

The stock concept revisited: perspectives on its history in fisheries

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Abstract

A fish stock concept should be defined by using inherited characters. Expression of these characters whether as particular phenotypes (i.e. from morphology, life history patterns and actions related to man) must be evaluated carefully with regard to longevity, variability and defined fish habitats. The history of the concept shows the close relationship of methods to the development of genetic emphasis in the concept. The past, present and future of the stock concept for fish is discussed with the conclusion that genotypic and phenotypic markers with generational repeatability would be helpful for the best application of a stock concept. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Fish stock concept; History; Perspectives

1. Introduction

A stock concept (Booke, 1981) is important to mankind because it can be used to help manage fish resources wisely for food use and also preserve genetic diversity. As new methods develop, they tend to force the issue of marker resolution and definition as required for a stock concept. Murray (1961) offers a variety of meanings for the word *stock*, and shows that since the 14th century the biological meaning of *stock* has been reversed. The term has been used recently to define what is presently called a species, as well as units within a species that are a race, a population or a subpopulation. Prior to these meanings, the term was used to mean the source of a line of descent.

The basic premise behind a modern definition of the stock concept, in general, is whether there is a marker, genetic or phenotypic, that will remain the same without much variation for all identification applications over time. It has been thought that as we use different biochemical characteristics, the closer we get to use of DNA and know how it is expressed at the population level, the marker of choice will be found. The facts about DNA and other molecular markers, however, do not indicate that the solution for a universal marker has been found (Ihssen et al., 1981; Carvalho and Pitcher, 1994). Phenotypic markers used without an understanding of their inheritance can lead to false acceptance of a stock unit.

Heincke (1898) can be credited with the first modern use of a stock concept to refer to groups of herring, *Clupea harengus*, as defined by means of phenotypic characters. From the beginning of the 20th century until 1945, many different kinds of fish body mole-

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cules were used to define species-specificity (Booke, 1964; Ligny, 1969). But, their marker use was limited because we lacked an understanding of the genetic basis of marker inheritance in order for these molecules to be used as specific markers. Irwin and Cumley (1940) showed conclusively that in pigeon crosses, species-specificity of certain serum proteins fell within the pattern of Mendelian inheritance. This important work along with other studies on fish (Deutsch and Goodloe, 1945) helped to stimulate more work involving markers with a known genetic basis. By the 1950s protein electrophoresis helped to produce an immense literature on fish species-specific proteins and their use in stock concepts. Where the methodology did not solve the problems of resolution required for fish group identification, newer methods were investigated.

Each decade from 1950 on had a favored series of biochemical or a combination of biochemical and morphological characters to be used to aid in development of a fish stock concept. From 1950 to 1980, protein electrophoresis was the favored methodology. Chromosomes (1960 through the 1980s) were useful for species identification, but they did not offer much hope for a species unit identifier. More use of proteins occurred in the 1970 decade and then from 1980 to the present, DNA and microsatellite DNA have been used to define markers and a stock concept (Hallerman and Beckmann, 1988). Whether the marker was a specific protein or DNA, each methodology had its shortcomings and eventual difficulties for defining a stock or group of fish that lived in a specific habitat and bred true in succeeding generations such that a marker could identify this process (Carvalho and Hauser, 1994).

At the present time, whether protein electrophoresis, chromosomes, DNA or morphological characters are used singly or in combination, a reasonable defined stock concept can be applied to fish groups. I would further emphasize that any acceptable stock concept could be applied using markers that are inherited and can define a specific fish group plus its habitat. This particular approach would permit use of inherited characters and the habitat the fish live in as a basis for a working stock concept. By using specific methods even with their shortcomings, a stock concept then depends on the defined methods and conditions under use that can be duplicated and confirmed.

In the future, even if fish culture or natural selection changes a specific marker, the event would be detected by a defined methodology (e.g., monitoring) and biological meaning or consequences could be understood. The use of specific habitats or evolutionarily significant units (ESU) versus limitations on their number used in diversity preservation (Waples, 1995) would be less controversial if a defined genetic marker and its behavior over time was evident.

We have experienced a history in fish stock concept usage where body molecules and morphology have been used with little or no knowledge of their inheritance and on to the present where highly specific DNA molecules can fingerprint individual fish. For each set of molecules to be useful as a stock marker, their functional behavior in stock units has to be understood and monitored in terms of genetic behavior for use in understanding stock specificity of the marker and its continuity.

The STOCS Symposium (Berst and Simon, 1981) brought together scientists to develop an updated fish stock concept, examine prospects for preserving gene pools and potentials for the concept's use in fish culture, seek applications for managers, and develop concept use for regulating fisheries. The amount of literature since published on the stock concept in fisheries (Utter, 1994) was certainly stimulated by this 1980 symposium and further encouraged the development of the symposium of which this paper is a part (Begg et al., 1999, these Proceedings).

I was one of the fortunate persons who helped organize and participate in the STOCS Symposium. The symposium led to many later symposia on stock concept, gene pool preservation, concept uses in fish culture and management applications. For me, one of the most important scientific aspects that developed at STOCS was to encourage investigators to assess further genetic behavior and possible consequent changes in relationship to marker inheritance. If markers were to be valid, they had to have a well-understood background along with how they worked as a marker over time. In this manner, a marker's basis whether genetic or phenotypic becomes effective in management use for preservation of genetic diversity.

Few studies have been completed on marker genetic behavior as described. I believe that there are sufficient published stock concept definitions (Booke, 1981; Ihssen et al., 1981; Carvalho and Hauser,

1994) to be used as working guidelines for stock recognition. But, the stock concept conundrum and possible stock mis-identification occurs when the marker is not easily recognized or not valid. It is here that future work is needed if a defined stock concept is to work for fish resource managers.

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