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Cover Document for Working Reports on the Endangered Species Act

Summarized and Synthesized
by
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A review of the status of Pacific salmon and steelhead trout of the upper Columbia River basin by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) under the provisions of the Endangered Species Act (ESA) of 1973 as amended in 1978 was announced in 1978 (1). It became apparent as this review proceeded that preliminary criteria were needed before the ESA could be applied to anadromous salmonids. Populations and species required - if possible - some degree of a priori definition. Criteria for critical levels of abundance were needed to identify a population or species as threatened or endangered. Guidelines for potential remedial actions through hatchery preservation and enhancement were also needed to insure that a rational and uniform policy was being invoked.

These requirements led to the drafting of three scientific reports. The first report (2) examined the biological basis for the definition of species (including distinct population segments) of anadromous salmonids. The second report (3) looked into biological criteria for classifying Pacific salmon and steelhead trout as threatened or endangered. The third report (4) considered artificial propagation of Pacific salmon and steelhead trout in relation to the ESA. These three reports will provide the basis and supporting documentation for NMFS policy positions in these and related areas.

This paper is a cover document for these three reports. Their content is summarized wherever possible in non-technical terms in order to broaden the potential audience and thereby increase the usefulness of this combined information. References of this cover document are made principally to these primary documents which, in turn, contain more detailed citations in support of their content.

Identification of species and distinct population segments (Summarized from (2)]

It is broadly accepted among biologists that distinct species of related organisms (e.g., sockeye and chinook salmon) and distinct populations within species (e.g., upriver and downriver steelhead populations of the Columbia River) are reflections of different levels of the same kinds of biological processes. The difference between these two categories is the amount of time that has elapsed since divergence of a particular pair of lineages from a common ancestor. Thus, the divergence of upriver and downriver steelhead populations of the Columbia River probably occurred between 10,000 and 50,000 years ago while perhaps a 100-fold greater time interval separates the divergence from common ancestral stock of sockeye and chinook salmon. It is not surprising, then, that differences between sockeye and chinook salmon are evident to the untrained eye (i.e., are qualitative) because of different evolutionary events affecting each lineage that have accumulated over a fairly long time interval while differences between upriver and downriver steelhead are much more subtle (i.e., are quantitative) and perhaps measurable only by specialized methods. It is also reasonable to assume that an entire spectrum of degrees of difference exists within such a complex group of organisms as native salmonids of the western United States.

It is therefore unrealistic to expect that a set of generalized criteria can be established that would adequately define distinct breeding groups over this full spectrum of population differences. Within the above framework of reference, it is expected rather that some groups of organisms are clearly definable while relationships among others are unclear and undefinable in the absence of definitive data. The terms "species", stock,

and population are conditionally used in this cover document as defined in (4). It must be emphasized, however, that these terms are used only in a very general sense, and that the relationships that they imply can only be established through data that do not presently exist for most groups of anadromous salmonids.

The components of definitive data for identifying stocks and relationships among them need to be established before proceeding further. A hierarchy of presumed relationships based on drainages has been used to define population structures of anadromous salmonids [See (3) and (4)] with linear stream distances between spawning groups being the basis for estimating degrees of relatedness among segments migrating at similar times, and the smallest interbreeding group being represented in the individual spawning stream. This model has provided a useful first approximation for defining distinct stocks in some instances because of the strong homing instincts of anadromous salmonids. However, the model fails to identify discontinuities of stocks reflecting biological or geological events of the past, and ignores innate differences in breeding structures among different species of anadromous salmonids. A stream distance model is therefore inadequate, in and of itself, to identify population structures of anadromous salmonids under the ESA.

An ideal set of complementary data would reflect purely genetic differences and therefore be capable of identifying discontinuities between adjacent populations, and of measuring relationships among groups of populations. Meristic data have achieved these objectives to some degree but interpretations remain confounded by an unknown degree of environmental influence. Electrophoretic data based on purely genetic variations lack direct environmental influence and therefore more closely approximate the

ideal data set particularly when a large number of variants are simultaneously examined. Both meristic and electrophoretic data have proven their complementary value to the stream distance model and are components of an appropriate data base for defining population structures of a particular area.

The requirement for genetic data to adequately define populations places severe limitations on most existing sets of data because of the absence or incompleteness of such data from most situations where action under the ESA is being considered. A general sequence of events leading to the collection of suitable data for describing the breeding structure within a species in a particular area has been outlined (2) and includes first accumulating available background data, then determining by successive approximations what data are missing and obtaining them, and finally, synthesizing the breeding structure of the area from the complete set of data. Although the uncertainties of this process preclude quick decisions in most instances, initial determinations on the basis of limited data are possible in areas where prompt remedial action is warranted followed by a final positive decision when more complete data become available.

Biological criteria for classification of "Species" [from (3)]

Much biological information beyond that required to identify distinct stocks is needed for classification of anadromous salmonids as threatened or endangered. It is particularly important to establish valid criteria for estimating whether or not a particular group is threatened or endangered, and to identify modifications of habitat and other management procedures that would facilitate the rehabilitation of such groups. Criteria for a particular stock being endangered would include data

indicating that the group is no longer capable of replacing itself and thus is destined for extinction; data indicating a steady decrease in abundance would constitute criteria that the group is threatened.

Indices of abundance (e.g., dam counts, redd counts, harvest data) are useful for estimating relative magnitudes of productivity over a number of years, but are subject to potentially misleading variables that need consideration. Joint use of multiple indices over a number of years is recommended as a basis for status determination. Dam counts are excellent sources of data for absolute numbers of fish returning to a particular area. These numbers alone, however, do not tell the entire story about the health of the particular spawning group because small escapements that more than replace themselves in the next generation are intrinsically healthier than larger escapements that consistently fail to maintain themselves. Redd counts are reliable indices of spawner abundance but tell nothing about events leading to fluctuations between generations. Harvest data under relatively constant fishing pressure are a reliable index of overall abundance but are usually a reflection of the simultaneous contributions of many breeding groups as well as varying harvest regulations from year to year, and are therefore of rather limited use in ESA reviews.

The ratio of individuals surviving to adulthood (i.e., recruits) in particular stocks or populations to the number of spawners giving rise to these survivors is called the production rate, and this ratio is probably the best single piece of information for evaluating the status of the breeding group. Production rates are affected by factors such as competition, disease, climatic events and predation. A recruitment curve graphs the number of recruits to spawners. Isolated adverse conditions may occasionally reduce the ratio of recruits to spawners below 1:1 without

indicating an unhealthy situation for a population unit. However, a ratio consistently less than 1:1 is a logical threshold for endangered classification. No recruitment/spawner ratio can be identified as a point where a particular group can be considered threatened because different groups tend to have different ratios that vary within predictable limits according to intrinsic environmental components.

Anadromous salmonids have different habitat requirements throughout their life cycles. The complete loss or alternation of any habitat segment could lead to the extinction of a particular stock or population while loss of a part of a segment may not necessarily jeopardize the group. For instance, if spawning of a particular population occurred in five streams and one of these streams was blocked by a dam, the habitat would have been reduced but not threatened because of the continued healthy productivity of the remaining streams; however, blockage of all streams would seriously threaten the entire group. Habitat degradation through factors such as sedimentation, water withdrawals, temperature increases, impediments to migration and pollution may also reduce the productivity of a stock or population. However, quantitation of the effects of degradation on the productivity of the unit is often difficult. A comparison of current and past use of fresh water spawning and rearing habitat is potentially useful for determining the status of stocks and populations although supportive data are needed to determine the causes of low densities.

The biological conditions and criteria that would be grounds for classifying a stock or population as either endangered or threatened are listed below. Criteria for endangered classification are listed first because they are less subjective and more easily defined, even though a breeding unit would usually be threatened before becoming endangered.

ENDANGERED: A stock or population would be in danger of becoming extinct when:

A. Production rate - A production rate of less than one recruit per spawner is persistent, regardless of the size of the escapement, with no return to higher rates envisioned.

B. Habitat - 1) all of the essential habitat needed by any life stage of a breeding unit (i.e., spawning, freshwater rearing, estuary rearing, migration routes) is destined to become unavailable, or is no longer available, and

2) the essential habitat for any life stage of a breeding unit has been degraded to such an extent that sufficient recruits to replace the parent generation are no longer being produced.

C. Indices of abundance - A persistent downward trend in abundance is evident in all indices and spawning escapements are only a small fraction of former levels. An all encompassing, quantitative value for this criteria cannot be set because of the large variation in breeding unit characteristics and the factors regulating abundance.

THREATENED: A stock or population would be threatened with extinction when:

A. Production rate - 1) barely more than one adult recruit is being produced per spawner (production rates greater than 1:1 but less than 2:1) and

2) the production rate has been consistently decreasing with no return to higher rates envisioned under existing conditions, and

3) the barely more than 1:1 production rate is a reduction from former years and has occurred with optimum or smaller than optimum numbers of spawners.

B. Habitat - Continuing significant losses or degradation of critical habitat for any life stage that would reduce the productivity of a breeding unit.

C. Indices of abundance - No universal criteria.

Additional criteria on production rates (redds, harvest, etc.), habitat (rate of use), or absolute abundance may be developed and used for specific stocks or populations. Such criteria would be tailored to fit a particular situation and cannot be listed as a criteria that would apply universally.

Artificial Propagation [from (4) and (2)]

Two questions concerning artificial propagation are raised in the context of the ESA: 1) should stocks or populations that must be maintained or supplemented by artificial propagation be protected under the ESA, and 2) can artificial propagation be used to perpetrate threatened or endangered groups without losing the characteristics that make them unique and worthy of consideration under the ESA? The differences between artificial propagation under the ESA and for other purposes must be examined in order to answer these questions.

The traditional uses of artificial propagation of salmon and steelhead have been to increase the numbers of fish available to a particular fishery. Hatchery stocks have genetically adapted to accommodate such features as crowded rearing conditions and restricted and altered spawning times. There has also been a tendency among production hatcheries to modify their genetic makeups through transfers of fish in and out of different facilities according to the needs and capacities of different facilities. Such genetic changes in production hatcheries are often inevitable and sometimes desirable but are contrary to goals of ESA

protection which seeks to preserve the original genetic status of the stock or population in question. However, it is possible to minimize the effects of hatchery maintenance through modifications of cultural procedures. Given the alternatives of extinction or artificial perpetuation, an affirmative answer is warranted to both of the above questions if the group in question is sufficiently valuable under the criteria of ESA.

Two different types of situations exist where artificial propagation may be needed for anadromous salmonids under the ESA. The first concerns habitat that has been irretrievably lost where the only options are indefinite artificial propagation or relocation. The second situation concerns instances where essential habitat remains but high mortality has nevertheless shifted production rates into threatened or endangered categories; an additional option of supplemental artificial propagation to augment natural spawning is available to this situation. This latter option could preclude the closure of a fishery brought about by simultaneous harvest of the unaugmented threatened or endangered stocks or populations with healthier groups.

The question of combining stocks for convenience in artificial propagation under the ESA is highly pertinent. It will probably be necessary to combine individuals from different spawning areas because of the impracticality of separate artificial propagation of a sizeable number of presumably similar groups. However, the inability to properly decide genetic relationships among stocks solely on the basis of geographic criteria has been established above (2). It is therefore necessary to have good genetic data that allows understanding of relationships among apparently similar groups before any combining is done, and to avoid combining of dissimilar stocks.

Certain practices common to production hatcheries that must be modified for artificial propagation under the ESA include (1) rearing conditions favoring reduction of territoriality, (2) propagation of a limited temporal segment of the natural run, (3) non-random selection of breeders generally favoring larger individuals, and (4) limited numbers of founder individuals. Care must be taken to avoid each of these tendencies in the establishment and maintenance of artificial propagated breeding units under the ESA.

Once it has been determined that artificial propagation is needed to prevent the extinction of a "species" warranting ESA protection and preservation, the following guidelines seem to be appropriate in view of our present state of knowledge on the effects of domestication of salmon and steelhead:

1. Native stocks of salmon and steelhead are usually the best adapted to survive in the environment of their home range. Artificial propagation under the ESA should be viewed as a means of perpetuating a unique segment of the stock in question. Retention of the genetic features of each unit that may contribute to its viability in the wild should be a high priority consideration in all propagation processes.

2. Whenever possible, stocks that are threatened or endangered should be propagated separately to minimize the alteration of the genetic structure of each stock from infusion of genes from outside stocks.

3. If populations are threatened or endangered, and it is impractical to propagate each of the stocks individually, sufficient representative stocks should be propagated so that each of the major groups can be supplemented with a hatchery stock that has similar characteristics.

4. The extend of propagation should be no more than is needed to prevent a particular unit from becoming threatened or endangered. For example, if spawn taking and stocking of rearing areas with fry to assure full seeding will increase the stock productivity the desired amount, then rearing fish to smolt stage should not be undertaken.

5. Spawners selected for artificial propagation should be representative of the stocks to be supplemented in terms of timing of maturity and age-size structure.

6. Periodic additions of wild fish to the hatchery stock may be needed to increase wild characteristics that may have become reduced through the cultural process.

7. Care should be taken to not eliminate segments of a stock because they are inconvenient to handle or do not become smolts at the same rate as other segments of the stock.

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