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Current methods for setting catch limits for data-limited fish stocks in the United States

David Newman[a,*], Jim Berkson[b,1], Lisa Suatoni[a]

[a] Natural Resources Defense Council, Oceans Program, 40 West 20th Street, New York, NY 10011, USA
[b] National Marine Fisheries Service, Southeast Fisheries Science Center, RTR Program at the University of Florida, PO Box 110410, Gainesville, FL 32611, USA

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ABSTRACT

This paper examines how the requirement for annual catch limits (ACLs) has been implemented for data-limited stocks in all federally-managed fisheries in the United States. The legal mandate to establish ACLs in the U.S. has spurred substantial scientific advances, including the development and adoption of at least 16 methods for establishing catch limits for data-limited fisheries. This study analyzed the assessment methods that form the basis of ACLs, those which determine the overfishing limits (OFLs) and the acceptable biological catches (ABCs). Nationally, 30% (150) of OFLs/ABCs are currently calculated using conventional data-rich assessment methods, 11% (59) using data-moderate methods, and 59% (295) using data-poor approaches. There is substantial variation in the proportion of stocks that are currently managed with data-rich versus data-limited methods across regions, and there are clear geographical patterns in the types and diversity of methods being utilized to calculate OFLs/ABCs. Data-poor methods are the most commonly used OFL/ABC-setting methods in the U.S., particularly in the Southeast, Atlantic highly migratory species (HMS), Pacific, and Western Pacific regions. The Southeast and Atlantic HMS regions use some form of catch scalar or an ABC of zero landings for each data-limited stock. The Pacific and North Pacific regions currently employ a higher diversity of data-limited methods than any other region; these include both data-moderate methods and data-poor methods. Regional disparities in data-limited method development and implementation are attributed to regional differences in the number of stocks being managed, the data types and lengths of the time series available, and the resources dedicated to data processing and stock assessment. Recommendations for improving management of data-limited stocks include establishing a complete inventory of all available data for each managed stock, dedicating resources and expertise to data-limited method development and evaluation, and developing a more streamlined assessment process to handle the expanded volume of stocks requiring ACLs.

1. Introduction

One of the most significant changes to the Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA) due to the 2006 amendments was the requirement for scientifically-derived annual catch limits (ACLs) for all federally-managed stocks in the United States, with some limited exceptions. By making this change, the U.S. Congress introduced a standard mechanism to limit catch and trigger measures to ensure accountability. While the adoption of ACLs for well-assessed stocks did not require significant new scientific methods, it had the power to transform the science for, and management of, previously unassessed stocks with limited data and/or assessment resources to analyze unprocessed data. These stocks, and the methods used to set ACLs for them, are referred to as "data-limited."

It is well acknowledged that ACLs have been effective at preventing overfishing and rebuilding assessed and relatively data-rich stocks, which has resulted in significant economic and social benefits (NMFS, 2013c). Since ACLs began to be implemented in 2010, the number of assessed stocks subject to overfishing has been reduced from 16% to 10% (NMFS, 2010a, 2013a), while the average U.S. commercial landings and revenues for 2011 and 2012 were at or near the highest levels seen in the previous 15 years (NMFS, 2012, 2013b). The application of ACLs to data-limited stocks and the methodologies for doing so are relatively new and thus less well developed and understood.

* Corresponding author. Tel.: +1 212 727 4557.
E-mail addresses: dnewman@nrdc.org (D. Newman), jim.berkson@noaa.gov (J. Berkson), lsuatoni@nrdc.org (L. Suatoni).
[1] Tel.: +1 352 294 0887.

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Glossary of Acronyms.

ABC	Acceptable biological catch
ACL	Annual catch limit
CFMC	Caribbean Fishery Management Council
DB-SRA	Depletion-based stock reduction analysis
DCAC	Depletion-corrected average catch
exSSS	Extended simple stock synthesis
FMP	Fishery Management Plan
GMFMC	Gulf of Mexico Fishery Management Council
HMS	Highly migratory species
MAFMC	Mid-Atlantic Fishery Management Council
MSFMCA	Magnuson-Stevens fishery conservation and management act
NEFMC	New England Fishery Management Council
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
OFL	Overfishing limit
ORCS	Only reliable catch stocks
PFMC	Pacific Fishery Management Council
SAFMC	South Atlantic Fishery Management Council
SSC	Scientific and Statistical Committee
WPFMC	Western Pacific Fishery Management Council
XDB-SRA	Extended Depletion-Based Stock Reduction Analysis

Historically, many of these unassessed stocks were overlooked by fisheries managers due to their relatively low commercial landings compared to the more commercially-valuable fisheries. This lack of prioritization has meant fewer resources expended for data-collection and assessment of these stocks. This changed when the U.S. Congress mandated the adoption of ACLs for most federally-managed stocks, including hundreds of previously unassessed, data-limited ones. Congress intentionally designed the ACL mandate broadly to include previously unassessed stocks to drive improvements in data collection and research into more precise assessment methods, and to improve the reliability of management measures to restrain mortality within sustainable levels (US Senate, 2006). The ACL mandate was widely supported, including by the U.S. Oceans Commission (US Commission on Ocean Policy, 2004), and the National Marine Fisheries Service (Witherell, 2005), and the mandate has the unanimous consent of all U.S. fishery management councils (US Senate, 2006).

This policy shift toward fully-managing data-limited stocks by requiring ACLs signaled Congress' desire to extend a well-tested management approach to all U.S. fisheries, including those that have traditionally been referred to as minor stocks due to low landings or revenues. The traditional measure of value for a fishery – resource extraction as quantified by landings and ex-vessel revenues – does not fully capture the economic and ecological importance of many data-limited stocks. Many data-limited stocks are significant components of recreational fisheries, which generated $56 billion in total economic output in 2011, yet released 63% of the 380 million fish caught (Lovell et al., 2013; NMFS, 2013b). Non-extractive uses of fisheries resources, such as catch-and-release fishing, diving, and wildlife viewing from boats, have been shown to be economically comparable to the value of commercial fisheries in the same region (Ihde et al., 2011; Ruiz-Frau, 2013). Lightly-targeted stocks also provide forage for more highly-valued, target stocks (e.g., Atlantic butterfish) or play other important ecological roles, such as the trophic energy transfer provided by parrotfishes in coral reef ecosystems (Bellwood, 1996; Choat, 1991).

Implementation of the 2006 ACL requirement has been a significant undertaking by the fishery management councils and NMFS. Regional differences in fish species, data availability, preferred modeling approaches, and fishery management council procedures provide an opportunity to examine the range of challenges and solutions to effectively managing data-limited stocks. This paper presents a summary and assessment of how the ACL mandate has been implemented for data-limited stocks in the U.S. Berkson and Thorson (2014) previously presented the number of ACLs in use by region, but limited their analysis to the overall number and percentage involving catch-only methods by region. This paper describes regional variations, analyzes progress and continuing challenges, and provides recommendations for improving the consistent use of best practices.

2. Methods

We reviewed all 47 federal fishery management plans to examine how the ACL provision has been implemented for data-limited stocks in the U.S. Additionally, we communicated with NMFS stock assessment scientists and fishery management council staff to verify our findings and to identify changes being proposed for 2015. The MSFCMA requires that ACLs must be set at or below the acceptable biological catch (ABC) level as defined by a fishery management council's scientific and statistical committee (MSFCMA, 2007). According to NMFS's Guidelines, the ABC must be set at or below the overfishing limit (OFL) that is prescribed by the most recent stock assessment, with the difference between the OFL and ABC based on a pre-defined control rule that is intended to account for scientific uncertainty in the OFL estimate (NMFS, 2009). In cases where a conventional stock assessment has not been conducted, as is typical of most data-limited stocks, other measures of reproductive potential and biomass may be used as reasonable proxies for OFL (NMFS, 2009).

In practice, fishery management councils have not applied this approach consistently in setting ACLs for data-limited stocks. Only in some cases are ABCs for data-limited stocks calculated using the two-step process described above where a data-limited method is used to calculate an OFL for a particular stock and the OFL is modified by a pre-defined control rule to calculate the ABC (e.g., ABC = 0.75 × OFL). In other cases, the same data-limited method is used to calculate both the OFL and ABC in relation to each other (e.g., OFL = 2 × catch scalar; ABC = 1 × catch scalar). In yet other cases, a data-limited method is used to calculate the ABC directly, while the OFL is listed as "unknown." Given this diversity of approaches, we refer to each data-limited method calculation as an "OFL/ABC calculation."

There are many ways to classify assessment and OFL/ABC-setting methods in terms of data availability (Berkson and Thorson, 2014; Vasconcellos and Cochrane, 2005). For purposes of this paper, "data-rich" OFL/ABC-setting methods are defined as those derived from conventional methods for fisheries stock assessments (e.g., surplus production models, virtual population analysis, or statistical catch-at-age models). These methods are based on population models that synthesize data that may include catch, relative abundance, and biological information to determine current stock size and fishing rate relative to maximum sustainable yield. "Data-limited" OFL/ABC-setting methods include those that lack sufficient information to conduct a conventional stock assessment. Data-limited methods are further defined along a continuum between "data-moderate" and "data-poor." A method is defined "data-moderate" if it provides some dynamic feedback on stock status based on information such as an index of abundance or biological sampling data. A method is considered "data-poor" if it is based on static assumptions that lack any feedback about current or historical stock status. Data-poor methods are generally based on catch history, as informed by expert judgment.