments

Barbara Schroeder
Office of Protected Resources

The loggerhead turtle (*Caretta caretta*) was listed as threatened throughout its global range in 1978. The species is found circumglobally, primarily inhabiting temperate and subtropical benthic and pelagic habitats. Nesting occurs primarily on subtropical and temperate mainland and island beaches. Analyses of mtDNA show that adult females exhibit natal homing (returning to nesting beaches where they were hatched). Juveniles, adult males, and non-nesting females from different nesting assemblages regularly mix at foraging grounds. Analyses of nDNA indicate that males provide an avenue of gene flow among nesting assemblages.

The southeast United States provides nesting habitat for one of the largest, globally significant nesting assemblages, with nesting primarily occurring from North Carolina through the panhandle of Florida. Four "subpopulations" have been identified within this nesting assemblage, based on mtDNA analyses. Two of these subpopulations, the "northern nesting unit" and the "Florida panhandle nesting unit" (Figure 10) were the subject of a 2002 listing petition. The petition requested that NMFS and FWS (sea turtles are jointly listed) reclassify the northern and Florida panhandle nesting units as DPSs and list them both as endangered.

NMFS and FWS issued a 90-day finding indicating that the petition presented substantial scientific information indicating that the petitioned action may be warranted. The Services then jointly conducted a formal review under the DPS policy, with the first step focused on the question of discreteness. As required by the DPS policy, discreteness may be determined under one or more criteria. A summary of our evaluation under each of these criteria follows:

Delimited by international governmental boundaries

- Petitioned 'units' did not meet this criterion.

Markedly separated from other populations of the same taxon by physical, physiological, ecological , or behavioral factors.

- Genetic factors, based on mtDNA and nDNA findings differed. The mtDNA analyses supported discreteness among the nesting units (indicative of natal homing) however, there were differences among analyses with regard to specific findings of genetic independence among the nesting units. Increased sampling at additional nesting beaches resulted in a more complex genetic picture with somewhat conflicting results. Preliminary nDNA analyses showed no substantial subdivisions across the nesting units suggesting that males breed with females from other nesting units, including their own.

- Several physiological and ecological factors were examined as possible indicators of marked separation including the annual variability in nesting within and between nesting assemblages, hatchling sex ratios among nesting assemblages, genetic composition of non-nesting distribution of individuals from the four nesting assemblages, the genetic composition of adult females on foraging grounds, and nesting female body size among the nesting assemblages.

While the lines of evidence examined indicated the identified nesting assemblages were discrete to some degree, the Services determined that the separation was not highly rigid and the assemblages were not markedly separated. Despite finding that the petitioned action was not warranted (*i.e.*, the northern and Florida panhandle nesting assemblages were not discrete and did not qualify for reclassification as DPSs), the Services did find that these nesting assemblages are critical components of the overall southeast United States nesting aggregation. Each nesting assemblage is interdependent for the overall species survival and recovery. The Recovery Team for the U.S. Atlantic Populations of the Loggerhead is revising the current recovery plan and is considering the various nesting assemblages as recovery units.

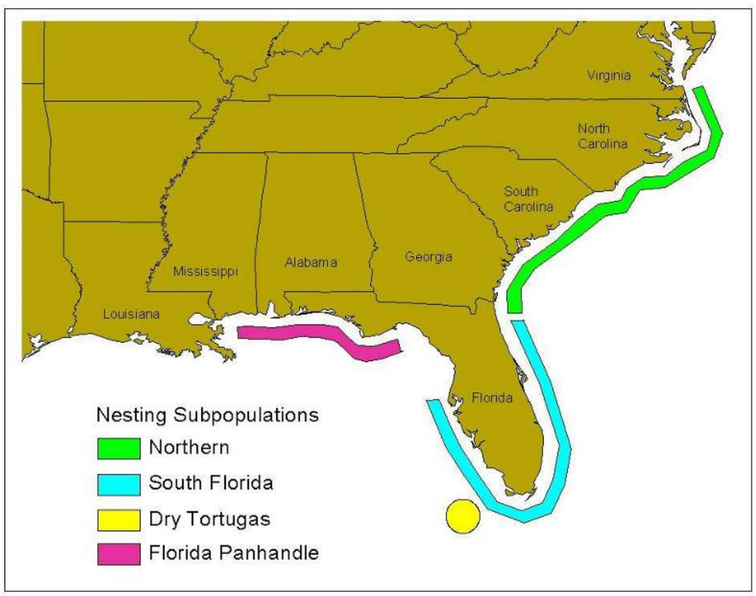

Figure 10. Location of nesting subpopulations of loggerhead sea turtles in the southeastern United States.

Humpback Whale: Gulf of Maine Stock Definition

Philip Clapham[1] and Richard Pace[2]
Northeast Fisheries Science Center

In the western North Atlantic, humpback whales feed during spring, summer and fall over a range which encompasses the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al.* 1992; Palsbøll *et al.* 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al.* 1995; Larsen *et al.* 1996).

Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Indeed, earlier genetic analyses (Palsbøll *et al.* 1995), based upon relatively small sample sizes, had failed to discriminate among the four western North Atlantic feeding areas. However, genetic analyses often reflect a timescale of thousands of years, well beyond those commonly used by managers. Accordingly, the decision was recently made to reclassify the Gulf of Maine as a separate feeding stock; this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. This reclassification has subsequently been supported by new genetic analysis based upon a much larger collection of samples than those utilized by Palsbøll *et al.* (1995). These analyses have found significant differences in mtDNA haplotype frequencies of the four western feeding areas, including the Gulf of Maine (Palsbøll *et al.* 2001). During the recent Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate stock for the purpose of management (IWC 2002).

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf. The objective of these surveys was to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys have now been compared to both the overall North Atlantic Humpback Whale Catalogue and a large regional catalogue from the Gulf of Maine (maintained by the College of the Atlantic and the Center for Coastal Studies, respectively); this work is summarized in Clapham *et al.* (2003). The match rate between the Scotian Shelf and the Gulf of Maine was 27% (14 of 52 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (26%, n=10 of

[1] Currently at the Alaska Fisheries Science Center
[2] Presented the paper

36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian Shelf, despite the additional distance of nearly 100 nautical miles (one whale was observed in both areas). In contrast, all (36 of 36) humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling effort in other regions in recent years. Overall, while it is not possible to define the Gulf of Maine population by drawing a strict geographical boundary, it appears that the effective range of many members of this stock does not extend onto the Scotian Shelf. Further work on the Scotian Shelf was conducted in August 2002 and August 2003; this sampling extended further north and east as far as the Laurentian Channel, and the results are expected to further clarify the issue of stock identity from this region. The very low match rate between the two sampled years (only one animal was resighted in the region in both 1998 and 1999) suggests that the Scotian Shelf is host to a larger population of humpback whales than was previously thought. However, preliminary analysis of photographs collected in 2002 and 2003 revealed a number of inter-annual matches; it is not yet clear whether a suitably precise abundance estimate can be calculated from these data.

In winter, whales from all feeding areas (including the Gulf of Maine) mate and calve primarily in the West Indies, where spatial and genetic mixing among subpopulations occurs (Clapham *et al.* 1993; Katona and Beard 1990; Palsbøll *et al.* 1997; Stevick *et al.* 1998). A few whales of unknown northern origin migrate to the Cape Verde Islands (Reiner *et al.*, 1996). In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank, on Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Whitehead and Moore 1982; Mattila *et al.* 1989, 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico to the coast of Venezuela (Winn *et al.* 1975; Levenson and Leapley 1978; Price 1985; Mattila and Clapham 1989).

It is apparent that not all whales migrate to the West Indies every winter, and that significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported 38 humpback whale strandings which occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas are becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data; Florida DEP unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is presently unknown.

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was recently investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (live or dead) were of sufficient quality to be compared to catalogues from the Gulf of Maine (the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (42.9%) matched to the Gulf of Maine, 4 (19.0%) to Newfoundland and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of recent photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground that is used by humpbacks for more than one purpose.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorus when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970's with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970's and early 1980's, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid 1980's, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased dramatically during 1992-1993, along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and the Northeast Peak on Georges Bank, and on Jeffreys Ledge; these latter areas are more traditional locations of herring occurrence. In 1996 and 1997, sand lance and, thus, humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, where an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

In early 1992, a major research initiative known as the Years of the North Atlantic Humpback (YONAH) (Smith et al. 1999) was initiated. This project was a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results from analyses of this ocean basin-wide study have helped elucidate much of the population structure pertaining to North Atlantic humpbacks. Abundant data collected at multiple geographic scales highlight the differences in establishing conservation management units to satisfy ESA versus MMPA. On the one hand, NA humpbacks are unequivocally panmictic among nearly all the major feeding areas. However, high feeding area fidelity together with our lack of knowledge relative to potential recolonization rates to vacant habitats suggests that the feeding area scale is more in keeping with the spirit of MMPA.

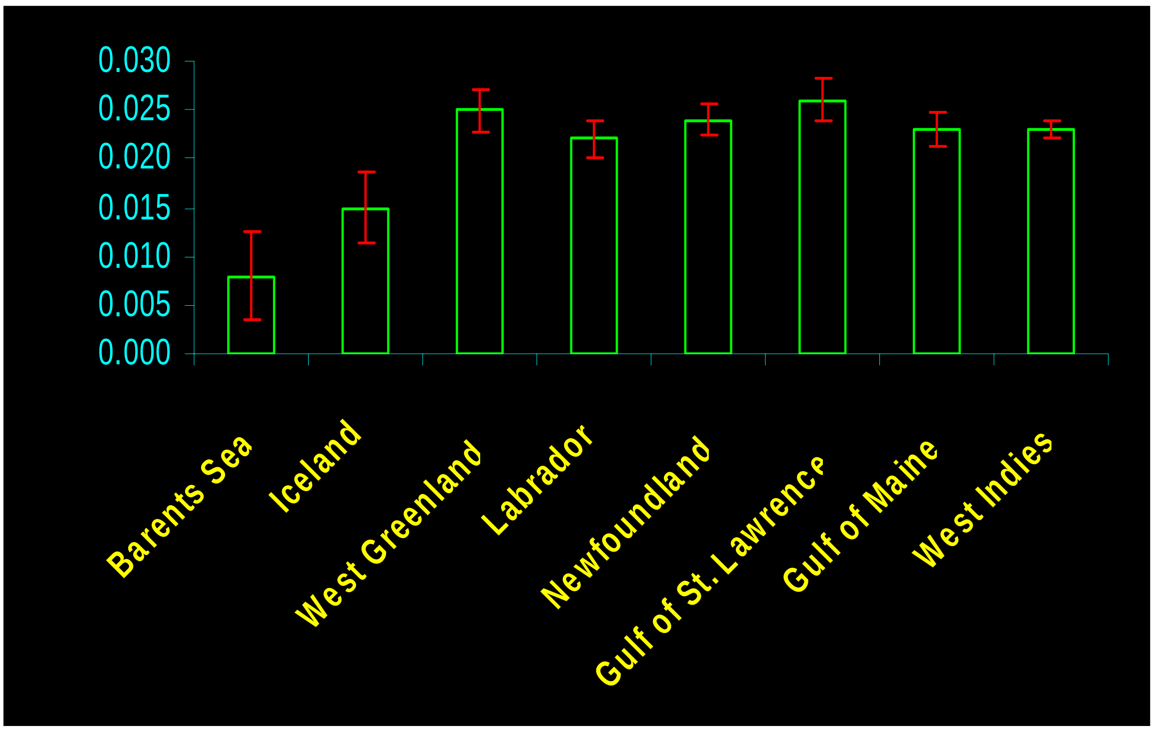

Figure 11. Nucleotide diversity within feeding aggregations of humpback whales in the Atlantic Ocean.

Pacific Salmon

Robin S. Waples
Northwest Fisheries Science Center

NMFS has ESA jurisdiction for the five species of Pacific salmon that occur in North America (Chinook, coho, sockeye, chum, and pink), as well as for steelhead, the anadromous form of rainbow trout. When the first petitions for ESA listing of Pacific Northwest salmon were filed in 1990, they invoked the provision in the ESA (Section 3(15)) that allows listing not only of taxonomic species and subspecies, but also DPSs of vertebrates such as salmon. At that time, neither of the agencies responsible for implementing the ESA (FWS and NMFS) had developed formal guidance for how to interpret the DPS provision in the ESA. A joint workshop was held with FWS in 1990, with the objective of developing an overall framework for DPS considerations by both agencies. It was expected that the NMFS policy on salmon would be consistent with this overall policy but provide more specific guidance for salmon. However, the joint policy soon stalled within FWS, while the clock continued to tick on the one-year deadline for response to the salmon petitions. Because of the pressing need for guidance on how to consider the DPS question for salmon, and because of the unusual biological attributes of these species, NMFS concluded that it needed to develop a DPS policy for Pacific salmon. To address this need, Waples (1991) developed a framework that stipulated that a salmon population (or group of salmon populations) would be considered a DPS if it represents an ESU of the taxonomic species. According to this framework, a population unit must satisfy two criteria to be considered an ESU: 1) reproductive isolation, and 2) evolutionary significance. These criteria capture two common meanings of the word 'distinct': "separate, or apart from" (reproductive isolation); and "unique, or distinctive" (evolutionary significance). Isolation does not have to be absolute; it only has to be strong enough to allow evolutionarily important differences to accrue in different units. The "significance" criterion is met if the population unit contributes substantially to ecological/genetic diversity of the species as a whole—that is, to its evolutionary legacy. Waples (1995) defined the evolutionary legacy as "genetic variability that is the product of past evolutionary events and that represents the reservoir upon which future evolutionary potential [of the species] depends."

NMFS adopted Waples' ESU approach for salmon as a formal policy in 1991 (FR 56, 58612, 20 November 1991). After dealing with the initial petitions, NMFS proactively initiated a series of comprehensive status reviews (FR 59, 46808, 12 September 1994) and used the policy framework to identify ESUs in all seven species of Pacific salmon from Washington, Idaho, Oregon, California, and parts of southern British Columbia (Weitkamp et al., 1995; Hard et al., 1996; Busby et al., 1996; Gustafson et al., 1997; Johnson et al., 1997, 1999; Myers et al., 1998). Reviewing a broad geographic range provided a context for interpreting local patterns of variation, and applying the same approach across seven species provided opportunities to learn from congruent patterns of relationships, as well as species-specific ones. A great deal of molecular genetic data are available for Pacific salmon, and these data, together with information from tagging studies and inferences about natural barriers, were the primary factors used to assess reproductive isolation. Traits that are evolutionarily significant must have a genetic basis and be adaptive or at least potentially adaptive, so life history variation was carefully evaluated for the second ESU criterion. However, since most life history traits can be affected by environmental as well as genetic factors, ecological features of the habitat (as a proxy for different selective regimes) were also considered important. Molecular genetic data are generally thought to reflect neutral (non-selective) differences and thus were considered relevant to the second criterion only if the differences were substantial enough to lead to the presumption that adaptive differences had developed.

Pacific salmon have a complex population structure and most species exhibit several hierarchical levels of diversity between the entire species on one hand and a local breeding population on the other. For example, in Oncorhynchus mykiss (steelhead/rainbow trout), eight separate hierarchical levels have been identified on the Oregon Coast, each of which potentially represents a biologically suitable unit for the focus of conservation units (Waples 2006). NMSF has defined ESUs of Pacific salmon at a scale intermediate to these two extremes, with the result that each ESU typically contains 20-30 or so of what most people would agree are separate populations or stocks. In contrast, it appears that most other published ESU frameworks would be more likely to identify units at either the local population or the species level (Waples 2006).

NMFS has identified over 50 ESUs in the 6 species of anadromous Pacific salmonids, and about half of these are currently listed as threatened or endangered “species” under the ESA. One of the first steps in formal ESA recovery planning for salmon is to identify DIPs within ESUs. These populations are the logical units for evaluating viability, which is done using the Viable Salmonid Populations framework described by McElhany et al. (2000).

Almost all listed salmon ESUs have hatchery fish associated with them. NMFS evaluated the ESU status of each hatchery population using the same criteria described above and determined many to be part of the listed ESUs. However, most of these hatchery populations were not listed, because doing so would not provide any conservation benefit but would create more regulatory burden for everyone. In 2001, a court ruling (Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, D. Oreg. 2001) held that this approach is not permissible because the smallest unit that can be listed under the ESA is a distinct population segment, and NMFS had listed only part of most salmon DPSs. As a consequence, NMFS revised its hatchery listing policy (70FR 37204; 28 June 2005) and the Biological Review Team (BRT) updated its assessments of the status of all listed salmon ESUs (Good et al. 2005).

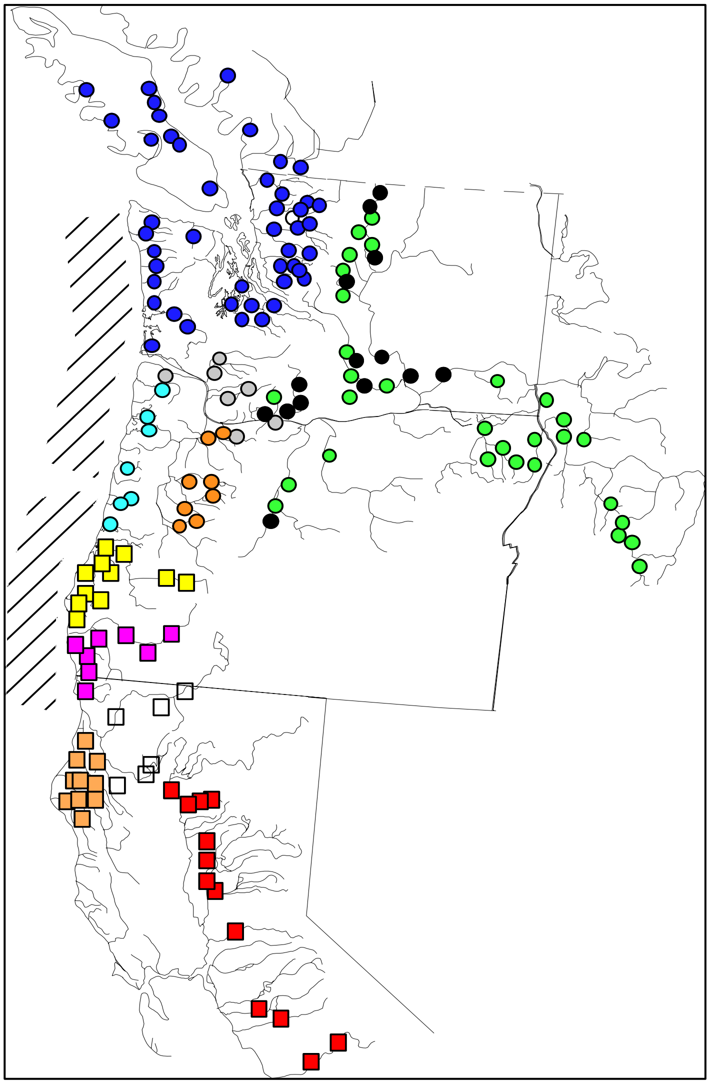

Figure 12. Genetic stock identification of juvenile chinook salmon (D. Teel, NMFS, unpublished data).

Delineation of an ESA Distinct Population Segment
Incorporating Cherry Point Pacific Herring

Richard G. Gustafson
Northwest Fisheries Science Center

Pacific herring that spawn at Cherry Point, near the USA-Canada border, were examined for possible listing under the ESA as a DPS. Although Cherry Point Pacific herring spawner biomass has more than doubled since 2000, the population biomass has declined by 87% since 1973. In 2004, this decline led organizations to submit two petitions to NOAA Fisheries to list the Cherry Point stock of Pacific herring as a DPS under the ESA. NOAA Fisheries determined that the second petition presented substantial information to suggest that listing may be warranted. A previous Pacific herring status review, completed in 2001, was initiated in response to a 1999 petition to list all Pacific herring in Puget Sound as a DPS. The 2001 status review concluded that Pacific herring stocks in Puget Sound do not constitute a DPS and identified a Georgia Basin Pacific herring DPS consisting of inshore stocks from Puget Sound (including Cherry Point) and the Strait of Georgia.

In 2004-05, a newly formed Pacific herring BRT examined the DPS question for Cherry Point Pacific herring and concluded that it is a “discrete” population under the provisions of the joint agency DPS policy; however, there was no support on the BRT for a finding that Cherry Point Pacific herring were “significant” to the taxon of Pacific herring as a whole, under the provisions of the DPS policy. The BRT identified multiple characteristics that distinguish the Cherry Point population as discrete from other local herring populations, including: locally unique spawn timing; an unusual, relatively exposed spawning location; discrete microsatellite DNA allele frequencies; and physiological factors such as unusual growth rate characteristics for the locality and differential parasite incidence, otolith microchemistry, and accumulation of toxic contaminants that were indicative of disparate rearing conditions compared to Pacific herring in Puget Sound proper. These discrete population differences were contrasted with data from other Pacific herring, both regionally and throughout the biological species’ range across the North Pacific Ocean, in order to evaluate the “significance” of the Cherry Point population to the taxon as a whole. Significance criteria articulated in the DPS policy that were identified as pertinent to the individual Cherry Point situation included the population’s persistence in an ecological setting that is unusual or unique for the taxon, the population’s marked differentiation from other populations of the taxon in its genetic characteristics, and other information that might bear on biological and ecological importance to the taxon as a whole. Evidence that supported the BRT’s conclusion that the discrete Cherry Point herring population was not “significant” included the observation that other Pacific herring stocks with unusual spawn timing for their area was not exceptional and that a number of other Pacific herring stocks also spawn on fairly exposed coastlines of inshore waters in the Pacific Northwest. The BRT interpreted the microsatellite genetic data as evidence that some Pacific herring sampling sites were somewhat demographically isolated from each other, but concluded that this level of divergence could not be characterized as differing “markedly from other populations of the species in its genetic characteristics.” In general, the genetic studies suggested that Pacific herring are characterized by high levels of gene flow among populations across fairly large geographic areas, consistent with the results of extensive physical tagging studies, which also indicated that widespread straying can occur among spawning localities.

The BRT concluded that Cherry Point Pacific herring were a component subpopulation of the Georgia Basin Pacific herring DPS, as described in the previous 2001 ESA status review. As currently defined, the Georgia Basin Pacific herring DPS encompasses spawning locations of Pacific herring in all the marine waters of Puget Sound, the Strait of Georgia, and eastern Juan de Fuca Strait in both the U.S. and Canada. In coming to this decision the BRT noted that the ecological discreteness of the Georgia Basin (the inshore waters of Puget Sound and the Strait of Georgia) and concordance of age composition of Pacific herring among the Strait of Georgia and Puget Sound locations provided support for this decision.

Finally, the BRT noted that available information (genetics, life history, and tagging studies) suggests that population structure of Pacific herring roughly conforms to the “mixed structure” concept of a metapopulation, in which local subpopulations are linked demographically by at least episodic migration, extinction and recolonization of local subpopulations are common over ecological time frames, and some populations, such as Cherry Point, are relatively more distinctive, based on spawn timing, growth rate, contaminant profiles, and genetic differences. These differences are not of a magnitude that suggests long-term evolutionary divergence, but it is possible that demographic linkages between Cherry Point and other subpopulations in the DPS are weak enough that they are largely demographically independent on ecological time scales.

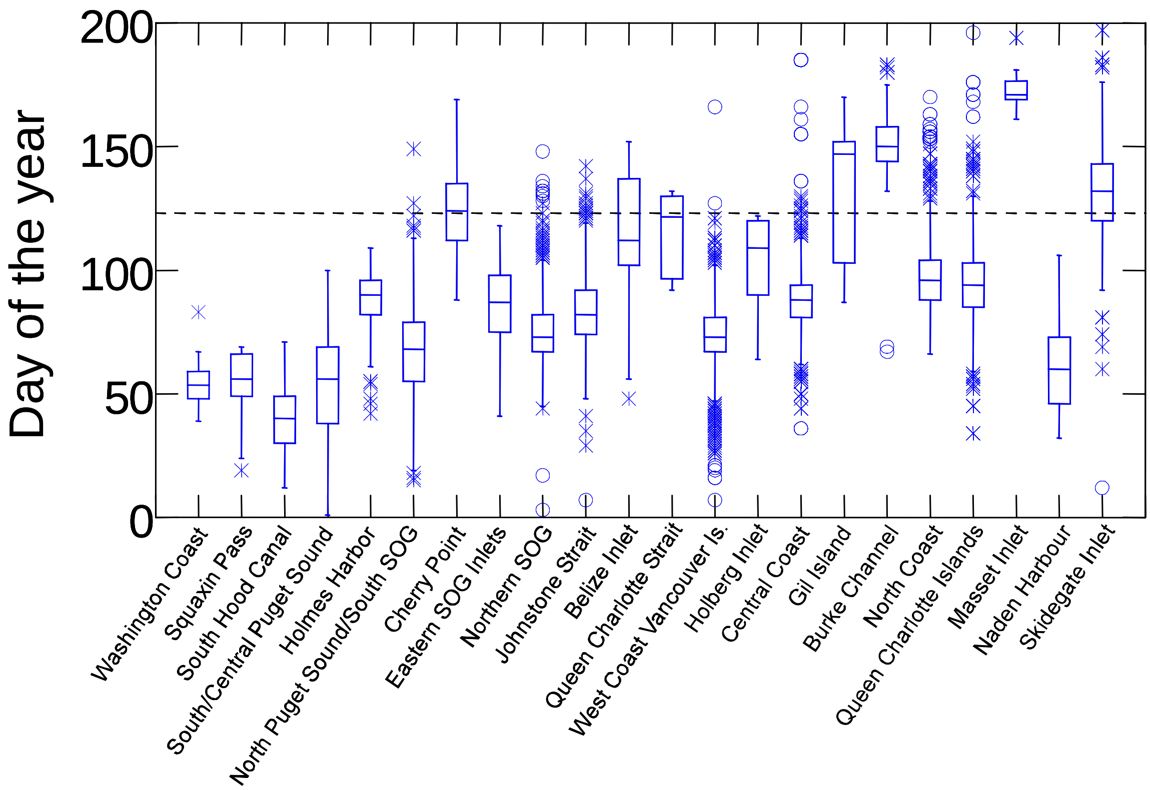

Figure 13. Spawning times of Pacific herring.

Distinct Population Segments of North American Green Sturgeon

Steve Lindley
Southwest Fisheries Science Center

In June 2001 NMFS received a petition to list North American Green Sturgeon (*Acipenser medirostris*) as a threatened or endangered species under the ESA. Green sturgeon are anadromous and are thought to return to their natal river for spawning. Fidelity to natal breeding sites can generate biologically important structure within species. The petition noted that stock structure in this species is not well described, and there may be more than one DPS within this species. NMFS convened a Biological Review Team (BRT) to review and interpret the best available information on the species to (1) recommend whether there was one or more DPSs within the species and (2) describe the risk of extinction for listable entities identified in the DPS analysis. The BRT reviewed information on population genetics (microsatellite DNA) and movements and breeding-site fidelity (from tagging studies). The genetics information indicates that there are at least two distinct groups of green sturgeon within the species. Allele frequencies in the Klamath River were very similar to those in the Rogue River, and significantly different from those in San Pablo Bay. However, these two groupings were significantly different from one another (Israel et al. 2004).

Tagging studies (Figure 14) suggested little movement among breeding sites, but extensive mixing of populations in some non-natal habitats.

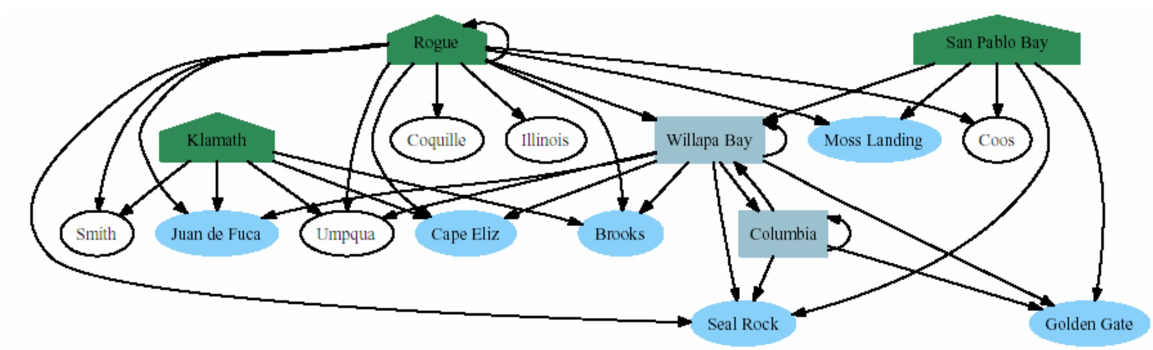

Figure 14. Movements of North American green sturgeon along the west coast of the North America. Arrows indicate movement from site of tagging to another area; green pentagons are spawning rivers, white ovals are non-natal rivers, light blue ovals are locations in the Pacific Ocean, and blue-grey rectangles are large estuaries.

Sturgeon have strong homing tendencies, which lead to high spawning site fidelity. Thus, isolation provides another argument supporting two DPSs of green sturgeon. A graphical representation of breeding site rivers (Figure 15) shows the Sacramento River is well separated from the more northern rivers; however, the northern rivers (Rogue, Klamath, and Eel) are relatively close together.

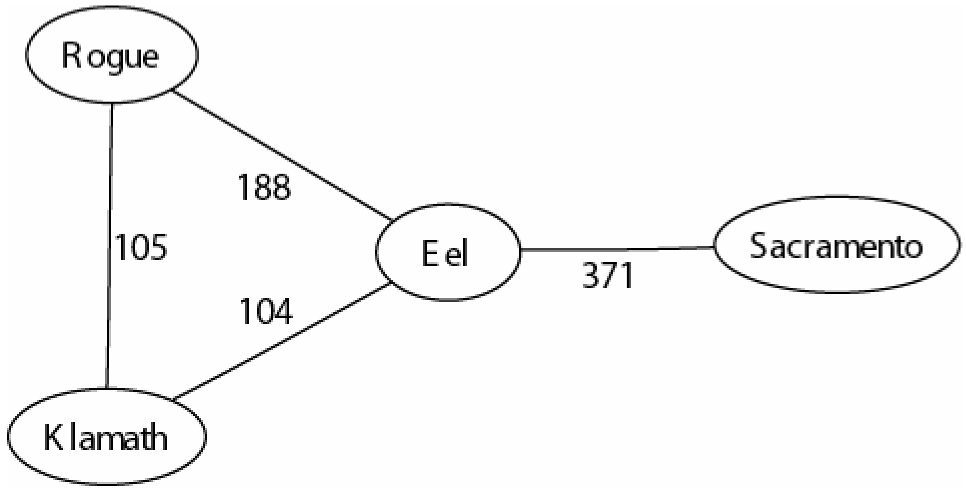

Figure 15. Graphical representation of breeding site rivers for North American green sturgeon (distances among rivers are km).

If green sturgeon dispersal differences are large (>370 km) then the graphical analysis suggests that there would be only one breeding population. Dispersal distances of less than about 100 km would indicate four different breeding populations.

The BRT concluded that the best available scientific evidence indicated there were at least two discrete groupings within the species, based on neutral genetic maskers, limited migration among spawning sites, the distances among the spawning areas, and that each of these discrete units is biologically significant to the species. NMFS concluded that there were two DPSs of green sturgeon; the Northern DPS included breeding groups in north of the Eel River, and the Southern DPS included green sturgeon breeding in the Sacramento River system.

Harbor Porpoise, Pacific Coast Stocks and Harbor Seals in Alaska

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Southwest Fisheries Science Center

Identifying the intersection of biological principles with statutory requirements is necessary for stock definition. Species with "discrete" biology fit more easily with "discrete" management definitions, but continuous distributions are most common for marine species and present a difficult case for successful management. We present two cases of continuous distributions: harbor porpoise and harbor seals. Both range roughly from California to Japan in all coastal waters with no clear gaps in their distribution. Both have tagging data indicating home ranges that are small relative to their large range within the North Pacific Ocean basin so a hypothesis of panmixia is biologically highly implausible. Nevertheless, it is likely that a stock boundary drawn anywhere within the range will have individuals that regularly cross back and forth.

Harbor porpoises are continuously distributed with non-uniform density, are non-migratory, have small group size, but exhibit differences in pollutant ratios, habitats and genetics. An expanded genetic study using both nuDNA and mtDNA revealed more structure. As information has increased on harbor porpoise off of California, Oregon and Washington the stock boundaries have been refined by the agency with the support of the Scientific Review Group (SRG) without controversy. The SRGs were created in the 1992 revisions to the MMPA to review the science produced and used by the agency to implement the MMPA.

Harbor seals are also continuously distributed with non-uniform distribution, are mostly non-migratory, and exhibit clinal differences in coat color, skull morphology, pupping timing, and geographic differences in trends in abundance, habitat and haul-out substrate. The 12 defined management units generally agree with trends in abundance and movement (see Figure 16). Revising stock structure in Alaska has been complicated by declines (past and on-going) and user groups that could be affected by changes, such as Alaskan natives that subsistent hunt the seals and fisheries that kill seals as bycatch. No revisions have been made to the original three stock boundaries (dashed lines in Figure 16) despite multiple lines of evidence supporting additional stock structure within each of the defined stocks. These case studies illustrate that whenever possible stock structure should be researched before management issues arise.

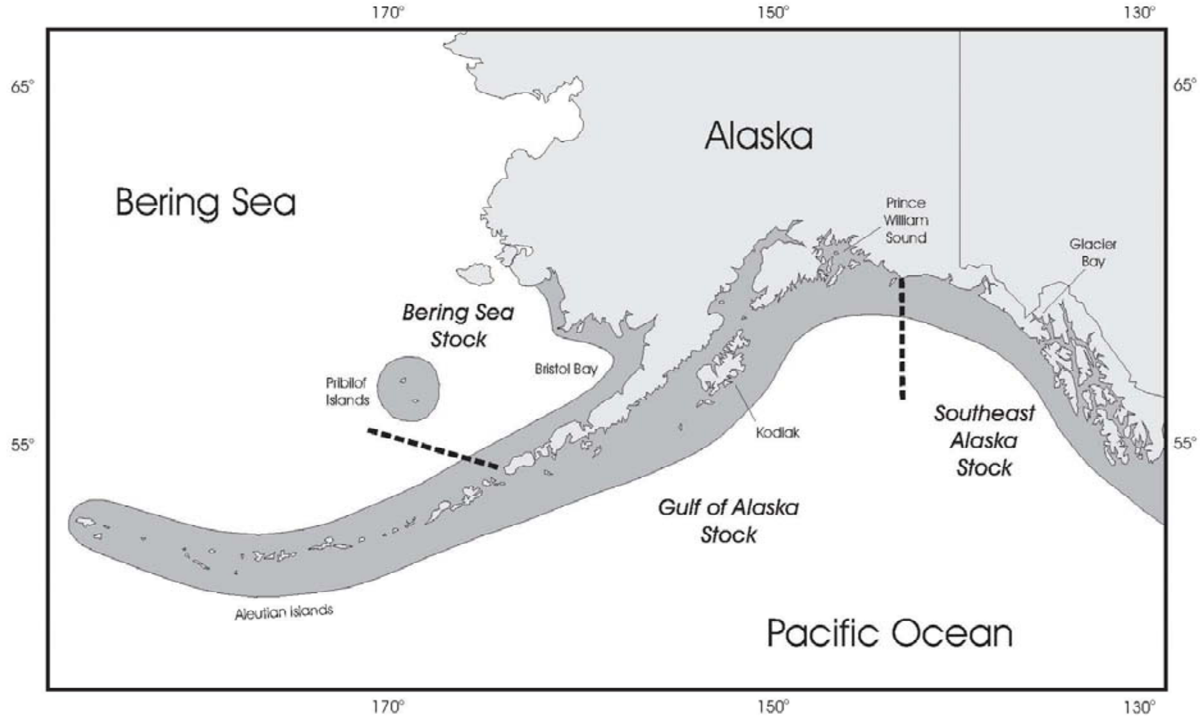

Figure 16. Genetic strata consistent with demographic independence (black circles), areas surveyed for trends in abundance (colored circles) and current stock boundaries for Alaskan harbor seals.

Defining Stock Structure of Coastal Bottlenose Dolphins, *Tursiops truncatus*, along the Atlantic Coast of the U.S.: A Multidisciplinary Approach

Aleta A. Hohn, Patricia E. Rosel, and Larry J. Hansen
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Bottlenose dolphins, *Tursiops truncatus*, are continuously distributed in coastal waters from New York through Florida and are found in multiple habitat types, including coastal and inshore-estuarine areas. The original stock assessment for this region, implemented in 1994, delineated a single coastal migratory stock. However, alternative hypotheses about stock structure exist- including multiple migratory populations, the presence of resident estuarine populations, or a combination of these hypotheses. The MMPA requires that assessments of abundance and human-caused mortality be stock specific. Therefore, evaluating these possible stock structure hypotheses is a critical component of the stock assessment for coastal bottlenose dolphins in the Atlantic. A multidisciplinary research approach was initiated and included photo-identification, genetics, stable isotope ratios and telemetry methodologies. Comparison of seasonal mixing among coastal animals in various locations and determining whether estuarine stocks exist and how much, if any, mixing occurs between coastal and estuarine animals at the same latitude and among estuarine populations at different latitudes were all necessary. Genetic information provided evidence of population structure for coastal bottlenose dolphins. Significant differences in isotope ratios showed promise for distinguishing between animals that inhabit estuarine versus coastal waters. Tagging data provided further support to reject the null hypothesis of a single coastal migratory stock. In conclusion, the single stock hypothesis was rejected. Instead, the population structure of coastal bottlenose dolphins is quite complex and a minimum of five populations are currently delineated on the basis of gene frequencies, supported by photo-identification and telemetry. A seasonal component to stock structure adds additional complexity and results in mixed stocks in some areas and times and further work is needed to tease apart this complicated population structure.

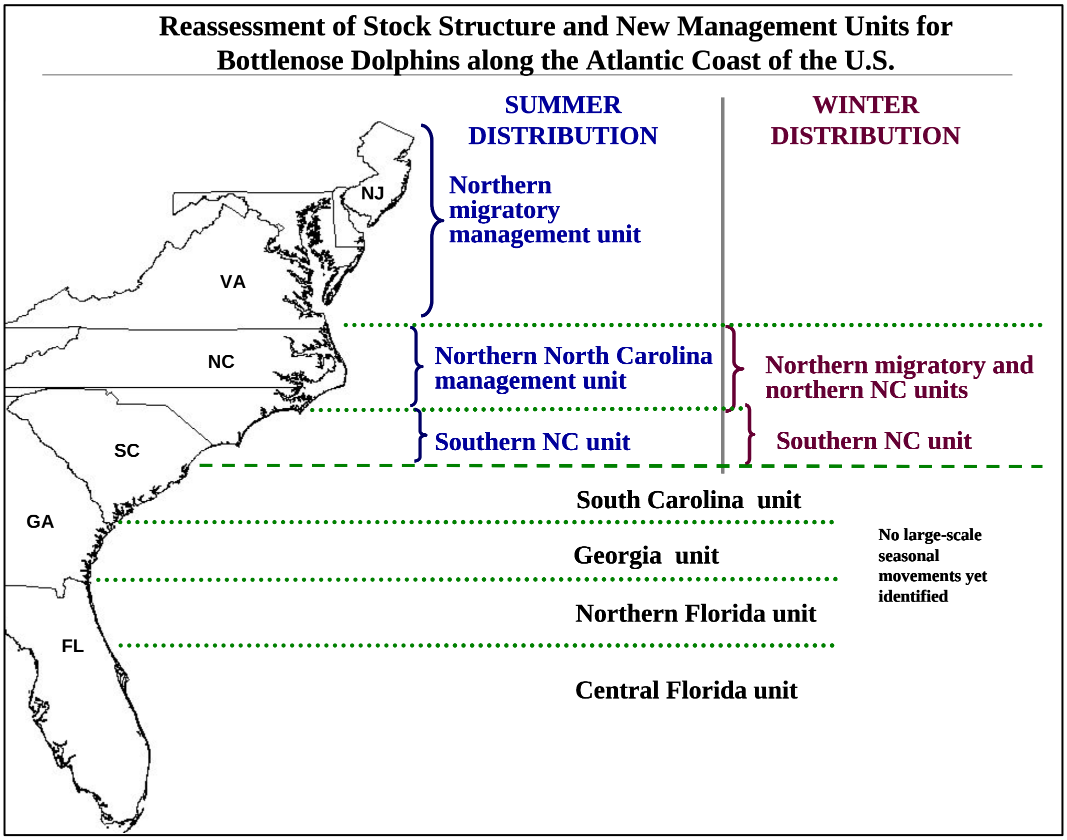

Figure 17. Seasonal ranges of provisional coastal bottlenose dolphin management units along the Atlantic coast as defined in the 2005 Stock Assessment Report.

Killer Whales

Paul Wade
Alaska Fisheries Science Center

Killer whales (*Orcinus orca*) are top level predators inhabiting all oceans of the world. Within the North Pacific Ocean, three forms or ecotypes of killer whales are recognized (Transient - mammal eaters; Resident – fish eaters, and Offshore). Differences among these forms and within residents and transients have been investigated using several lines of evidence, including genetics (mitochondrial and nuclear DNA), morphology (dorsal fin and saddle patch [Figure 18]), behavior (movements and associations, diet, acoustics, etc.), and chemistry (fatty acids and polychlorinated biphenyls).

Figure 18. Examples of dorsal fins and saddle patches of resident, transient and offshore killer whales.

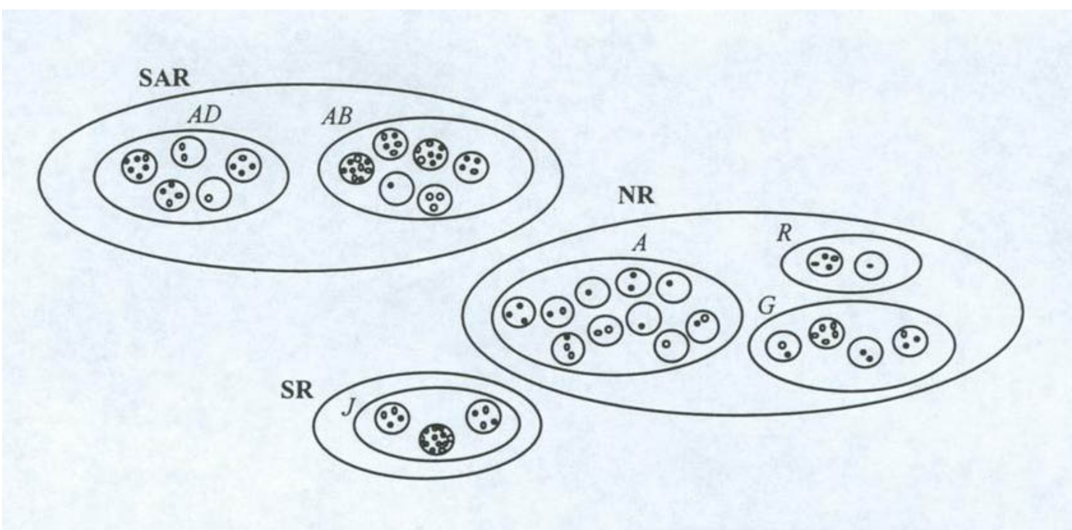

Figure 19. Hierarchical population structure in resident killer whales. The outer ellipses depict sub-populations (each has been recognized as a population stock under the MMPA), the inner ellipses clans, the larger circles pods, and the smaller circles matrilines. NR, SAR, and SR refer to the northern resident, southern Alaskan resident, and southern resident subpopulations, respectively.

Resident forms of killer whales have been well-studied and demonstrate fine-scaled population structure (Figure 19). NMFS received a petition to list Southern Resident killer whales under the ESA. A BRT convened to advise NMFS noted that Southern Resident killer whales are discrete from other groups of killer whales and are likely to be a DPS only if Northern Pacific Residents are the taxon of reference in the analysis for significance. NMFS determined that the global species was the reference taxon and did not list Southern Resident killer whales as a species under the ESA. That determination was overturned in court, which noted that NMFS could not accept the single species as the best available information because it was wrong. In 2004, the BRT was reconvened and recommended that Southern Resident killer whales should be recognized as a DPS, with evidence for its significance including their occupation of a unique ecological setting, their loss would result in a significant gap in the range of North Pacific Residents, and they differ markedly from other North Pacific residents in their genetic characteristics.

Under the MMPA, NMFS recognizes eight stocks of killer whales in the Eastern North Pacific Ocean. These include three resident stocks (Alaska Resident, Northern Resident, and Southern Resident), three transient stocks (Gulf of Alaska/Aleutian Islands/Bering Sea Transient, AT1 Transient, and West Coast Transient), one offshore stock, and a Hawaii stock.

Discussion Sessions

Workshop participants held a large-group discussion about conservation units and meaning of various terms under the statutes, especially the ESA. These discussions included a participant’s view of management units under the ESA indicating that management involves a wide range of units from entire species to individual. Following this discussion, workshop participants agreed that the ESA applies to various levels of organization below the DPS level; however, the guidance from NMFS leadership suggested emphasis on aggregations or groups of individuals that could be listed under the ESA. Accordingly, remaining discussion on conservation units under the ESA workshop participants agreed that the purpose of the workshop, with respect to the ESA, was limited to species, sub-species, or DPS.

Workshop participants then divided into breakout groups to discuss two topics. In the first session, three groups were identified, based upon the statutory program (MSA, ESA, or MMPA). Although many individuals conducted program activities on more than one statute (with a blending of ESA and MMPA more likely than MSA with one of the other two statutes), participants were asked to select the program in which they had done most of their work. Each working group was to assess how well guidelines for identifying conservation units supported NMFS' mission under the statute.

In the second session, participants were divided again into three groups to discuss the workshop objective to understand how activities under one statute could inform decisions related to the structure of conservation units of another program. In this session, participants were to discuss linkages or common themes under the statutes and how identification of conservation units under the primary statutes contributed to NMFS' ecosystem approach to management.

<u>Statute-specific Discussions</u>

In this session, participants were divided by their statute (MSA, ESA, or MMPA) of expertise or most experience. The three groups were asked to address three questions:

1. Do the guidelines meet the requirements of the Act?
2. Do the guidelines go far enough?
3. Is the language in the guidelines clear enough?

Magnuson-Stevens Act Group

Three questions were posed to the breakout group:

1. <u>Do guidelines meet requirements of the act?</u>
    a. The breakout group felt that the guidelines adequately address the “*unity of management*” requirement in NS3, particularly in the context of interjurisdictional resources.

    b. However, guidance on stock identification that should be considered in the implementation of other requirements of the Act (e.g., National Standard 1) is not met by the guidelines.
2. <u>Do they go far enough?</u>
    a. The group agreed that more guidance is needed to promote consistency and application of "*the best scientific information available*" for stock identification. For example, the term 'stock' is not defined in the guidelines. The term 'management unit' is not in the Act and only adds confusion to definitions of 'fishery' and 'stock.'
3. <u>Is the language clear enough?</u>
    a. There was consensus in the group that the guidelines were not clear enough, particularly with respect to confusion about the use of 'fishery,' 'stock,' and 'management unit.'
    b. The group proposed that:
        i. A FMP unit should include a collection of fisheries and stocks that benefit from closely coordinated management.
        ii. The 'management units' section of NS3 guidelines should be replaced with a section on "stocks and coordinated management" that promotes close coordination of all fisheries that harvest the same stocks, even those crossing regional or international management boundaries.
        iii. The terms fishery and stock are used interchangeably all too often. Guidance should be provided to clarify the distinction between the two terms:
            1. The term 'stock' should be defined as a conservation unit for which MSY and status determination can be appropriately determined.
            2. The term 'fishery' should be defined as the activity of fishing for a stock (or stocks) for which OY is determined. The group felt that these definitions will also improve clarity of NS1 guidelines.
        iv. Clarify the apparent contradiction of managing a stock "*throughout its range*" and defining a stock as a "*geographical grouping*."
        v. Guidance is needed for management of mixed-stock fisheries to avoid local depletion, while maintaining a consistent definition of the term 'stock.'

Relevant portions the Act and Guidelines are excerpted in Appendix 3a.

Endangered Species Act Group

After quickly deciding to tackle the differences between "significant portion of its range" and "distinct population segments" another day, this group spent most of its time discussing the meaning of "discreteness" in the joint NMFS/ FWS Policy on the Recognition of Distinct Vertebrate Population Segments under the ESA (DPS policy).

Does “discreteness” as described in the DPS policy equate to “reproductive isolation” as described in the NMFS Policy on the Definition of Species for Pacific Salmon under the ESA (ESU policy)?

Background on the development of the DPS policy

Marta Nammack provided background on how the DPS policy was developed. She said that John Fay of FWS developed a draft based partially on previous FWS attempts to develop policy. Nammack and Fay worked together to address issues raised by both agencies. Nammack coordinated reviews with the NMFS regions and science centers, and NMFS’ input focused on the desire to make this policy consistent with the ESU policy. During these discussions, it was clear that the first criterion of the draft DPS policy, “discreteness,” was intended to have the same meaning as the first criterion of the ESU policy, “substantial reproductive isolation.” And the second criterion, “significance to the taxon,” was intended to have the same meaning as the second criterion of the ESU policy, “important to the evolutionary legacy of the species.” The only difference is that a second factor can be considered to satisfy the first criterion in the DPS policy: delimitation by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist. Nammack noted that managers may choose to satisfy the “discreteness” criterion under the international governmental boundary factor, but based on her many years of experience working on the DPS policy and listing actions, substantial reproductive isolation is necessary for satisfying the first factor of the “discreteness” criterion (i.e., “markedly separated”).

“Discreteness” requires “substantial reproductive isolation”

The first factor of the “discreteness” criterion is: “It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.” The fact that the “markedly separated” language is followed with “as a consequence of physical, physiological, ecological, or behavioral factors” supports the view that “markedly separated” equates to “substantially reproductively isolated.” Physical, physiological, ecological, and behavioral factors are all considered mechanisms that lead to reproductive isolation. If two animals cannot breed because of physical distance, this can lead to reproductive isolation. Animals can also diverge physiologically enough so that, even if they are located in the same place: 1) they cannot interbreed; 2) their gametes will be infertile; 3) their zygotes will not develop; or 4) their embryos will abort. Animals that occupy different ecological niches are, in effect, reproductively isolated from each other. And if animals do not choose to mate with each other because of behavioral factors (e.g., not attracted to each other), then they will not reproduce successfully.

The ESA’s purpose of preventing extinction or irreplaceable loss means that genetic diversity needs to be preserved. This is the rationale for requiring a certain degree of reproductive isolation between populations before they can be recognized as DPSs.

Rationale for interest in alternate interpretation

This group had numerous participants who believed that populations do not have to be reproductively isolated in order to satisfy the "discreteness" criterion. This issue arose principally because some felt that we could protect some populations more easily if we could identify them as separate DPSs that could be listed separately under the ESA. The rationale was that providing the flexibility to list populations separately, even if they are not substantially reproductively isolated, would make sense for certain species (i.e., humpback whales, loggerheads). Others explained that these populations could be protected through other mechanisms, such as the section 7 consultation process and recovery units identified under a recovery plan, even if the populations are not listed separately. Those who supported greater flexibility argued that it would be easier to delist a population of a species of marine mammal than the entire species. However, others noted that only populations that are genetically independent should be listed or delisted as units. Otherwise, problems with sink/source dynamics could occur.

The group began discussing factors other than reproductive isolation that could be considered for satisfying "discreteness." Most members of the group believed that there may be other "sufficient conditions" for satisfying the discreteness criterion. Some stated that perhaps we could equate "discreteness" or "markedly separated" to DIPs by looking at taxonomy, geography, genetics, ecology, and demographics.

Work group on other "sufficient conditions" for satisfying "discreteness" criterion

Because of the interest among participants, a work group of this group met several times by conference call (after this workshop) to discuss whether substantial reproductive isolation was necessary to satisfy the "discreteness" criterion of the DPS policy. A summation of the work group's discussions is attached. The majority of the work group agreed that reproductive isolation is not a necessary criterion for "discreteness," stating that: (1) the DPS policy is clear in its intent that marked separation as a consequence of physical, physiological, ecological, or behavioral factors can fulfill the "discreteness" criterion in either the absence or presence of reproductive isolation;[3] and (2) the provision

[3] Nammack disagrees and notes that the DPS policy is not clear in its intent that marked separation as a consequence of physical, physiological, ecological, or behavioral factors can fulfill the "discreteness" criterion in either the absence or presence of reproductive isolation. As discussed earlier, because of the "as a consequence" language, substantial reproductive isolation is necessary before the "discreteness" criterion can be satisfied (except for the international governmental boundary factor, which is a special case).

Post-workshop discussions with FWS staff indicate that FWS still considers "discreteness" to mean "substantial reproductive isolation." In fact, there is some discussion at FWS of the possibility of revising the DPS policy to require more genetic differentiation between populations before they can be considered DPSs. To date, both agencies have required populations to be substantially reproductively isolated from each other before qualifying regarding international governmental boundaries clearly establishes that reproductive isolation is not a requisite condition for "discreteness." Instead of developing other "sufficient conditions" that might satisfy the "discreteness" criterion, as initially charged, the work group members agreed that the language in the DPS policy already provides adequate guidance and flexibility for delineating DPSs. While the majority of the work group believed that the DPS policy does not require population "discreteness" to coincide with independent risks of extinction, others in the work group disagreed, stating that a listed organism should be an independent entity (i.e., not dependent on input from other members of the same species outside of the population for long-term viability). This latter argument is supported by the fact that independence is necessary in order to manage the recovery (as well as the other legal mandates outlined in sections 4, 6, 7, 9, and 10 of the ESA) of these taxa.

Significance criterion of the DPS policy

The group then moved on to a discussion of the "significance" criterion of the DPS policy. What does it mean to have a "significant gap in the range" of a species, and would the fact that the loss of a particular discrete population would result in a significant gap in the range of a species be important enough to support a separate DPS? This factor under "significance" seems to be overused. We have supported identification of a DPS in the northern or southern extreme of a species' range by stating that its loss would represent a significant gap in the range of a species.

Also, how should "time" play into how significant or discrete a population is? Some believe that evolutionary timeframes of separation are appropriate for assessing whether discrete populations are significant to the taxon. Others believe that the time required for separation can be much shorter (e.g., a hydropower dam that has separated populations for 100 years). In general, we have tried to think in terms of evolutionary timeframes, as we do when applying the ESU policy to Pacific salmon.

Other issues

The "sparingly" language in a 1979 House Report was discussed, and it was noted that Congress urged the two agencies to use the "distinct population segment" provision sparingly. Congress didn't want to see it abused, using the squirrels in a city park as an example of a "distinct population segment" that could be identified if the provision was used less than sparingly. Some participants argued that this was further rationale for interpreting the "discreteness" criterion to mean "substantial reproductive isolation."

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as "discrete" populations, with the exception of the instances in which the international governmental boundary factor of the "discreteness" criterion has been invoked. The DPS policy is a joint FWS/NMFS policy, and it is good practice to interpret the same policy in the same way in both agencies.

It was noted that the "significance" criterion of the DPS policy is assessed in relation to the taxon to which the population belongs, and this can be a taxonomic species or subspecies.

Regarding the definition of subspecies, it was noted that there is no good definition. Subspecies are identified and named, but there is no accepted set of criteria for determining whether a population or group of populations can qualify as a subspecies. Given this, it is a good idea to provide the rationale used to delineate a subspecies that isn't already recognized formally in the scientific community.

It was pointed out that flexibility considerations are not good rationale for changing the interpretation of a policy that has been clear, consistent, and defended against legal challenges in the past.

Some discussion attempted to differentiate among DPSs, DIPs, population stocks, and recovery units. This was discussed further by the full group of participants.

Marine Mammal Protection Act Group

Three questions were posed to breakout groups:

1. Do the guidelines meet requirements of the act?

Participants expressed strong concurrence that the existing guidelines for identifying population stocks of marine mammals met the requirements of the act. The guidelines have been a part of a larger set of guidelines for preparing marine mammal stock assessment reports for more than 10 years, with their initiation following the MMPA Amendments of 1994. Although the guidelines have been reviewed and modified twice (1997 and 2003), with emphasis in each review on stock identity, the modifications have been minor. The modifications resulting from these reviews clarified particular aspects of identifying population stocks of marine mammals and have not been a substantial change in the way stocks are identified.

2. Do the guidelines go far enough?

Participants felt the guidelines adequately addressed the considerations that must be given to a variety of biological information (or lack thereof) to identify stocks of marine mammals in a manner consistent with the purposes and policies of the MMPA.

3. <u>Is the language in the guidelines clear enough?</u>

Although the group felt that generally the marine mammal stock identity guidelines were clear, there were a few places where additional clarification would be warranted. These areas are as follows:

- Some managers and constituents have expressed concern that additional information generally leads to identification of increasingly smaller aggregations of marine mammals as stocks. Such smaller groups would make it increasingly difficult to correctly assign abundance and mortality to the appropriate stock, particularly when individuals from neighboring aggregations overlap in distribution. The group stated a goal for the stock identity guidelines, which is to define stocks well enough that abundance/mortality can be assigned correctly.

- When does identified statistical significance not mean separate biological stocks (e.g., bowhead whales)? The stock identity guidelines state that many different types of information can be used to identify stocks and that differences in this information indicate reproductive isolation, which, in turn, is proof of demographic isolation among different aggregations. Thus, when [statistical] differences are found in measures for these groups, separate management is appropriate. The group felt in general this guidance should continue to apply; however, they noted an exception where recent genetic analyses of bowhead whales indicate differences from older samples available from specimen archives. These differences were the result of the recent samples being collected from a much-reduced population (following over-exploitation of bowhead whales in commercial whaling operations), and these differences do not indicate additional stock structuring in the Western Arctic stock of bowhead whales. Therefore, additional clarification in the stock identity guidelines would be appropriate to advise that exceptions may be found for certain situations where statistical differences between samples do not necessarily indicate biological difference between aggregations.

- The existing guidelines note that our goal in identifying stocks of marine mammals is to identify demographically isolated (or independent) aggregations as separate stocks. The guidelines state, "Demographic isolation means that the population dynamics of the affected group is more a consequence of births and deaths within the group (internal dynamics) rather than immigration or emigration (external dynamics). Thus, the exchange of individuals between population stocks is not great enough to prevent the depletion of one of the populations as a result of increased mortality or lower birth rates."

  The choice for demographic isolation as the major criterion for identifying marine mammal stocks was based in large part upon the purposes and policies of the MMPA, which state that marine mammal stocks should not diminish beyond the point at which they cease to be significant functioning elements in the ecosystems in which they are a part. The MMPA's definition for population stock states that stocks are groups of marine mammals in common spatial arrangement that interbreed when mature. In some cases, such as where large whales form feeding aggregations based upon matrilines and breeding areas include interbreeding individuals from more than one feeding aggregation, these two concepts could be confused. Because the statutory definition of population is more important in a legal sense than inferences from purposes and policies statements, the guidelines should be modified to indicate that "demographic independence" is consistent with the statutory definition of population stock.

- The MMPA requires that stock assessment reports describe the geographic range of the affected stock, including any seasonal or temporal variation in such range. The geographic ranges of stocks are usually depicted by maps, with the ranges for various stocks delineated by lines on the map. In most cases, the ranges of different population stocks of the same species of marine mammal overlap at least seasonally. Such overlap is especially true in continuously distributed species, where individuals from one stock may be found at almost anytime within the range of the adjacent stock. The group indicated that the guidelines should be revised to indicate that any line drawn on a map should not be interpreted as a fail-safe separator between adjacent stocks of marine mammals. Rather, such lines indicate the general range of the affected stock of marine mammals, and a few individuals from adjacent stocks may cross the line at times.

- There was a mixed reaction in the group to a statement that the guidelines define or describe "demographic isolation" too loosely. The majority of members of the group were satisfied with descriptions of this term in the guidelines, and a minority said further clarification would be appropriate. Rather than try to come to consensus on this issue, the group recommended that this suggestion be included in a future effort to revise the guidelines. If the results of that discussion indicated clarification to "demographic isolation" was necessary, this future effort should suggest the appropriate changes.

Blended Discussions

A second set of breakout discussions consisted of blended expertise in small groups describing common themes among the statutes related to the use or identification of conservation units. These discussions identified linkages among the various Acts and support our identifying ways in which decisions under one statue would inform or be helpful in one or more of the others. Although there were separate presentations from three different groups, these presentations contained substantial overlap due to the objective of identifying common themes. Therefore, the results of these discussions are presented as a single summary.

Workshop participants noted that the MSA and MMPA have many similarities in goals despite the focus of the MSA on yield from stocks of fish and managing the Nation’s fisheries and that of the MMPA on protection and recovery of marine mammal stocks. Among the key concepts in managing fish stocks are MSY, which has been defined in regulations as the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions (50 CFR 600.310(c)(1)), and OY, which is defined with respect to yield from a fishery as the amount of fish that will provide the greatest net benefit to the Nation. The basis for OY for a fishery is the MSY of affected fish stocks, reduced by relevant economic, social, or ecological factors. Under the MSA, the first of the National Standards for developing Fishery Management Plans is to prevent over-fishing and achieve, on a continuing basis, the OY from each fishery for the U.S. fishing industry (50 CFR 600.310(f)(1)). As directed by National Standard 1, FMPs must provide for rebuilding overfished stocks to their MSY stock size, the abundance or biomass that provides maximum net annual production) within certain periods of time.

Unlike the MSA, the MMPA protects individual animals, regardless of their status, by prohibiting the take (which includes the killing, injuring, or harassing, or attempting to kill, injure, or harass marine mammals). The MMPA contains many exceptions to this general moratorium on taking marine mammals, and most of these exceptions require a determination that authorized taking be consistent with the policies and purposes of the MMPA, which include maintaining stocks of marine mammals as functioning elements of their ecosystems and encouraging each stock not to diminish below its OSP, the lower limit of which is the maximum net productivity level (MNPL), the abundance or biomass that provides maximum net annual production.

Despite the different focuses of the two statutes (MSA on yield or catch and MMPA on protection and recovery), fundamental objectives of the statutes are similar, which is to maintain the affected populations at levels at or above the abundance or biomass providing maximum net annual production.

Participants noted and discussed the similarities between MSY stock size and MNPL and between the fishing mortality rate (or catch) that would result in the MSY stock size (Fmsy) and the per capita rate of increase that results in maximum net annual production (Rmnpl or ½ Rmax). Participants concluded that demographic considerations are of primary importance in identifying conservation units for implementing both of these acts to ensure that catch or taking did not reduce the population size below stated limits.

The ESA, on the other hand, is designed to prevent the extinction of species, which includes sub-species and DPSs, thereby, preserving genetic diversity. NMFS earlier noted that a review of the legislative history of the ESA indicated a major motivating factor for the act was the desire to preserve genetic variability, between and within species (56 FR 58612, November 20, 1991). Accordingly, identifying conservation units (that could be listed as threatened or endangered) required both demographic and reproductive considerations.

The considerations of demographic independence and reproductive isolation under the three major statutes are summarized in Table 1. As noted in Table 1, conservation units in each of the three statutes require a consideration of discreteness. Intra-specific groups must be demographically independent from other aggregations to be considered as conservation units under each of the three statutes. Although there may be consideration of the extent of reproductive isolation in identifying fish stocks under MSA and population stocks under the MMPA (e.g., stock-recruit relationships), the conservation

Table 1. A summary of organizing concepts in identifying conservation units and identified discreteness and significance as key terms in the statutes, and several characteristics could be attributed to each of these terms.

Decision Criterion	MSA Stock	MMPA Stock	ESA ESU	ESA DPS	ESA Recovery unit[4]
1. Discreteness					
a. demographically independent	X	X	X	X	X?
b. reproductively isolated					
i. ecological time	X	X		X?	X
ii. evolutionary time			X	X?	
c. Political boundaries					
2. a. Significance				X	
b. Evolutionary Legacy			X		

goals of these statutes are focused primarily on demographic considerations; therefore, reproductive isolation on an ecological time scale can be of secondary importance in identifying discrete conservation units. Under the ESA, however, with its major goal of preserving genetic diversity within and between species, a consideration of the degree of reproductive isolation is a major factor in identifying discrete units. Furthermore, the DPS policy requires a consideration of discreteness as well as a consideration of the significance or importance of the discrete unit to the species or sub-species to which it belongs.

Workshop participants agreed that DIPs seemed to be a unifying concept in identifying management or conservation units under the three statutes. For purposes of the MSA or MMPA, demographic independence was equated with "discreteness" so that aggregations of individuals that are demographically independent of one another should be managed separately because their population dynamics would be independent of each other.

Under the ESA, demographic independence alone is insufficient to identify discrete units. Accordingly, DIPs could be aggregated (Figure 20) into larger units that are substantially, but not completely reproductively isolated from other groups of conspecifics. If these discrete units are significant or important to the species or subspecies as a whole, then the resulting aggregations of DIPs would be considered a DPS.

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[4] Workshop participants originally included recovery units in their discussions; however, the group later agreed that ESA conservation units should be limited to "listable" entities (species, sub-species, or DPSs) for purposes of this workshop. Therefore, there was no additional discussion of recovery units.

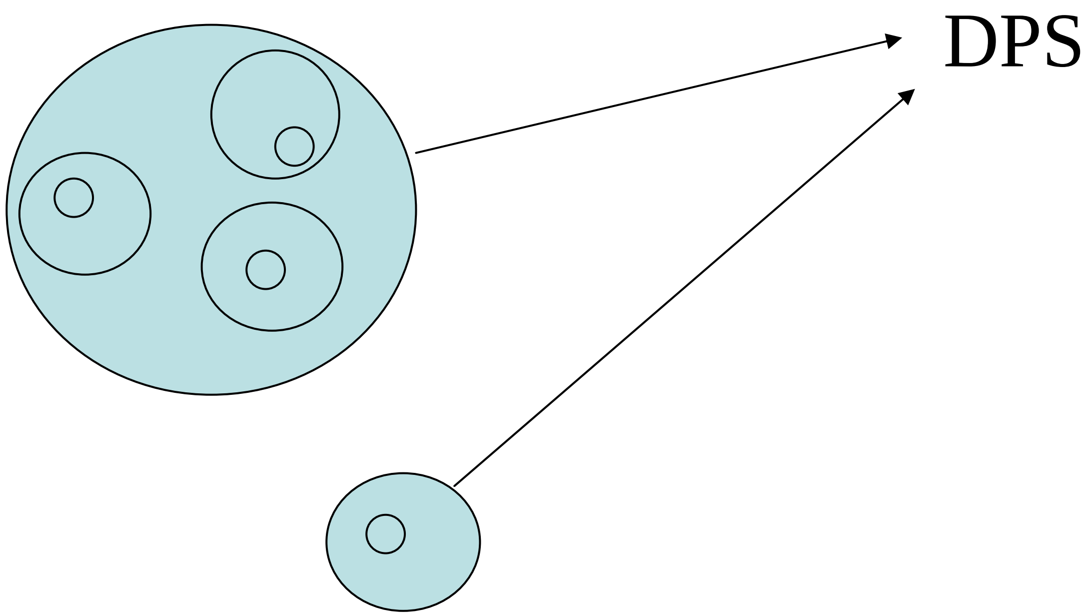

Figure 20. An illustration of combining groups of individuals (circles) into DIPs (shaded circles) and the further aggregation of DIPs into reproductively isolated units for consideration as a DPS.

Workshop participants also noted that correctly identifying conservation units under each of the three statutes was critical to an informed ecosystem approach to management. Furthermore, each of the statutes had ecosystem considerations embodied within its text. The MSA incorporates protecting the ecosystem as an integral part of the definition of OY (MSA section 3(28)), which is one of the fundamental concepts of that law. In addition, MSA section 3(29)(b) requires that MSY be reduced by economic, social, or ecological factors in defining Optimum Yield. ESA section 2(b) states a purpose of the act is to "…provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…". MMPA section 2(6) states the act's primary objective as maintaining the health and stability of marine ecosystems and notes that population stocks of marine mammals should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part. Accordingly, each of these laws contains ecosystem considerations, and the identification of conservation units under each of them should be consistent with NOAA's ecosystem approach to management. Therefore, delineation of conservation units should consider conventional boundaries of Large Marine Ecosystems (Sherman and Alexander 1986).

Workshop participants discussed Secor's pyramid (Secor 2005) as a model to illustrate various aggregations, individuals, DIPs, DPSs, Subspecies, and Species. These discussions related the aggregations to time (years of coherence) and action (listing vs. management or recovery) under the three statutes. Workshop participants agreed that an illustration such as Figure 21 is a useful and concise summary of the relationship between stock units and management under the three statutes.

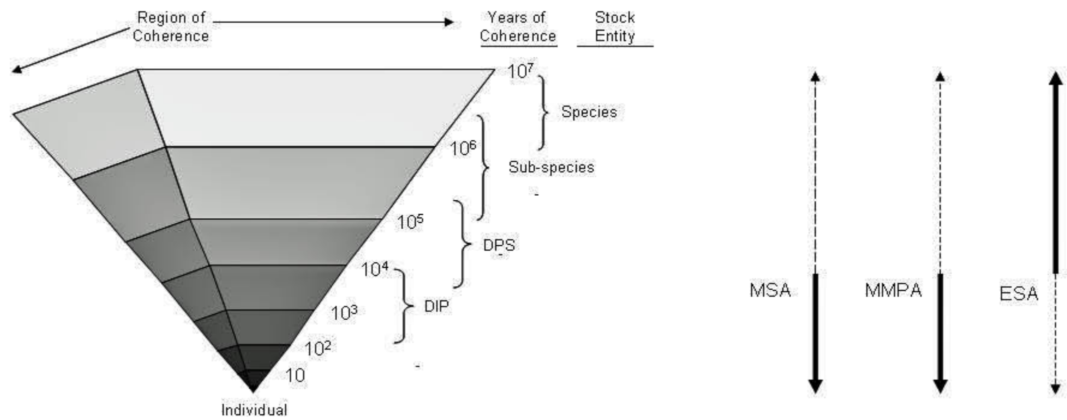

Figure 21. Conservation units of the MMPA, MSA and ESA depicted as a continuum of time of coherence within groups (adapted from Secor 2005).

Under the MMPA the major focus of conservation is at the population stock level with important protections being applied at the level of individuals marine mammals (depicted by a solid arrow in Figure 21). The MMPA also considers, but at a less extent, species and sub-species of marine mammals (depicted by a dashed arrow in Fig. 2). The MSA gives primary conservation focus at the stock level, which may be identified by a DIP. The ESA is more complicated with its definition of species (that could be listed as threatened or endangered) as a biological species, subspecies, or DPS. Although the ESA and MMPA provide protections for individuals, such protections were not within the scope of the workshop.

In closing, workshop participants identified two areas that will present difficulties in identifying conservation units under all three statutes.

- How to identify mixed stocks. This problem can also be termed as correctly assigning mortality or abundance to the correct stock in areas where individuals from more than one biological population may be found.

- Clines. Individuals from well-separated areas may be reproductively or demographically isolated from one another, but boundaries between adjacent aggregations cannot be identified reliably.

Conclusions and Recommendations

The conclusions and recommendations in this report are those of the steering committee and were compiled following the conclusion of the workshop.

As noted by the representatives of NMFS' Leadership Council, the identification of conservation units for managed fish (MSA), threatened and endangered species (ESA), and marine mammals (MMPA) differs among the affected living resources. Such differences are confusing to some constituents, and a clear, concise explanation of these differences and the rationales for them would be helpful. The Leadership Council expressed the need for a common paradigm that can help NMFS guide the identification of conservation units under the three statutes.

Waples and Gaggiotti (2006) described a conceptual framework for identifying populations. They recognized two different paradigms for a working definition of "population":

> *Ecological paradigm:* A group of individuals of the same species that co-occur in space and time and have an opportunity to interact with each other.
>
> *Evolutionary paradigm:* A group of individuals of the same species living in close enough proximity that any member of the group can potentially mate with any other member.

Conservation units under the MSA and MMPA, where it is important to identify groups that are demographically independent from one another, would likely be considered under the ecological paradigm, above. Under the ESA, where the potential loss of genetic variability within and between species is important, conservation units would more likely be identified as populations under the evolutionary paradigm.

Earlier, Taylor and Dizon (1996) noted that conservation units under the ESA are framed predominantly by population genetics criteria. The MMPA, on the other hand, has more demographic-based objectives, such as OSP and maintaining stocks as functioning elements of their ecosystems. They also note that population structure may not be identified from a genetics (reproductive isolation) perspective because gene flow may be sufficiently high to homogenize populations genetically yet may be too low to alter demographics of the affected groups. That is, DIPs may not be distinguishable genetically due to a low but sufficient degree of interbreeding among them. Consequently, each reproductively isolated group contains one or more DIPs, which results in a DIP being the fundamental conservation unit under the MSA, ESA, and MMPA.

In general, many people perceive that managed fish stocks are aggregated to the greatest degree, threatened and endangered species are intermediate, and marine mammal population stocks or stocks are subjected to the smallest aggregations identified for conservation. The steering committee notes that in some cases under the ESA (*e.g.*, large whales and sea turtles) the entire taxonomic species was listed as threatened or endangered; however, the workshop focused only on those situations where DPSs were identified for listing.

One of the first major questions asked of workshop participants was whether the differences in identification of conservation units are simply artifacts of the different objectives of the Federal laws requiring conservation of living marine resources. To some extent, different objectives account for different degrees of separation under the three statutes. The protections of the ESA attempt to prevent the extinction of species; thus, they are designed to avoid the irreplaceable loss of genetic traits or adaptations. The MSA and MMPA provide a framework for managing the population dynamics of fish and marine mammals, respectively. Accordingly, conservation units (aggregations that may be identified for listing) under the ESA should be based primarily upon the degree of reproductive isolation and would contain one or more DIPs. Another factor that explains the tendency to identify relatively small stocks of marine mammals is the nature of marine mammal populations, which typically involve internal fertilization, live birth, parental care, and maintenance of family groups; these features act as barriers to mixing among groups and help produce fine-scale population structure.

The MSA and MMPA, however, attempt to maintain discrete aggregations of fish and marine mammals within certain abundance or biomass limits, and a single DIP would be identified as a conservation unit under either of these statutes. Accordingly, DPSs would be expected to be larger than stocks of fish or marine mammals because the criterion for separation is more difficult to achieve.

The MSA and MMPA apply active management to all stocks within their jurisdiction and might be considered as pro-active approaches to prevent problems from developing. Thus, it is logical that they seek to apply their management to the smallest reasonable units. On the other hand, the ESA is called into action only when some aspect of conventional management has not adequately protected the species. Accordingly it seems logical that protection under ESA scales back to a broader degree of stock aggregation (DPSs).

Participants at the workshop generally agreed that the guidance used to identify conservation units under the three statutes is generally acceptable and has worked well for years. Despite the general acceptance, discussions at the workshop revealed a number of places each set of guidance could be improved. In particular, two challenges were noted for identifying conservation units under all three statutes: (1) mixing of individuals from various stocks seasonally and (2) clines or continuously-distributed species. The steering committee also recommends that each set of guidelines for identifying conservation units explicitly address transboundary circumstances, that is, where stocks, DPSs, or population stocks extend beyond the U.S. Exclusive Economic Zone where the affected living marine resources may be subject to exploitation or mortality that is not subject to conservation or regulatory mechanisms under the three statutes.

In addition to these three areas in common among the statutes, there are a few statute-specific recommendations that would benefit the identification of conservation units. These statute-specific recommendations appear below.

Magnuson-Stevens Act

Although participants in the workshop generally agreed that the guidance in the MSA and National Standards met the requirements and objectives of the act, there is confusion among terms that are used almost interchangeably in fishery management. These terms are "stock", "fishery", and "management unit". The steering committee agrees with the MSA breakout group in noting the need to distinguish more clearly between "stock" and "fishery". Further, the term "management unit" within the National Standard 3 guidelines enables a wide diversity of bases for these units and does not provide a primary focus on demographically isolated units.

Most stocks of fish had already been identified when the MSA was enacted in 1976. Since these stocks were identified, the technology for describing the biological basis of population structure has improved, and much new information has been collected, analyzed, and, at least partially, interpreted related to fish population structure. As NMFS and its fishery management partners begin to use more recent information to review fish stock structure and make necessary changes, clear and concise guidance for distinguishing among stocks of fish would benefit the process by promoting a more consistent national approach to fish stock identification. The steering committee recommends that such guidance be developed in the near future. The process for developing these guidelines would benefit by including marine mammal biologists to discuss the aspects of marine mammal stock identity guidelines that have worked well or not so well.

Endangered Species Act

DPS policy guidance was developed jointly by NMFS and FWS. This policy has generally worked well, has been subjected to legal challenge and review, and was upheld by Federal court.

Is it necessary to have a significant degree of reproductive isolation to meet the discreteness test in the DPS policy? Discussion in the ESA breakout group indicated disagreement among biologists experienced in implementing programs under the ESA regarding the requirement for discrete groups to be reproductively isolated from one another. Part of that group noted that reproductive isolation was implicit in the discreteness criteria, and others maintained that other factors could result in marked separation between or among groups. NMFS' ESU policy explicitly includes substantial reproductive isolation as one of its tests (56 CFR 58612, November 20, 1991), and the DPS policy (61 FR 4722, February 7, 1996) notes that NMFS and FWS consider the ESU policy to be consistent with the DPS policy. It follows, therefore, that substantial reproductive isolation is implicit in the discreteness test of the DPS policy. However, the steering committee notes that if such disagreement exists among experienced biologists, then the procedure must be confusing to a less-informed public.

The discreteness test includes the term "markedly separated from other populations" and notes that quantitative evidence of genetic discontinuity may provide evidence of discreteness. Similarly, the significance test includes “discrete population segment differs markedly from other populations of the species in its genetic characteristics.” The use of “markedly separated” in one test and “differs markedly”, particularly with respect to genetic analyses, is confusing. Accordingly, the steering committee recommends that NMFS and FWS review the wording of the DPS policy and revise it to reduce the potential for confusion and to explicitly address the role of reproductive isolation in the discreteness test.

The DPS policy is strong and well-supported; however, it is incomplete as a tool for promoting consistency in the overall identification of “species” under the ESA. The term “species” includes species, sub-species and DPSs. As noted earlier in this document, the list of endangered species lumps two species of right whales in a single listing. Scientists may sometimes disagree as to whether a currently recognized species would be better described as two or more species, even upon examining the same information. Consequently, the naming of new species may be much slower than information is accumulated. However, in a recent case involving Southern Resident killer whales, the court held that NMFS must consider the best available scientific information regarding taxonomy even if taxonomists have not completed a formal change of the existing nomenclature.

Marine Mammal Protection Act

The guidelines for assessing marine mammal stocks, including the stock identity provisions, were drafted initially in 1994 and revised twice (1997 and 2005). Each set of guidelines was evaluated by independent scientific review groups and by the public, including many academics and well-informed constituents. The steering committee notes that the two revisions made only minor modifications to the initial guidelines prepared in 1994; therefore, the stock identity approach in these guidelines appear to have withstood the test of time. However, it is among marine mammals that smaller groupings of marine mammals have been identified as stocks as information has accumulated, leading to concern expressed from various constituent groups. Accordingly, the steering committee recommends that the guidelines for assessing marine mammal stocks be updated in a future revision to include a discussion of these concerns.

The guidelines clearly support the use of DIPs as stocks of marine mammals. However, the MMPA defines stock to mean groups that interbreed when mature. Unfortunately, the MMPA does not indicate to what extent breeding should occur within the stock instead of among stocks. The guidelines should, therefore, include a rationale for recognizing DIPs as stocks in cases where males from one stock may breed with females from the same stocks and other stocks.

Workshop participants reviewed aspects of population structure, requirements under three major Federal statutes, existing guidance for identifying conservation units under these statutes, and case studies describing various aspects of the implementation of the existing guidance. Based upon the discussions at the workshop, the steering committee concluded that DIPs form a rational basis for describing conservation units, which may vary under the three statutes. Although the existing guidance under each statute is consistent with the law and its policies, each set of guidance could be improved. The steering committee, therefore, recommends that NMFS address the statute-specific guidance as described above.

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Appendices

1. Workshop agenda

2. Workshop participants

3. Statutory Text, Existing Guidelines
    a. MSA
    b. ESA
    c. MMPA

Appendix 1. Workshop Agenda

Management Units Workshop

Primary objective: Review the identification of management (conservation) units, and guidelines by which units are identified, under the MSFCMA, MMPA, and ESA to determine if NMFS' current management units are appropriate for the conservation of resources under the appropriate statute and an ecosystem approach to management. If changes are needed in identifying management units or internal guidelines for identifying management units, recommend such changes to NMFS management.

Expected product or outcomes from the workshop: Because this is a NMFS-only workshop, the expectations should end with identifying issues, how we have addressed them in the past, and alternatives (plus strengths and weaknesses) to address them in the future. When we want to get to specific resolutions or recommendations for resolutions, we may have to broaden participation to include people from outside NMFS, particularly for MMPA and ESA issues. The products would be (1) a report containing introductory material, summaries of all presentations (due by presenters before workshop), a summary of the discussion, and recommendations of the workshop, and (2) identifying a team to put the Methot white paper in final form for publication in an appropriate outlet.

Workshop Details

Duration: 2 ½ to 3 days in length

Location: SSMC2, Room 2358
1325 East West Highway
Silver Spring, MD 20910

Dates: February 14-16, 2006 (Tues, Wed, Thurs)

Target Audience: NMFS employees; resource managers and policy makers

Lodging:
A block of rooms has been reserved at the Courtyard (Marriott) in Silver Spring.

Group name: NOAA Fisheries (Call by Jan 23 for the Group block)
Gov't Rate: $187/night

Courtyard by Marriott (Downtown)
8506 Fenton Street
Silver Spring, MD 20910
Phone: 301-589-4899
or Toll Free Reservations: 800-321-2211

There is no budget for the workshop; therefore, participants' home office would have to support travel.

Day 1 - February 14, 2006

Welcome and Introductions:

Workshop Moderator: Megan Caldwell, Office of Sustainable Fisheries

8:30 Welcome – Jim Lecky, Office of Protected Resources

8:40 Introductions – participants introduce themselves; describe their connection or interest in identifying management/conservation units

8:55 Reiterate workshop objectives, structure and flow – Megan

PRESENTATIONS

Session 1: The Biology of Population Structure and Associated Issues

9:00-10:00 **Biology of Population Structure**

- What is a Population? -- Robin Waples, Northwest Fisheries Science Center
- Identifying Units to Conserve – Barbara Taylor, Southwest Fisheries Science Center
- Management of Biological Stocks under the MSFCMA, ESA, and MMPA – Rick Methot (Office of Science and Technology)

10:00 – 10:45 **Session 2: Legal requirements and guidance related to identifying management units**

Session introduction: Megan

Presentations will:

- Summarize general objectives of each act (to help explain why implementation of stock ID decision may be different among the acts)

- Explain references, definitions or requirements for management units in each act, and how this has been "clarified" by case law or congressional reports.

MSFCMA -- Stacey Nathanson - General Counsel for Fisheries

ESA – Karl Gleaves, General Counsel for Fisheries

MMPA - Karl Gleaves

10:45-11:15 **Break**

11:15-12:00 **Population Structure Issues as Discussed in the Leadership Council**
(Video link)
Bill Fox – Southwest Fisheries Science Center
Doug DeMaster – Alaska Fisheries Science Center

12:00 – 12:45 **Session 3: Current Guidelines for Identifying Conservation Units**

Presentations will:

- Identify the intersection of biological principles (population structure) with statutory requirements
- Describe the development of technical guidelines and criteria
- Discuss challenges in applying (or developing) policies

ESA – Species, Sub-species and DPS policy – Marta Nammack, Office of Protected Resources

MMPA – Stock ID guidelines - Tom Eagle, Office of Protected Resources

MSFCMA – Steve Cadrin – Northeast Fisheries Science Center
Discussing the state of the art techniques for defining a management unit or a stock; the need to develop policy guidance for this issue, will discuss where international agreement (e.g., in ICES and NAFO) are issues

12:45 – 2:00 **Lunch** on your own

Session 4: Case Studies

Session introduction: Megan Caldwell
Presentations will:

- Summarize the population's structure
- Identify the intersection of biological principles with statutory requirements
- How has the individual act’s policy guidance been applied?
- What was the basis for the decision made to identify the management unit?
- Describe how stock ID implementation has helped meet agency missions (successes)
- Describe challenges or impediments to implementing (or developing) policies (failures)
- What has not been successful to this point?

2:00 Regional Groundfish (multidisciplinary approach) (1 hour total)
Alaska – Grant Thompson, Alaska Fisheries Science Center
Northwest – Rick Methot
Northeast – Steve Cadrin

3:00-3:30 **Break**

3:30 Bluefin Tuna – Clay Porch, Southeast Fisheries Science Center (Video link), MSFCMA/Intl Agreements

4:00 Scallops – Dvora Hart, Northeast Fisheries Science Center – via video) MSFCMA

4:30 Atlantic loggerhead turtles – Barbara Schroeder, Office of Protected Resources – ESA

5:00 Western North Atlantic Humpback Whales –. Richard Pace, Northeast Fisheries Science Center – ESA/MMPA

5:30 Adjourn – Megan

Day 2 – February 15, 2006

8:30 Opening comments, brief plan for day – Megan Caldwell

8:45 Pacific salmon – Robin Waples – ESA

9:15 Cherry Point, WA, Herring - Rick Gustafson, Northwest Fisheries Science Center – ESA

9:45 Green Sturgeon – Steve Lindley, Southwest Fisheries Science Center - ESA

10:15 – 10:30 **Break**

10:30 Harbor Porpoise, Pacific Coast Stocks and Harbor Seals in Alaska – Barbara Taylor, Southwest Fisheries Science Center -- MMPA

1100 Bottlenose Dolphins, Western N. Atlantic coastal stocks) – Aleta Hohn and Patty Rosel, Southeast Fisheries Science Center – MMPA

11:30 Killer whales – Paul Wade, Alaska Fisheries Science Center – ESA/MMPA

12:00 – 1:30 **Lunch on your own**

DISCUSSION AND BREAKOUT

1:30-2:15 – Breakout 1
2:15-3:00 – Plenary, report of breakouts and discussion

3:00-3:15 **Break**

3:30 3:45 – Breakout 2
3:45-4:30 – Plenary, report of breakouts and discussion
4:30 – Overview of the day's discussion and adjourn – Megan

Day 3 – February 16, 2006

8:30 – Opening comments and brief plan for the day – Megan

8:45-9:30 - Breakout 3
9:30-10:15 – Plenary, report of breakout and discussion

10:15-10:30 **Break**

10:30-11-15 - Breakout by statute interest for recommendations to prepare for afternoon discussion with senior managers

1. Does the approach under the statute make sense for our stewardship responsibilities?
2. What concerns do we have about this approach, and are revisions needed?
3. Suggestions to resolve the concerns.

11:15 – 12:00 – Plenary, report of breakout and discussion

12:00 – 1:30 Lunch on your own

1:30-?? Reconvene for discussions with senior managers, including recommendations from the morning breakout sessions and discussions

Identify team to work with Rick Methot to complete white paper for publication and adjourn

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Breakout sessions (number of groups depends upon number of participants)

Guiding Questions for Discussion: Each breakout group will be assigned several of these questions, and it may be good for at least some questions to have more than one breakout group address the question.

1. What level of consistency should there be in identifying stocks (at least discrete management units) under the 3 statutes, or should different policies and purposes of the

three laws allow very different approaches in identifying management units under each statute? (This question is, in part, based on the different interpretations for Atlantic humpback whales and loggerhead turtles, where NMFS recognized the Gulf of Maine feeding aggregation as a separate population stock of Atl humpbacks but the Northern and Southern Florida sub-populations of loggerheads failed the discreteness test under the DPS policy for the ESA)

2. What are the biological and socio-economic consequences of large vs. small conservation units (i.e., what are the trade-offs for lumping and splitting)?

3. Sometimes a subregion of a stock is designated as a management unit (managed fish example, West. N. Atl coastal bottlenose dolphins, ESA example) to provide temporal or spatial control for mortality. Should the management units be reported as if they were separate stocks?

4. Sometimes an assessment boundary is drawn along a political boundary that clearly is not a biological stock boundary. Do we get reliable results by assessing a portion of a stock's range? Can we deal with transboundary issues more effectively?

5. When a large management unit contains highly structured aggregations (even mixed stocks), it seems necessary to align the assessment (demographic analysis) boundaries with new information on stock boundaries. Is it always necessary to create finer-scale management boundaries?

6. Do we have taxonomic inconsistencies (or discrimination) in stock structure (particularly under the ESA)? E.g., salmon and killer whales. In other words, do we lump more for fish than for marine mammals?

7. Ephemeral vs evolutionary separation. (Question getting to our jobs under the MMPA and MSA vs the ESA) This could also get to the question of just how separated aggregations should be from one another before we recognize them as a separate stock.

8. Do we need a written set of guidelines for identifying stocks under the MSA comparable to the DPS policy under the ESA and the SAR guidelines under the MMPA?

Plenary sessions:

Report of breakout results and discussion among all participants.

Workshop Products:

NOAA Technical Memorandum with biological background, recommendations, and rationale.

Identification of authors and steps to produce the “white paper” or “primer” for outreach and education related to identifying conservation units.

Appendix 2. Workshop Participants (M-Moderator, P-Presenter ,S-Steering Committee)

Douglas	DeMaster (by video conference)	Alaska Fisheries Science Center	P
Grant	Thompson	Alaska Fisheries Science Center	P
Paul	Wade	Alaska Fisheries Science Center	P
Corey	Niles	Ecosystem Goal Team	
Steve	Cadrin	Northeast Fisheries Science Center	P,S
Trish	Clay	Northeast Fisheries Science Center	
Dvora	Hart (by video conference)	Northeast Fisheries Science Center	P
Phil	Logan	Northeast Fisheries Science Center	
Richard	Pace	Northeast Fisheries Science Center	P
Kim	Damon-Randall	Northeast Region	
David	Gouveia	Northeast Region	
Richard	Gustafson	Northwest Fisheries Science Center	P
Robin	Waples	Northwest Fisheries Science Center	P
Donna	Darm	Northwest Region	
Scott	Rumsey	Northwest Region	
Christopher	Rogers	Office of International Affairs	
Melissa	Andersen	Office of Protected Resources	
Thomas	Eagle	Office of Protected Resources	P,S
Craig	Johnson	Office of Protected Resources	
Patricia	Lawson	Office of Protected Resources	
James	Lecky	Office of Protected Resources	
Katherine	McFadden	Office of Protected Resources	
Marta	Nammack	Office of Protected Resources	P,S
Michael	Payne	Office of Protected Resources	
Susan	Pultz	Office of Protected Resources	
Cheryl	Ryder	Office of Protected Resources	
Barbara	Schroeder	Office of Protected Resources	P
Richard	Methot	Office of Science and Technology	P,S
Megan	Caldwell	Office of Sustainable Fisheries	M,S
Debra	Lambert	Office of Sustainable Fisheries	
Mark	Millikin	Office of Sustainable Fisheries	
Karl	Gleaves	Office of the General Counsel for Fisheries	P
Stacey	Nathanson	Office of the General Counsel for Fisheries	P
Melissa	Snover	Pacific Islands Fisheries Science Center	
Sheryan	Epperly	Southeast Fisheries Science Center	
Aleta	Hohn	Southeast Fisheries Science Center	P
Clay	Porch (by video conference)	Southeast Fisheries Science Center	P
Patricia	Rosel	Southeast Fisheries Science Center	P
Kyle	Baker	Southeast Region	
John	McGovern	Southeast Region	
William	Fox (by video conference)	Southwest Fisheries Science Center	P
Steve	Lindley	Southwest Fisheries Science Center	P
Barbara	Taylor	Southwest Fisheries Science Center	P
Christina	Fahy	Southwest Region	

Appendix 3a. Excerpts from MSA and supporting documents related to stock identification of managed fish.

Magnuson-Stevens Fishery Conservation and Management Act

- National Standard 1: *"Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimal yield from each fishery for the United States fishing industry."*
- National Standard 2: *"Conservation and management measures shall be based upon the best scientific information available."*
- National Standard 3: *"To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination."*
- Stock of fish: *"a species, subspecies, geographical grouping, or other category of fish capable of management as a unit."*
- Overfishing: *"a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce maximum sustainable yield on a continuing basis."*
- Optimal yield: *"maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and in the case of an overfished fishery, provides for rebuilding to a level consistent with producing maximum sustainable yield…"*
- Fishery: *"one or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics; and any fishing for such stocks."*
- Rebuilding Overfished Fisheries – fishery management plans shall *"specify a time period for ending overfishing and rebuilding the fishery that shall… not exceed ten years…"*

National Standard 1 Guidelines

- Mixed-stock fisheries: *"In the case of a mixed-stock fishery, MSY should be specified on a stock-by-stock basis. However, where MSY cannot be specified for each stock, then MSY may be specified on the basis of one or more species as an indicator for the mixed stock as a whole or for the fishery as a whole."*
- Overfishing 'stocks:' *"To overfish means to fish at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis."*
- *"Overfishing occurs whenever a stock or stock complex is subjected to rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis."*

National Standard 3 Guidelines:

§600.320 National Standard 3—Management Units.

(a) Standard 3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

(b) General. The purpose of this standard is to induce a comprehensive approach to fishery management. The geographic scope of the fishery, for planning purposes, should cover the entire range of the stocks(s) of fish, and not be overly constrained by political boundaries. Wherever practicable, an FMP should seek to manage interrelated stocks of fish.

(c) Unity of management. Cooperation and understanding among entities concerned with the fishery (e.g., Councils, states, Federal Government, international commissions, foreign nations) are vital to effective management. Where management of a fishery involves multiple jurisdictions, coordination among the several entities should be sought in the development of an FMP. Where a range overlaps Council areas, one FMP to cover the entire range is preferred. The Secretary designates which Council(s) will prepare the FMP, under section 304(f) of the Magnuson-Stevens Act.

(d) Management unit. The term "management unit" means a fishery or that portion of a fishery identified in an FMP as relevant to the FMP's management objectives.

(1) Basis. The choice of a management unit depends on the focus of the FMP's objectives, and may be organized around biological, geographic, economic, technical, social, or ecological perspectives. For example:

(i) Biological—could be based on a stock(s) throughout its range.

(ii) Geographic—could be an area.

(iii) Economic—could be based on a fishery supplying specific product forms.

(iv) Technical—could be based on a fishery utilizing a specific gear type or similar fishing practices.

(v) Social—could be based on fishermen as the unifying element, such as when the fishermen pursue different species in a regular pattern throughout the year.

(vi) Ecological—could be based on species that are associated in the ecosystem or are dependent on a particular habitat.

(2) Conservation and management measures. FMPs should include conservation and management measures for that part of the management unit within U.S. waters, although the Secretary can ordinarily implement them only within the EEZ. The measures need not be identical for each geographic area within the management unit, if the FMP justifies the

differences. A management unit may contain, in addition to regulated species, stocks of fish for which there is not enough information available to specify MSY and OY or to establish management measures, so that data on these species may be collected under the FMP.

(e) Analysis. To document that an FMP is as comprehensive as practicable, it should include discussions of the following:

(1) The range and distribution of the stocks, as well as the patterns of fishing effort and harvest.

(2) Alternative management units and reasons for selecting a particular one. A less-than-comprehensive management unit may be justified if, for example, complementary management exits or is planned for a separate geographic area or for a distinct use of the stocks, or if the unmanaged portion of the resource is immaterial to proper management.

(3) Management activities and habitat programs of adjacent states and their effects on the FMP's objectives and management measures. Where state action is necessary to implement measures within state waters to achieve FMP objectives, the FMP should identify what state action is necessary, discuss the consequences of state inaction or contrary action, and make appropriate recommendations. The FMP should also discuss the impact that Federal regulations will have on state management activities.

(4) Management activities of other countries having an impact on the fishery, and how the FMP's management measures are designed to take into account these impacts. International boundaries may be dealt with in several ways. For example:

(i) By limiting the management unit's scope to that portion of the stock found in U.S. waters;

(ii) By estimating MSY for the entire stock and then basing the determination of OY for the U.S. fishery on the portion of the stock within U.S. waters; or

(iii) By referring to treaties or cooperative agreements.

[61 FR 32540, June 24, 1996, as amended at 63 FR 24234, May 1, 1998]

Appendix 3b. Definition of "species" from the ESA and the joint DPS policy

<u>ESA definition of species, section 3(15):</u>

The term "species" includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species or vertebrate fish or wildlife which interbreeds when mature.

<u>DPS policy (text version of the act retrieved from GPO Acces)s:</u>

Federal Register: February 7, 1996 (Volume 61, Number 26)]
[Notices]
[Page 4721-4725]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr07fe96-107]
[[Page 4721]]

Part IV
Department of the Interior
Fish and Wildlife Service

Department of Commerce
National Oceanic and Atmospheric Administration

Policy Regarding the Recognition of Distinct Vertebrate Population;
Notice
[[Page 4722]]
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

Policy Regarding the Recognition of Distinct Vertebrate
Population Segments Under the Endangered Species Act

AGENCIES: Fish and Wildlife Service, Interior; National Marine
Fisheries Service, NOAA, Commerce.

ACTION: Notice of policy.

SUMMARY: The Fish and Wildlife Service and the National Marine
Fisheries Service (Services) have adopted a policy to clarify their
interpretation of the phrase ``distinct population segment of any
species of vertebrate fish or wildlife'' for the purposes of listing,

delisting, and reclassifying species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et. seq.) (Act).

ADDRESSES: The complete record pertaining to this action is available for inspection, by appointment, during normal business hours at the Division of Endangered Species, U.S. Fish and Wildlife Service, in Room 452, Arlington Square Building, 4401 North Fairfax Drive, Arlington, Virginia.

FOR FURTHER INFORMATION CONTACT: E. LaVerne Smith, Chief, Division of Endangered Species, U.S. Fish and Wildlife Service at the above address (703/358-2171), or Russell Bellmer, Chief, Endangered Species Division, National Marine Fisheries Service, 1335 East-West Highway, Silver Spring, Maryland 20910 (301/713-1401).

SUPPLEMENTARY INFORMATION:

Background

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et. seq.). (Act) requires the Secretary of the Interior or the Secretary of Commerce (depending on jurisdiction) to determine whether species are endangered or threatened. In defining ``species,'' the Act as originally passed included, `` * * any subspecies of fish or wildlife or plants and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature.'' In 1978, the Act was amended so that the definition read ``* * * any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.'' This change restricted application of this portion of the definition to vertebrates. The authority to list a ``species'' as endangered or threatened is thus not restricted to species as recognized in formal taxonomic terms, but extends to subspecies, and for vertebrate taxa, to distinct population segments (DPS's).*

Because the Secretary must ``* * * determine whether any species is an endangered species or a threatened species'' (section 4(a)(1)), it is important that the term ``distinct population segment'' be interpreted in a clear and consistent fashion. Furthermore, Congress has instructed the Secretary to exercise this authority with regard to DPS's `` * * sparingly and only when the biological evidence indicates that such action is warranted.'' (Senate Report 151, 96th Congress, 1st Session). The Services have used this authority relatively rarely; of over 300 native vertebrate species listed under the Act, only about 30 are given separate status as DPS's.*

It is important in light of the Act's requirement to use the best *available scientific information in determining the status of species that this interpretation follows sound biological principles. Any interpretation adopted should also be aimed at carrying out the purposes of the Act (i.e., ``* * * to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section'' (section 2(b)).*

Available scientific information provides little specific enlightenment in interpreting the phrase ``distinct population segment.'' This term is not commonly used in scientific discourse, although ``population'' is an important term in a variety of contexts. For instance, a population may be circumscribed by a set of experimental conditions, or it may approximate an ideal natural group of organisms with approximately equal breeding opportunities among its members, or it may refer to a loosely bounded, regionally distributed collection of organisms. In all cases, the organisms in a population are members of a single species or lesser taxon.

The National Marine Fisheries Service (NMFS) has developed a Policy on the Definition of Species under the Endangered Species Act (56 FR 58612-58618; November 20, 1991). The policy applies only to species of salmonids native to the Pacific. Under this policy, a stock of Pacific salmon is considered a DPS if it represents an evolutionarily significant unit (ESU) of a biological species. A stock must satisfy two criteria to be considered an ESU:

(1) It must be substantially reproductively isolated from other conspecific population units; and

(2) It must represent an important component in the evolutionary legacy of the species.

This document adopts an interpretation of the term ``distinct population segment'' for the purposes of listing, delisting, and reclassifying vertebrates by the U.S. Fish and Wildlife Service (FWS) and NMFS. The Services believe that the NMFS policy, as described above, on Pacific salmon is consistent with the policy outlined in this notice. The NMFS policy is a detailed extension of this joint policy. Consequently, NMFS will continue to exercise its policy with respect to Pacific salmonids

The Services' draft policy on this subject was published on December 21, 1994 (59 FR 65885) and public comment was invited. After review of comments and further consideration, the Services adopt the policy as issued in draft form.

Summary of Comments and Recommendations

The Services received 31 letters from individuals and organizations commenting on the draft policy. In addition, since publication of the draft policy, the National Academy of Sciences, National Research Council (NRC), has published a report titled ``Science and the Endangered Species Act,'' prepared by a committee appointed by the Academy at the request of several members of Congress. This report in part examines the definition of ``species'' under the Act, and endorses the recognition of scientifically identified evolutionary units for conservation purposes. It discusses the recognition of DPS's in terms of ``distinctiveness,'' which is consistent with the concept of ``discreteness'' as presented in the draft policy except that it would not recognize an international political boundary to delimit a DPS. The committee noted that: ``Although there can be good policy reasons for such delineations, there are not sound scientific reasons to delineate species only in accordance with political boundaries.'' The Services agree that the inclusion of international boundaries in determining whether a population segment is discrete is sometimes undertaken as a matter of policy rather than science. Although the committee

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expressed the belief that application of a distinctiveness test (analogous to the standard of discreteness in the policy) would adequately carry out the congressional instruction that the authority to address DPS's be exercised sparingly, the Services continue to believe that a judgement regarding the significance of any unit found to be discrete is necessary to comply with congressional intent.

Respondents presented a wide range of opinion regarding the recognition of DPS's. Some argued that the draft policy would be too restrictive and make it difficult or impossible to protect important elements of biodiversity; others maintained that the draft was not restrictive enough and would allow the Services to extend protection to entities never intended to be eligible for protection under the Act. A few respondents questioned the need for any policy framework and advocated case-by-case determinations of the eligibility of entities for listing under the DPS provision. The Services continue to believe that the Act will be best administered if there is a general policy framework governing the recognition of DPS's that can be disseminated and understood by the affected public.

Several respondents questioned the relationship of the draft policy to the NMFS policy regarding salmonids. The Services believe that the NMFS policy for salmonids is consistent with the general policy outlined in this notice, although the salmonid policy is formulated specifically to address the biology of this group. Several respondents also questioned the use of qualifying words such as ``significant'' or* *``markedly'' in the policy. The Services intended these words to have their commonly understood senses. At the time any distinct population is recognized or not recognized the reasons for which it is believed to satisfy or not satisfy the conditions of the policy will be fully explained.

Several respondents maintained that a policy of this nature required adoption under rulemaking procedures of the Administrative Procedure Act. The Services disagree, and continue to regard the policy as non-regulatory in nature. Specific recommendations advanced by respondents are paraphrased and responded to below.

Only Full Species are Genetically Distinct From one Another, and Listing Should Only be Extended to These Genetically Distinct Entities.

Restricting listings to full taxonomic species would render the Act's definition of species, which explicitly includes subspecies and DPS's of vertebrates, superfluous. Clearly, the Act is intended to authorize listing of some entities that are not accorded the taxonomic rank of species, and the Services are obliged to interpret this authority in a clear and reasonable manner.

The Services Should Focus on Genetic Distinctness in Recognizing a Distinct Population Segment. Conversely, Some Respondents Believed There Should be No Requirement That a DPS be Genetically Differentiated or Recognizable for it to be Protected Under the Act

There appears to be a diversity of understanding regarding the purposes of the Act, with some individuals viewing it as directed almost exclusively toward the conservation of unique genetic resources while other individuals emphasize its stated intention of conserving ecosystems. This diversity of viewpoints is reflected in comments addressing the role to be played by genetic information in the draft policy. The Services understand the Act to support interrelated goals of conserving genetic resources and maintaining natural systems and biodiversity over a representative portion of their historic occurrence. The draft policy was intended to recognize both these intentions, but without focusing on either to the exclusion of the other. Thus, evidence of genetic distinctness or of the presence of genetically determined traits may be important in recognizing some DPS's, but the draft policy was not intended to always specifically require this kind of evidence in order for a DPS to be recognized. The ESU policy of NMFS also does not require genetic data before an ESU can be identified. Thus in determining whether the test for discreteness has been met under the policy, the Services allow but do not require genetic evidence to be used. At least one respondent evidently understood the draft policy to require that genetic distinctness be *demonstrated before a DPS could be recognized, and criticized the draft on that basis. As explained above, this was never intended.*

The Elements Describing Reasons for Considering a Population Segment Significant Should be Laid Out Comprehensively, Rather Than Presented as an Open-Ended Set of Examples as in the Draft Policy

The Services appreciate the need to make a policy on this subject as complete and comprehensive as possible, but continue to believe that it is not possible to describe in advance all the potential attributes that could be considered to support a conclusion that a particular population segment is ``significant'' in terms of the policy. When a distinct population is accepted or rejected for review pursuant to a petition or proposed for listing or delisting, the Services intend to explain in detail why it is considered to satisfy both the discreteness and significance tests of the policy.

In Assessing the Significance of a Potential Distinct Population Segment, the Services Should Focus on its Importance to the Status of the Species to Which it Belongs. Alternatively, the Services Should Emphasize the Importance of a Potential DPS to the Environment in Which it Occurs

Despite its orientation toward conservation of ecosystems, the Services do not believe the Act provides authority to recognize a potential DPS as significant on the basis of the importance of its role in the ecosystem in which it occurs. In addition, it may be assumed that most, if not all, populations play roles of some significance in the environments to which they are native, so that this importance might not afford a meaningful way to differentiate among populations. On the other hand, populations commonly differ in their importance to the overall welfare of the species they represent, and it is this importance that the policy attempts to reflect in the consideration of significance.

International Boundaries are not Appropriate in Determining That a Population is Discrete in the Draft Policy; Political Boundaries Other Than Those Between Nations may be Appropriate in Some Cases to Delimit DPS's

The Services recognize that the use of international boundaries as a measure of discreteness may introduce an artificial and non-biological element to the recognition of DPS's. Nevertheless, it appears to be reasonable for national legislation, which has its principal effects on a national scale, to recognize units delimited by international boundaries when these coincide with differences in the *management, status, or exploitation of a species. Recognition of international boundaries in this way is also consistent with practice under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which is implemented in the United States by the Act. Recognition of other political boundaries, such as State lines within the United States, would appear to lead to the recognition of*

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entities that are primarily of conservation interest at the State and local level, and inappropriate as a focus for a national program. The Services recognize, as suggested in some comments, that infra-national political boundaries offer opportunities to provide incentives for the favorable management of species if they were used as a basis for recognizing discrete entities for delisting or for exclusion from a listing. Particularly when applied to the delisting or reclassification of a relatively widespread species for which a recovery program is being successfully carried out in some States, recognition of State boundaries would offer attractive possibilities. Nevertheless, the Act provides no basis for applying different standards for delisting than those adopted for listing. If the Services do not consider entities for listing that are not primarily of conservation interest at a national level, they must also refrain from delisting or reclassifying units at this level.

Complete Reproductive Isolation Should be Required as a Prerequisite to the Recognition of a Distinct Population Segment

The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment. This would be an impracticably stringent standard, and one that would not be satisfied even by some recognized species that are known to sustain a low frequency of interbreeding with related species.

The Services Should Emphasize Congress' Instruction to use Their Authority to Dddress DPS's ``Sparingly''

The Services believe that application of the policy framework announced in this document will lead to consistent and sparing exercise of the authority to address DPS's, in accord with congressional instruction.

The Occurrence of a Population Segment in an Unusual Setting Should not be Used as Evidence for its Significance

The Services continue to believe that occurrence in an unusual ecological setting is potentially an indication that a population segment represents a significant resource of the kind sought to be *conserved by the Act. In any actual case of a DPS recognized in part on this basis, the Services will describe in detail the nature of this significance when accepting a petition or proposing a rule.*

The Authority to Address DPS's Should be Extended to Plant and Invertebrate Species

The Services recognize the inconsistency of allowing only vertebrate species to be addressed at the level of DPS's, and the findings of the NRC committee also noted that such recognition would be appropriate for other species. Nevertheless, the Act is perfectly clear and unambiguous in limiting this authority. This policy acknowledges the specific limitations imposed by the Act on the definition of ``species.''

The Services Should Stress Uniqueness and Irreplaceability of Ecological Functions in Recognizing DPS's

The Services consider the Act to be directed at maintenance of species and populations as elements of natural diversity. Consequently, the principal significance to be considered in a potential DPS will be the significance to the taxon to which it belongs. The respondent appears to be recommending that the Services consider the significance of a potential DPS to the community or ecosystem in which it occurs and the likelihood of another species filling its niche if it should be extirpated from a particular portion of its range. These are important considerations in general for the maintenance of healthy ecosystems, and they often coincide with conservation programs supported by the Act. Nevertheless, the Act is not intended to establish a comprehensive biodiversity conservation program, and it would be improper for the Services to recognize a potential DPS as significant and afford it the Act's substantive protections solely or primarily on these grounds.

Congress did not Intend to Require That DPS's be Discrete. In a Similar Vein, Congress did not Require That a Potential DPS be Significant to be Considered Under the Act

With regard to the discreteness standard, the Services believe that logic demands a distinct population recognized under the Act be circumscribed in some way that distinguishes it from other representatives of its species. The standard established for discreteness is simply an attempt to allow an entity given DPS status under the Act to be adequately defined and described. If some level of discreteness were not required, it is difficult to imagine how the Act could be effectively administered or enforced. At the same time, the standard adopted does not require absolute separation of a DPS from *other members of its species, because this can rarely be demonstrated in nature for any population of organisms. The standard adopted is believed to allow entities recognized under the Act to be identified without requiring an unreasonably rigid test for distinctness. The requirement that a DPS be significant is intended to carry out the expressed congressional intent that this authority be exercised sparingly as well as to concentrate conservation efforts undertaken under the Act on avoiding important losses of genetic diversity.*

A Population Should Only be Required to be Discrete or Significant, but not Both, to be Recognized as a Distinct Population Segment

The measures of discreteness and significance serve decidedly different purposes in the policy, as explained above. The Services believe that both are necessary for a policy that is workable and that carries out congressional intent. The interests of conserving genetic diversity would not be well served by efforts directed at either well-defined but insignificant units or entities believed to be significant but around which boundaries cannot be recognized.

Requiring That a DPS be Discrete Effectively Prevents the Loss of Such a Segment From Resulting in a Gap in the Distribution of a Species. Essentially, if Distinct Populations are Entirely Separate, the Loss of One Has Little Significance to the Others

If the standard for discreteness were very rigid or absolute, this could very well be true. However, the standard adopted allows for some limited interchange among population segments considered to be discrete, so that loss of an interstitial population could well have consequences for gene flow and demographic stability of a species as a whole. On the other hand, not only population segments whose loss would produce a gap in the range of a species can be recognized as significant, so that a nearly or completely isolated population segment could well be judged significant on other grounds and recognized as a distinct population segment.

The Services Lack Authority to Address DPS's of Subspecies

The Services maintain that the authority to address DPS's extends to species in which subspecies are recognized, since anything included in the taxon of lower rank is also included in the higher ranking taxon.

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The following principles will guide the Services' listing, delisting and reclassification of DPS's of vertebrate species. Any proposed or final rule affecting status determination for a DPS would clearly analyze the action in light of these guiding principles.

Policy

Three elements are considered in a decision regarding the status of a possible DPS as endangered or threatened under the Act. These are applied similarly for addition to the lists of endangered and threatened wildlife and plants, reclassification, and removal from the lists:

1. Discreteness of the population segment in relation to the remainder of the species to which it belongs;

2. The significance of the population segment to the species to which it belongs; and

3. The population segment's conservation status in relation to the Act's standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened?).

Discreteness: A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:

1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.

2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

*Significance: If a population segment is considered discrete under one or more of the above conditions, its biological and ecological significance will then be considered in light of Congressional guidance (see Senate Report 151, 96th Congress, 1st Session) that the authority to list DPS's be used `` * * * sparingly'' while encouraging the conservation of genetic diversity. In carrying out this examination, the Services will consider available scientific evidence of the discrete population segment's importance to the taxon to which it belongs. This consideration may include, but is not limited to, the following:*

1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,

2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon, *3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or*

4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

Because precise circumstances are likely to vary considerably from case to case, it is not possible to describe prospectively all the classes of information that might bear on the biological and ecological importance of a discrete population segment.

Status: If a population segment is discrete and significant (i.e., it is a distinct population segment) its evaluation for endangered or threatened status will be based on the Act's definitions of those terms and a review of the factors enumerated in section 4(a). It may be appropriate to assign different classifications to different DPS's of the same vertebrate taxon.

Relationship to Other Activities

The Fish and Wildlife Service's Listing and Recovery Priority Guidelines (48 FR 43098; September 21, 1983) generally afford DPS's the same consideration as subspecies, but when a subspecies and a DPS have the same numerical priority, the subspecies receives higher priority for listing. The Services will continue to generally accord subspecies higher priority than DPS's.

Any DPS of a vertebrate taxon that was listed prior to implementation of this policy will be reevaluated on a case-by-case basis as recommendations are made to change the listing status for that distinct population segment. The appropriate application of the policy will also be considered in the 5-year reviews of the status of listed species required by section 4(c)(2) of the Act.

Effects of Policy

This guides the evaluation of distinct vertebrate population segments for the purposes of listing, delisting, and reclassifying under the Act. The only direct effect of the policy is to accept or reject population segments for these purposes. More uniform treatment of DPS's will allow the Services, various other government agencies, private individuals and organizations, and other interested or concerned parties to better judge and concentrate their efforts toward the conservation of biological resources at risk of extinction.

Listing, delisting, or reclassifying distinct vertebrate population segments may allow the Services to protect and conserve species and the ecosystems upon which they depend before large-scale decline occurs that would necessitate listing a species or subspecies throughout its entire range. This may allow protection and recovery of declining *organisms in a more timely and less costly manner, and on a smaller scale than the more costly and extensive efforts that might be needed to recover an entire species or subspecies. The Services' ability to address local issues (without the need to list, recover, and consult rangewide) will result in a more effective program.*

Author/Editor: The editors of this policy are Dr. John J. Fay of the Fish and Wildlife Service's Division of Endangered Species, 452 ARLSQ, Washington, DC 20240 (703/358-2105) and Marta Nammack of the National Marine Fisheries Service's Endangered Species Division, 1335 East-West Highway, Silver Spring, Maryland 20910 (301/713-2322).

Authority: The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Dated: February 1, 1996.
John G. Rogers,
Acting Director, Fish and Wildlife Service.

Dated: February 1, 1996.
Nancy Foster,
Deputy Assistant Administrator for Fisheries, National Marine Fisheries Service.
[FR Doc. 96-2639 Filed 2-6-96; 8:45 am]
BILLING CODE 3510-22-P

Appendix 3c. Definition of population stock from the MMPA and the population identity segment of NMFS' guidelines for assessing marine mammal stocks.

MMPA definition (Section 3(11)):

The term "population stock" or "stock" means a group of marine mammals of the same species or smaller taxa in common spatial arrangement, that interbreed when mature.

Excerpt from NMFS' guidelines for assessing marine mammal stocks. This document is available at: http://www.nmfs.noaa.gov/pr/sars/

"Population stock" is the fundamental unit of legally-mandated conservation. The MMPA defines population stock as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature." To fully interpret this definition, it is necessary to consider the objectives of the MMPA. In Sec. 2 (Findings and Declaration of Policy) of the MMPA it is stated that "...species and populations stocks of marine mammals...should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population." Further on in Sec. 2, it states "...the primary objective of their management should be to maintain the health and stability of the marine ecosystem. Whenever consistent with this primary objective, it should be the goal to obtain an optimum sustainable population keeping in mind the carrying capacity of the habitat." Therefore, stocks must be identified in a manner that is consistent with these goals. For the purposes of management under the MMPA, a stock is recognized as being a management unit that identifies a demographically isolated biological population. It is recognized that in practice, identified stocks may fall short of this ideal because of a lack of information, or for other reasons.

Many types of information can be used to identify stocks of a species: e.g., distribution and movements, population trends, morphological differences, differences in life history, genetic differences, contaminants and natural isotope loads, parasite differences, and oceanographic habitat differences. Different population responses (e.g., different trends in abundance) between geographic regions is also an indicator of stock structure, as populations with different trends are not strongly linked demographically. When different types of evidence are available to identify stock structure, the report must discuss inferences made from the different types of evidence and how these inferences were integrated to identify the stock.

Evidence of morphological or genetic differences in animals from different geographic regions indicates that these populations are reproductively isolated. Reproductive isolation is proof of demographic isolation, and, thus, separate management is appropriate when such differences are found. Demographic isolation means that the population dynamics of the affected group is more a consequence of births and deaths within the group (internal dynamics) rather than immigration or emigration (external dynamics). Thus, the exchange of individuals between population stocks is not great *enough to prevent the depletion of one of the populations as a result of increased mortality or lower birth rates.*

Failure to detect differences, however, does not mean that populations are not demographically or reproductively isolated. Dispersal rates, though sufficiently high to homogenize morphological or genetic differences detectable between putative populations, may still be insufficient to deliver enough recruits from an unexploited population (source) to an adjacent exploited population (sink) so that the latter remains a functioning element of its ecosystem. Insufficient dispersal between populations where one bears the brunt of exploitation coupled with their inappropriate pooling for management could easily result in failure to meet MMPA objectives. For example, it is common to have human-caused mortality restricted to a portion of a species' range. Such concentrated mortality (if of a large magnitude) could lead to population fragmentation, a reduction in range, or even the loss of undetected populations, and would only be mitigated by high immigration rates from adjacent areas.

Therefore, careful consideration needs to be given to how stocks are identified. In particular, where mortality is greater than a PBR calculated from the abundance just within the oceanographic region where the human-caused mortality occurs, serious consideration should be given to identifying an appropriate management unit in this region. In the absence of adequate information on stock structure and fisheries mortality, a species' range within an ocean should be divided into stocks that represent defensible management units. Examples of such management units include distinct oceanographic regions, semi-isolated habitat areas, and areas of higher density of the species that are separated by relatively lower density areas. Such areas have often been found to represent true biological stocks where sufficient information is available. In cases where there are large geographic areas from which data on stock structure of marine mammals are lacking, stock structure from other parts of the species' range may be used to draw inferences as to the likely geographic size of stocks. There is no intent to identify stocks that are clearly too small to represent demographically isolated biological populations, but it is noted that for some species genetic and other biological information has confirmed the likely existence of stocks of relatively small spatial scale, such as within Puget Sound, WA, the Gulf of Maine, or Cook Inlet, AK.

In trans-boundary situations where a stock's range spans international boundaries or the boundary of the U.S. Exclusive Economic Zone (EEZ), the best approach is to establish an international management agreement for the species. In the interim, if a stock is migratory and it is reasonable to do so, the fraction of time in U.S. waters should be noted, and the PBR for U.S. fisheries should be apportioned from the total PBR based on this fraction. In a non-migratory situation, the PBR for U.S. fisheries should be calculated based on the abundance estimate of the stock residing in U.S. waters. For situations where a species with a broad pelagic distribution which extends into international waters experiences mortalities within the U.S. EEZ, PBR calculations should be based on the abundance in the EEZ. If there is evidence for movement of individuals between the EEZ and offshore pelagic areas and there are estimates of mortality from US and other sources throughout *the stock's range, then PBR calculations may be based upon a range-wide abundance estimate for the stock.*

Prospective Stocks

When information becomes available that appears to justify a different stock structure or stock boundaries, it may be desirable to include the new structure or boundaries as "prospective stocks" within the existing report. The descriptions of prospective stocks would include a description of the evidence for the new stocks, calculations of the prospective PBR for each new stock, and estimates of human-caused mortality and serious injury, by source. The notice of availability of draft reports with prospective stocks would include a request for public comment and additional scientific information specifically addressing the prospective stock structure. Prospective stocks would be expected to become separate stocks in a timely manner unless additional evidence were produced to contradict the prospective stock structure. Summary information for prospective stocks should be included in the standard table in the SARs that summarizes Nmin, Rmax, etc. for each stock.