

Measuring the social and economic performance of catch share programs: Definition of metrics and application to the U.S. Northeast Region groundfish fishery

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ABSTRACT

In May 2010 the New England Fishery Management Council introduced a catch share, program in the Northeast Multispecies (groundfish) Fishery. Amendment 16 of the Northeast Multispecies Fishery Management Plan allocated quota to 17 self organized groups of permit holders based on their collective catch history. These groups are commonly referred to as Sectors and are similar to harvest cooperatives. Sectors represented a significant shift from previous management approaches reliant on limits to days at sea and other input controls. Given the potential for significant social and economic effects of catch shares and other management programs, social and economic performance measures were developed from 2009 to 2010 by Northeast Fisheries Science Center (NEFSC) social scientists. Previous social and economic monitoring of management outcomes had been ad hoc and provided minimal opportunity for inter-fishery comparison. This paper describes the process of identifying performance measures and associated indicators to serve as the foundation of monitoring social and economic outcomes for all federal fisheries in the U.S. Northeast Region, and for planning NEFSC social and economic research priorities. It then presents how these performance measures were applied to assess the first year of the Amendment 16 Sector program. Challenges and limitations of this process are presented along with a description of efforts underway to broaden the use of these social and economic metrics to other fisheries.

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1. Introduction

The development of social and economic indicators to inform policy making began in earnest in the 1960s [1]. Researchers then and since have sought to develop indices that both speak to policy needs and have the academic rigor necessary to allow meaningful analyses [2]. Some track purely objective economic indicators (e.g., Consumer Price Index) while others primarily track subjective indicators across a variety of domains [3,4] and others do both [5,6].

In fisheries in the United States, basic economic and some social data have been tracked by NOAA/NMFS¹ for some time. *Fisheries of the U.S.*, available annually online back to 1995 and in print to 1959, includes national level data on landings, ex-vessel prices and the value of U.S. processed fishery products and imported seafood. *Fisheries Economics of the U.S.*, published annually online since 2006, provides national, regional and state

level data on commercial and recreational economic impacts trends (e.g., jobs, income, sales, value added, ex-vessel value). *Fishing Communities of the U.S.* (providing primarily basic census data) was first published in 2006 and has not been updated, as regions have individually published fishing community profiles that combined census and fishery data. However, all these data are intended to describe in broad strokes the characteristics of the fisheries and communities rather than to illuminate social and economic changes via targeted indicators that support a process of ecosystem-based adaptive management.

In this paper the authors describe, as social scientists within NMFS' Northeast Fisheries Science Center, a process undertaken to define and implement a framework for examining social and economic outcomes of fisheries management in the U.S. Northeast Region (Northeast) to be used for directing investments in social science research as well as supporting more effective and informed fisheries management in the region. It then discusses NEFSC use of these measures to assess the first year of the Sector program, and future plans to apply this process to other fisheries and improve the available input data.

U.S. marine fisheries management is overseen and approved by NOAA/NMFS, but day-to-day crafting of regulations occurs largely

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¹ The U.S. National Marine Fisheries Service (NMFS), the agency that oversees all management of U.S. marine fisheries, is located within the National Oceanic and Atmospheric Administration (NOAA).

through regional fisheries management councils. Council members and stakeholders have voiced concerns over the difficulty of fully integrating social science into management discussion [7,8]. This limits council and NMFS ability to practice the ecosystem-based, adaptive management they have been charged to do by legislation (MSA² Section 406(a)–(f)), executive order (E.O.13547) and NOAA policy [9]. Part of the difficulty has lain in the lack of appropriate social and economic trend data to complement existing biological trend data. Ecosystem-based management requires social and economic data as well as biological and ecological data [5,6], and adaptive management requires trend data [10], to assess when a course change is warranted.

In May 2010, the New England Fishery Management Council (NEFMC) introduced a new catch shares program via Amendment 16 to the U.S. federal Northeast Multispecies³ (groundfish) Fishery Management Plan (FMP). As a fundamental part of this program, quota was allocated to each of 17 groups of self-organized and self-managed permit holders (called Sectors). Allocations to Sectors were based on the catch history of their individual members. While encouraged by NOAA/NMFS at the policy level [11] (see Fig. 1 for current U.S. programs), catch shares are not without controversy in the U.S. Seen by some as the ideal tool for reining in overfishing and improving efficiency, others have deep concerns about potential economic, social and cultural consequences including fleet consolidation and coastal community impacts.

2. Developing social and economic performance measures for Northeast Fisheries

To measure the performance of this and other Northeast FMPs, NEFSC social scientists initiated a process in 2009 to identify and define social and economic performance measures. Previous social and economic monitoring occurred on an ad hoc basis, limiting opportunities for cross fishery comparisons. Given the controversy surrounding Amendment 16 [12–21], the large number of fishermen involved (see Section 4.1), the many social and economic objectives of this Amendment (see Section 4.2) and the likelihood of a major transformation to the social and economic context of the fishery, it was critical to measure and track the social and economic performance of this program. Additionally, because of the widespread interest and impact of these new measures, NEFSC felt it especially important to include fishermen and other stakeholders in the indicator development process. This approach was also supported by now well documented research [22–24] indicating that stakeholder participation is likely to lead to more legitimate and effective outcomes.

To identify relevant regional social and economic performance measures, legal requirements, management objectives, academic literature and reports from non-governmental organizations (NGOs) on management impacts for overall commonalities and expected outcomes of catch share programs were reviewed. The authors developed a draft set of indicators based on that review that was vetted by the full NEFSC Social Science Branch (SSB) staff. Input was sought from industry leaders, the Mid Atlantic and New England Fishery Management Councils, staff at the NMFS Northeast Regional

Office (NERO), academics and other regional NMFS social scientists to further refine the measures and ensure their saliency to the region. Presentations were made at council meetings to reach out broadly to the fishing community and other interested parties. Additionally, outreach meetings were held opportunistically in the field to try to reach groups that might not attend more formal (and lengthy) council meetings. Importantly, because crew members are typically under represented at public meetings, a contract was initiated with the Gulf of Maine Research Institute to conduct extensive field interviews to integrate crew perspectives into the final set of performance measures and indicators. To seek maximum industry involvement, NEFSC informed regional press of our efforts [25].⁴

2.1. Literature

In the academic literature, fisheries-specific examples of indicators include the Jepson and Jacob vulnerability index [26,27], the Canadian Genuine Progress Index [28] focusing on resilience, the Pollnac et al. [7] Fisheries Social Impact Assessment Model focusing on well-being, the Tuler et al. [29] analysis of vulnerability, the Mahon et al. [30] approach to governance characteristics of large marine ecosystems, the World Bank [31] case for fisheries reform, multiple studies of job satisfaction [32,2] and numerous applications of economic indicators [33–39].

Another set of literature concentrates on variables related specifically to catch shares and the related concept of property rights. Overall, the academic literature⁵ shows that where property-like systems are implemented, vessel profitability rises—largely due to increases in output prices [40,41,35,42–44]. This may be accompanied by consolidation. While consolidation can be good for vessels that remain in the fishery, fishing communities overall can experience negative impacts to local economies [45–48] and sociocultural fabric [49–53]. Results on stewardship and safety are mixed [54,–60,53,61]. Finally, catch share programs may lead to higher monitoring and enforcement costs for the fishing industry and higher organizational costs for cooperatives and similar organizations [53], though lower costs for government [62].

Environmental groups have also been actively engaged in the discussion of indicators specifically related to catch share programs. For example, the Environmental Defense Fund [60] proposed compliance, safety, capacity, season length, boat yields, revenues, employment, and ownership concentration. More recently, the Meridian Institute and MRAG Americas [64], under grant to the Betty Moore Foundation, proposed measuring stock condition, discarding, quota compliance, ability to match catch to quota, operational flexibility, participation in stock assessment/cooperative research/use of experience-based knowledge, decentralized decision-making, capital/infrastructure and fishing community employment.

Most of these indices – whether specific to property/pseudo-property (e.g., catch shares) or to fisheries more generally – rely on objective measures, because subjective data are harder to acquire [28]. Yet people's subjective experiences are often at odds with their objective condition [70,71]. Thus indices without subjective measures may miss important trends, as well as differences between groups [72,2].

2.2. Management requirements

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires U.S. fisheries to adhere to 10 National Standards (NSs) (16 U.S.C. 1851 § 301), including many directly related to social

² Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended through 2007 (16 U.S.C. § 1801 et seq.).

³ Species currently managed under the FMP are: winter flounder (blackback, lemon sole) (*Pleuronectes americanus*), Atlantic cod (*Gadus morhua*), dab (American Plaice) (*Hippoglossoides platessoides*), haddock (*Melanogrammus aeglefinus*), Ocean pout (*Macrozoarces americanus*), pollock (*Pollachius virens*), redfish (*Sebastes fasciatus*), red hake (ling) (*Urophycis chuss*), windowpane flounder (sand flounder) (*Scophthalmus aquosus*), witch flounder (gray sole) (*Glyptocephalus cynoglossus*), yellowtail flounder (*Limanda ferruginea*), white hake (*Urophycis tenuis*), Atlantic halibut (*Hippoglossus hippoglossus*) and Atlantic wolffish (*Anarhichas lupus*).

⁴ See [63] for more details on the process.

⁵ For good overviews see [65–69].

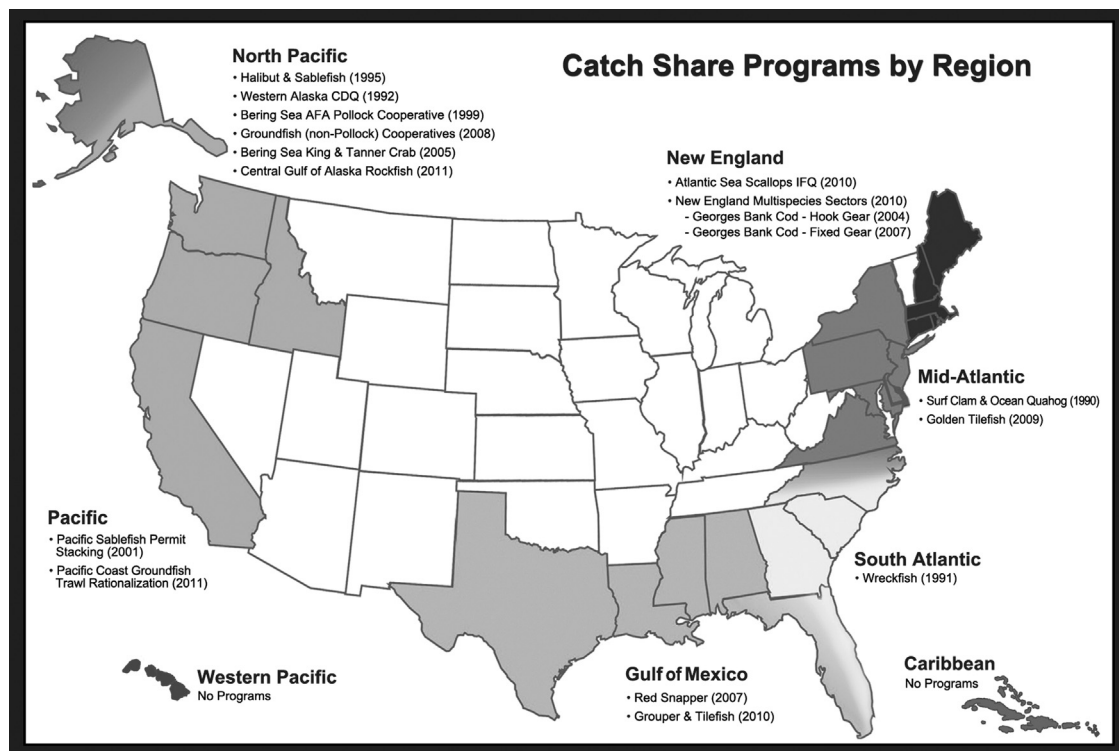


Fig. 1. Locations of all U.S. Catch Shares Fisheries. On the internet at (http://www.nmfs.noaa.gov/sfa/domes_fish/catchshare/catchshare_region.htm) [accessed February 7, 2012].

and economic outcomes: NS4—do not discriminate between residents of different states, NS5—consider economic efficiency, NS7—minimize costs, NS8—take into account the importance of fishery resources to fishing communities, and NS10—promote safety at sea. Within the MSA, the majority of catch share fisheries are managed since 2006 as Limited Access Privilege Programs (LAPPs), required to reduce capacity if needed; promote safety and social and economic benefits; ensure fair/equitable initial allocations; sustain participation of small owner-operated fishing vessels and their fishing communities; avoid excessive geographic/other consolidation; and assist entry-level and small vessel owner-operators, captains, crew, and fishing communities (16 U.S.C. 1853a § 303A).

Stated objectives for FMPs in the Northeast were also reviewed. These vary widely, including across FMPs within a council⁶, and can be contradictory even within a single FMP. For instance, within NEFMC FMPs the social and economic goals and objectives for catch share programs alone include: control capacity, achieve economic efficiency, encourage diversity of the fishing fleet, minimize adverse impacts on fishing communities and shore side infrastructure, promote stewardship, provide incentives to self-govern, prevent excessive consolidation that would eliminate the day boat fishery, prevent overcapitalization and limit new entrants, and allow for regulatory flexibility and adaptation.

3. Final performance measures

Based on the review of literature and policy, and the outreach efforts to industry, academia and other NMFS social scientists, five general outcomes (performance measures) related to management programs consistently emerged: financial viability, distributional outcomes, stewardship, governance and well-being. While not surprising or particularly remarkable, they largely mirror those identified as

critical during other regional efforts to identify key objectives, e.g., [73]. This suggests these areas have been and continue to be salient to a broad range of stakeholders and key in evaluating the social and economic performance of fisheries under different management regimes. To facilitate clarity of discussions and implementation, NEFSC created initial definitions for each performance measure.

In thinking about *financial viability* SSB staff considered the financial condition of fishing vessel owners and crew, fishing households, businesses that provide fishing-related goods and services (e.g., fuel, ice, gear, insurance), and businesses in the marketing chain (processors, dealers, retailers). However, thus far the harvest sector has been the focus since the link to fisheries management is more tenuous for businesses whose success is influenced by a much broader set of factors and because data are currently strongest for the harvest sector.

SSB staff considered *distributional outcomes* as the outcomes and implications related to the distribution of benefits and costs of a fishery management program among individuals, groups, and communities. The major focus is on access/exclusion to quota and fishing opportunities, concentration of quota, and employment opportunities.

Stewardship is defined here as the degree to which participants use the resource in a careful and responsible way and perceive that they are contributing to improving the quality of the resource base. Though the U.S. government is the official steward of the Nation's fisheries, this definition is used because increased stewardship on the part of fishermen is frequently mentioned by catch share supporters as a by-product of catch shares. It is also mentioned in the community-based fisheries literature as an outcome of community ownership of natural resources. Stewardship can be difficult to measure, but interesting options are available in the environmental psychology literature. One set of variables was tested in recent contract surveys on job satisfaction and is being analyzed for effectiveness [85].

Here *governance* is the degree to which stakeholders participate in the process of decision-making and implementation, the perceived and objective transparency and legitimacy of that process, the

⁶ The Northeast Region has two councils: New England and Mid-Atlantic.

effectiveness and complexity of regulations, and the degree of adaptability/flexibility of the management process. An additional component of governance is the cost to government and participants to implement a management program.

As an individual performance measure, *well-being* is narrowly defined as covering individual, family, or group (e.g., firm, community) physical, mental, and psychological health.

More broadly, social and economic well-being is a summary index for all the performance measures [7]. There is a long tradition of studies on social well-being [71]. Nonetheless, such a summary index is complex and difficult to design, and SSB staff are only just beginning to map out a plan for what individual indicators from each performance measure will be included. This process will also involve statistical testing to understand which indicators account for the most meaning [74,75]. Though thorny and challenging, an overall measure of well-being is worth attempting as it will provide a social counterpart to two similar overall measures that are already in use in fisheries management: the biological measure Maximum Sustainable Yield (MSY) and the economic measure Maximum Economic Yield (MEY).

Table 1 provides indicator categories for each performance measure and an initial list of indicators within each category. These indicators are thought to provide reliable, though not definitive, indications or supporting evidence that an outcome has changed. For any indicator, several complementary approaches may be required. For example, change in the amount of bycatch can be an indicator of a change in stewardship because, apart from being influenced by economic factors, this can reflect attention to maintaining ecosystem balance. However, tracking bycatch alone is not a sufficient measure of change in stewardship, even if SSB staff had data showing the intent of fishermen in reducing bycatch was indeed stewardship. The same is true for other indicators identified under this and other performance measures. As a set under each performance measure, however, they provide triangulation that buttresses their effectiveness.

4. Assessing impacts to the groundfish fishery

As anticipated, the first opportunity to apply these indicators, developed in 2009, came from the need to provide information to fisheries managers, policy makers and fishery participants about the social and economic outcomes of the first year of Sector management.⁷ This controversial fisheries regulatory action generated an unusually high demand for this type of information. This analysis of social and economic outcomes was required to evaluate a claim by the state of Massachusetts that the Sector program had provoked an economic disaster [76], and to evaluate whether the new regulations had disproportionately affected any particular groups—in order to formulate mitigating actions, if needed. These needs were addressed in [77], in combination with a contracted study examining subjective, perceived impacts on captains and crew [53]. After a brief description of the groundfish fishery and the transition from input to output controls, the authors discuss how the indicators were applied and modified in producing the NEFSC 2010 Final Report.

4.1. Northeast U.S. multispecies fishery

Atlantic cod, the iconic Northeast groundfish, is a subject of monuments (e.g., the Sacred Cod in the Massachusetts State House [78]) and popular literature (e.g., [79]). Groundfish are the cornerstone of the U.S. Northeast Region's fishing industry, with the greatest

number of vessels of any fishery in the region (1347 limited access permits and 450 vessels landing groundfish in fishing year 2010) [77]. Though a handful of ports account for the majority of landings, the range is large (Maine to Delaware along the U.S. eastern seaboard—see Fig. 2), with many smaller ports depending to varying degrees on groundfish. In the 2010 fishing year, the commercial limited access groundfish fishery produced a combined commercial value of over \$83 million [77] primarily by bottom trawl (about 75%) and gillnet gear (about 20%), but also by longline, hand line, lobster traps and scallop dredges [80], p. 33. There is also a commercial open access fleet, and a significant recreational fishery for groundfish that accounts for over 30% of total landings [81].

An FMP was first implemented for the groundfish fishery in 1986, due to concerns about overfishing [82,83]. In 1994, with the stocks still in decline, limited entry was introduced along with restrictions on the number of days vessels could fish per year. These regulations were paired with closed areas, trip limits, minimum fish sizes, and gear restrictions. In 1997, the days at sea (DAS) were reduced by 83% (50 Fed. Reg. 127711 [May 31, 1966]). Significantly, a partial transition from input control to output control occurred in 2003 when members of the Cape Cod Commercial Hook Fishermen's Association requested and received special status as a "Sector" paving the way to future such allocations to other groups. In return for receiving an allocation of Gulf of Maine cod, the Georges Bank Hook Sector was exempt from select input restrictions. A second Sector, the Georges Bank Fixed Gear Sector, was created in 2005. In addition, DAS leasing was permitted as a method to mitigate the economic impact of DAS reductions.

In 2010, Amendment 16 created the framework under which 17 Sectors formed. Sectors account for over 90% of the groundfish quota (now called Annual Catch Limits or ACLs⁸). Permit holders can join a Sector or remain in a "common pool" that continues to operate under the DAS restrictions. Sectors receive an allocation of annual catch entitlement⁹ (ACE), determined by summing the potential Sector contribution or PSC (based on individual catch history) of each member when they join. It is up to each Sector to determine how its ACE is then harvested by its members. Sectors can trade ACE of specific stocks to avoid going over the limits of each. Permit holders can also change Sectors, but only at the end of each fishing year. If they leave a Sector, their PSC goes with them and the resulting ACE is subtracted from the ACE of the Sector they leave and added to the ACE of their new Sector. Sectors were welcomed by participants who felt they would provide more flexibility and increase economic efficiency, but feared by others concerned about the costs of participation and impacts to communities (including consolidation and loss of the small vessel fleet), among other issues.

4.2. Use and expansion of indicators

To the extent possible, the framework described in Table 1 was used to evaluate the first year of the groundfish Sector program and produce the 2010 Final Report. While not all indicators were used—due to data and time limitations, existing data were complemented by the development of economic models and implementation of timely fieldwork. Though specific goals and objectives of Amendment 16 were not explicitly evaluated in the 2010 Final Report, they were considered in the choice of how the indicators were applied. Those pertinent to social and economic performance include: controlling fleet capacity, achieving

⁸ ACLs are set for specific species and sometimes stocks.

⁹ It should be noted that "entitlement" is an unfortunate term, since this – as part of a catch share – is subject to revocation by the government at any time.

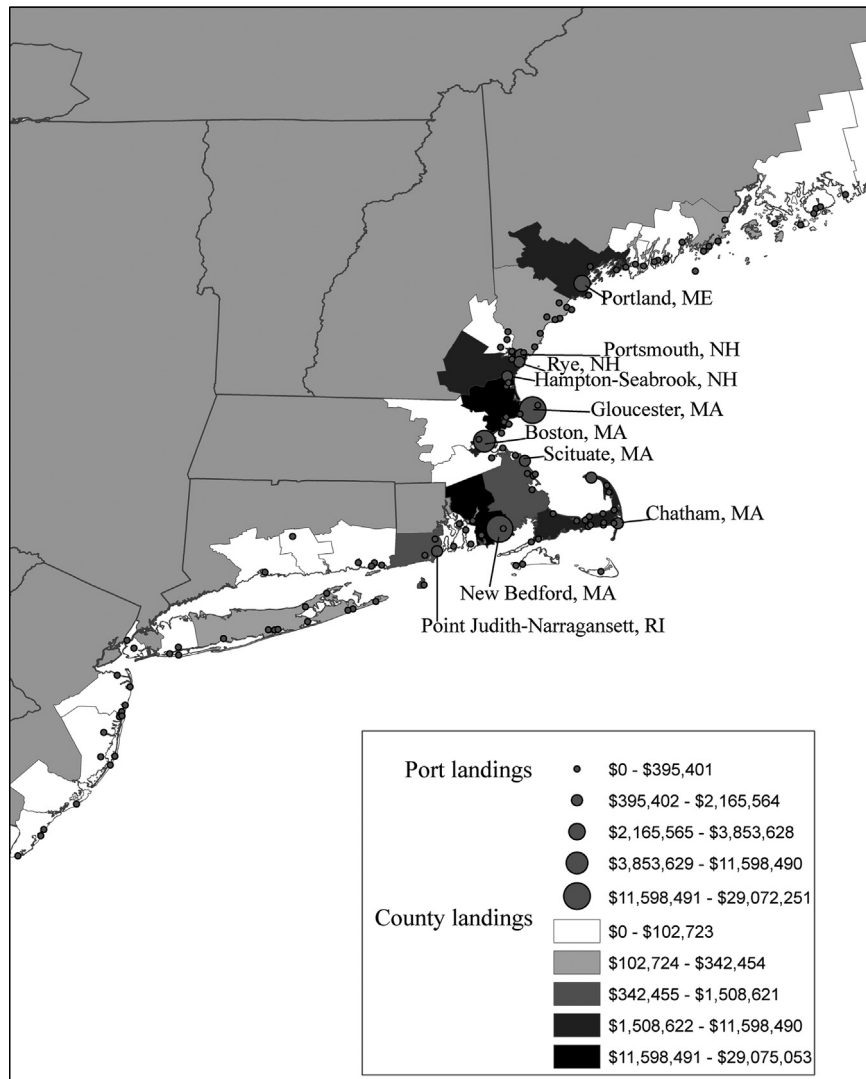
⁷ Officially the 2010 year ran May 2010 through April 2011.

Table 1
Social and economic performance measures and indicators.

| Financial viability | |
|--|---|
| Indicator category | Indicators |
| Profitability and productivity | <ul style="list-style-type: none"> • Malmquist index^a (Technical measure of transformation of inputs into outputs) • Capacity utilization • Revenue per unit effort • Revenue per active vessel^a • Revenue per vessel day^a • Lease price^a • Share price^a • Lease or share price to ex-vessel price^a • Fishing capacity of active vessels^a |
| Landings distributions over time | <ul style="list-style-type: none"> • Chart distribution of landings over time |
| Distributional outcomes | |
| Employment trends | <ul style="list-style-type: none"> • Total annual fishermen days^a • Employment demographics^a • Total number of active crew^a • Average crew earnings by day* • Total crew earnings as a percent of net revenue^a • Changes in crew duties/ payment arrangements • Survey participants about opportunities for new entrants (crew and owners) |
| Ownership trends | <ul style="list-style-type: none"> • Industrial concentration (Herfindahl index) and income distribution (Gini coefficient) • Revenue by vessel type and community/geographic location |
| Price of quota/ability to purchase quota | <ul style="list-style-type: none"> • Lease and share prices • Debt ratio (total debt/total assets) • Survey participants about ability to purchase quota |
| Community scale outcomes | <ul style="list-style-type: none"> • Revenues by community^a |
| Governance | |
| Participation in governance | <ul style="list-style-type: none"> • Survey participants about perception of degree of influence, levels of attendance at meetings, and participation in leadership |
| Effectiveness | <ul style="list-style-type: none"> • Number of regulatory infractions • Quota overages/^aunderages |
| Transparency/legitimacy | <ul style="list-style-type: none"> • Survey participants about perceptions of transparency/legitimacy of governance systems |
| Conflict | <ul style="list-style-type: none"> • Survey participants about changes in the level of conflict |
| Adaptability/flexibility | <ul style="list-style-type: none"> • Survey participants about regulatory adaptability/flexibility |
| Management costs | <ul style="list-style-type: none"> • Survey participants about cost to participate in fishery • Percent of total fisheries revenue spent on participation costs • Survey participants about time spent participating in process, understanding process, attending meetings • Number and/or frequency (time between) of amendments and frameworks per year |
| Management complexity | <ul style="list-style-type: none"> • Size of amendments/frameworks (e.g., length) • Survey participants about perception of management complexity |
| Stewardship | |
| Compliance | <ul style="list-style-type: none"> • Develop compliance index based on enforcement statistics |
| Bycatch/Discards/Highgrading | <ul style="list-style-type: none"> • Measure with existing monitoring data |
| Conservation ethic | <ul style="list-style-type: none"> • Survey participants about perception of compliance |
| Activities that benefit the stock | <ul style="list-style-type: none"> • Survey participants about going beyond the regulations and engaging in other activities that improve the condition of the stock (e.g., improving habitat, developing more selective gear) |
| Well-being | |
| Health status and access to health insurance | <ul style="list-style-type: none"> • Survey participants about health insurance coverage • Develop index based on community level health statistics |
| Community level indicators | <ul style="list-style-type: none"> • Develop indices of community level vulnerability and resilience |
| Port infrastructure | <ul style="list-style-type: none"> • Profile relevant ports |
| Job Satisfaction | <ul style="list-style-type: none"> • Survey participants about job satisfaction |
| Changes in social networks and relationships | <ul style="list-style-type: none"> • Survey participants about social networks |
| Safety | <ul style="list-style-type: none"> • Number of fisheries-related injuries/hospitalizations^a • Number of fisheries-related fatalities^a |

Table 1 (continued)

| Financial viability | |
|---------------------|---|
| Indicator category | Indicators |
| | <ul style="list-style-type: none"> • Number of vessels lost^a • Damage costs^a • Survey participants about perception of riskier/safer fishing practices |

**Fig. 2.** 2010 Nominal Value of Groundfish Landings by Port and County Landed [77, p. 81].

economic efficiency, encouraging diversity within the fishery¹⁰, minimizing adverse impacts on fishing communities and shore-side infrastructure, promoting stewardship, and developing economic and social measures of success. Ultimately, only indicators within the financial viability and distributional issues performance measures were feasible to use at the time of the report.

Two types of comparisons were made in the evaluation: (1) pre-Sector management (fishing years 2007 through 2009) versus post-Sector management (fishing year 2010) and (2) performance of common pool versus Sector vessels. Financial viability indicators

used included a measure of vessel productivity (through use of a Malmquist index), revenue per active vessel, revenue per vessel trip and per vessel day, and an estimate of fishing year 2010 ACE lease prices.¹¹ Charts showing both landings and revenue by month showed the distribution of fishing activity over time (e.g., Fig. 3).

The ratio of ACE lease price to ex-vessel price was not calculated since lease values were only available for fishing year 2010 and therefore the values could not be compared against the 2007–2009 baseline. Improvements in both the quality of the data

¹⁰ "Diversity" was not defined by the Council in Amendment 16, though it will be in the upcoming Amendment 18. NEFSC, however, is currently defining this in terms of the distribution of vessels across different size categories (e.g., gross registered tons (GRT), length) and geographic locations (e.g., ports, states).

¹¹ Since a large portion of the ACE transfer data did not contain dollar values (many were fish-for-fish trades) a model was developed to estimate these missing values.

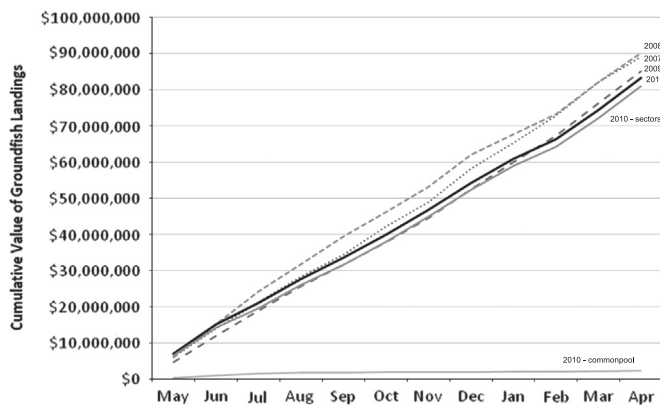


Fig. 3. Cumulative nominal revenue from groundfish (all trips) [77, p. 79].

and the models are expected over time that will facilitate use of the lease price to ex-vessel price ratio as a performance indicator.

An additional profitability indicator was developed. Net revenue, i.e., gross revenue less trip costs, was estimated at the trip level and then expressed as net revenue per vessel, per trip, and per day. Net revenues were also aggregated to the vessel and fleet level. Sector management has led to new costs, including membership fees and monitoring costs. A majority of these costs (including all monitoring costs) were subsidized by NMFS in fishing years 2010–2012, but that it is expected industry will be responsible for these costs in the future. These costs were thus incorporated into the net revenue analysis to show the impact should Sectors eventually be required to cover them.

The primary reason for including the revenue per day indicator in Table 1 is that it was thought to provide a reasonably good estimate of changes in profitability¹², since time at sea correlates closely with costs, and is simple to calculate from standard fish dealer and logbook information. Net revenue estimates require a more extensive level of analysis, since the available cost data comes from a sample of trips and so must be expanded to the population. The net revenue estimates lined up well with the revenue per day values, helping to confirm the assumption that revenue per day may be a good proxy for net revenue and could be used when time and/or cost data are lacking.

Other financial viability indicators provided information on ex-vessel prices and the level of effort in the fishery, in terms of number of active vessels, trips and days absent from port.¹³ Together with revenue, landings, net revenues, and the productivity measure (Malmquist index), this additional information provided context and a fuller understanding of how the fishery was changing over the period evaluated. While a true evaluation of financial viability requires comparing the cost of the effort to the revenue received, changes in effort, revenue, and prices are additional tools for evaluating the financial viability of the fleet.

The indicators under distributional outcomes included estimates of employment trends, ownership trends, number of active vessels, and reporting of many of the financial viability indicators by vessel size category, revenue category, ports where fish are landed and ports declared by vessel owners as “home port” (Fig. 4). Also included were discussions of qualitative data pertaining to distributional outcomes of the impacts of Sectors on crew from [53].

Since actual employment data were not available, estimates of employment were based on the crew size reported on fishermen’s logbooks. Three metrics were used to show yearly changes in the

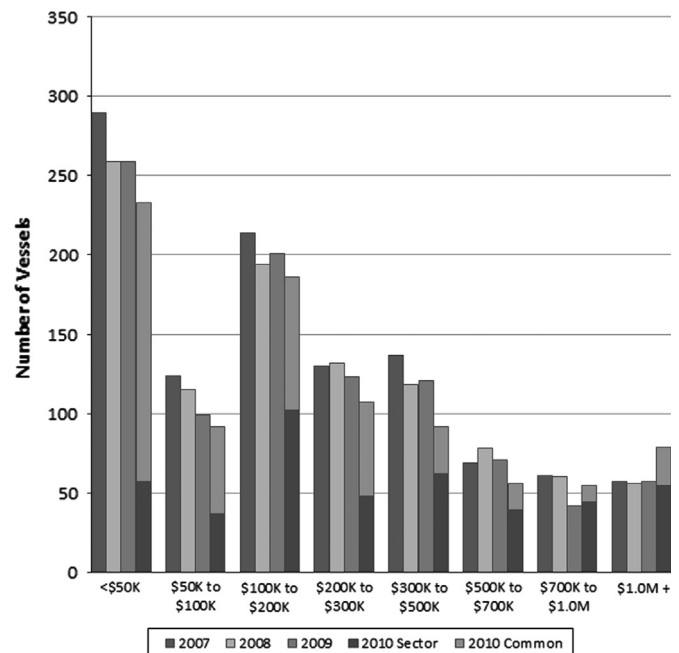


Fig. 4. Number of vessels with revenue from any species by total nominal revenue category (all trips) [77, p. 92].

opportunities crew had to work. The first metric was crew positions, measured by summing the average crew size of all active vessels. This metric represents an estimate of the maximum number of “jobs” available, but does not account for the level of activity within these crew positions.¹⁴ To address time-at-sea, two additional indicators were provided—crew-trips and crew-days. Crew-trips are the sum of crew size across all trips taken and crew-days are the sum of crew size multiplied by the number of days absent from port across all trips taken. An additional indicator, the ratio of crew-days to crew-trips, was used to provide information about changes in trip length. Though the number of active crewmembers may decline, in most cases their annual income increases (though cf. [84]). However, time spent at sea per crewmember may also increase [85] such that levels of job satisfaction and overall well-being are not always improved.

Consolidation in the groundfish fishery was evaluated by yearly changes in the number of vessels that accounted for the top 25% (and then top 50%, 75%, and 100%) of revenue. Fewer vessels earning revenue, especially in the top quartiles, suggests that vessel consolidation occurred. This may correspond to participants leaving the fishery but may also be attributed to owners of multiple vessels consolidating their operations onto fewer vessels. The social and economic implications of these two types of consolidation are very different. To help distinguish between these types of consolidation, available data on vessel ownership were examined. Vessel owner data for the groundfish fishery were available to aggregate vessels into groups according to a common owner or multiple affiliated owners. Changes in the number of vessel affiliations (groups of vessels connected by common owners) earning the top 25% of revenue, and so on, were then used to evaluate consolidation at the owner level.

Measures of consolidation focused on the number of entities earning various components of revenue. Measures complementary to the consolidation indicators, but more generally related to

¹² This measure, however, does not account for increases in input prices.

¹³ Note that DAS are similar to days absent, but measured differently.

¹⁴ For instance, the actual number of crew who currently fill these positions will be less because crew often work on more than one vessel. In some fisheries the number could be greater as crew may “hot bunk”—with two crews working on the same vessel in shifts.

revenue distribution, were also provided. Gini coefficients, which measure the skewness of the distribution of revenue among participants, were calculated at both the vessel and vessel affiliation levels (see Fig. 5).

The application of this framework to the groundfish fishery (particularly during this paradigm shift to catch shares), along with the great demand for copies of the 2010 Final Report and summary presentations, indicates the value of fishery performance indicators to fisheries managers, the fishing industry, and the public. The process of applying the framework to this fishery was a useful pilot test and the evaluation will be used as a template for applying both consistent reporting formats and procedures for calculating social and economic indicators in other fisheries.

The result of applying the indicators to the groundfish fishery showed that three clear changes were evident in 2010 versus the 2007, 2008 and 2009 fishing years: (1) average prices for all groundfish and non-groundfish species were higher, (2) revenue from all species landed (groundfish and non-groundfish) returned to 2007 levels after declining in 2008 and 2009, and (3) groundfish vessel economic performance improved. Ongoing trends from 2007 through 2010 included: (1) total landings, effort, and the number of active vessels declined, (2) opportunities for crew declined, and (3) consolidation of the fishery and concentration of revenue to top earners continued [77].

5. Remaining challenges

Indicators will be added to similar reports over time as new streams of data and new models come online.¹⁵ For example, two new time series surveys to cover a range of basic sociocultural and economic variables for owners and crew are being implemented in the Northeast in 2012. They are based in part on two pilot surveys, a 2010 social capital survey [86] and a 2010–2011 well-being/job satisfaction/environmental stewardship survey [87]. A Fishing Vessel Fixed Cost Survey (implemented annually) was also revised and is being re-administered in 2012.^{16,17} Additionally, a set of socio-economic indices of fishing community vulnerability and resilience, based on statistical analysis of existing secondary data, have been developed. Further, given that human communities are not defined by fisheries and that fishermen in a given community often participate in multiple fisheries, efforts are underway to coordinate fishery and community indicators to augment our understanding of changes over time in social and economic variables related to a broader context than an individual fishery. While the performance measures focus on fisheries alone, NEFSC recognizes that ecosystem-based management and more holistic approaches also need to address multi-fishery issues and issues related to the broader communities and their vulnerabilities. Fishery measures have a real though less direct impact on communities as a whole.

Finally, there are areas of research where surveys are impractical or inappropriate due to the research question (e.g., drug use and its effect on crew turnover) or the small size of the frame (e.g.,

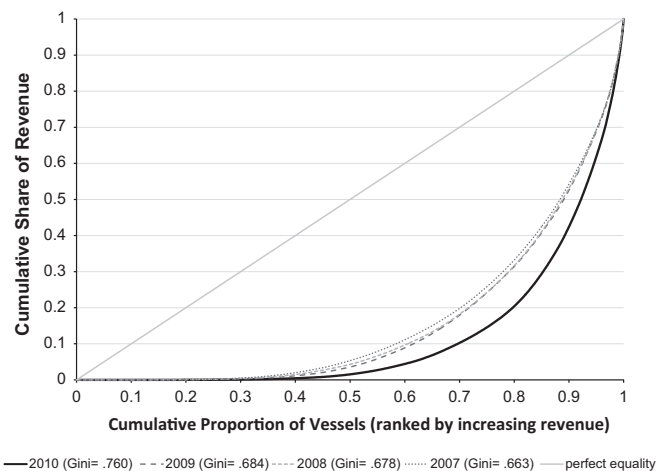


Fig. 5. Lorenz curves and Gini values at the active vessel level for groundfish nominal revenues [77, p. 96].

Sector governance structures) or the status of the population (e.g., legal status of fishworkers). To begin to fill these and other gaps, additional research is underway on topics including Sector governance, consolidation and the concept of excessive shares. Our collection of oral histories to document the human experience of fisheries stakeholders is ongoing. Many of these oral histories are, or will eventually be, housed in Voices from the Fisheries (www.voices.nmfs.noaa.gov). NEFSC is working with NERO to improve understanding of permit ownership patterns and revise permit databases accordingly. NEFSC is also delving into the Coast Guard accident database [88,89].

In implementing indicators created with both existing and new data, significant challenges remain. Not all existing databases were created with research in mind. There is no crew registry or other sample frame for crew; creative yet valid sampling approaches, based on intercept surveys, are being employed for the crew survey. Additionally, outreach efforts with crew were conducted to determine the best method of reaching out to this segment of the industry over time [53]. Finally, while NEFSC is well placed to conduct the ongoing data collection necessary for long-term monitoring and trend analysis, this is difficult in a constantly changing funding environment. Effective long-term monitoring for adaptive management will require sufficient and sustained funding.

6. Conclusion

Defining performance measures and tracking social and economic outcomes of fisheries in the U.S. Northeast Region and elsewhere is critical to effective ecosystem-based and adaptive management. Stock assessments provide powerful metrics for guiding the way fisheries are managed. In order to effectively integrate analysis of social and economic outcomes into the management process, corresponding social science metrics such as those presented in this paper need to be refined and supported with new data and funding. Current indicators were successfully used to evaluate changes in the groundfish fishery post introduction of a catch shares program. By involving a broad range of stakeholders in the process, the emerging metrics are salient and serve as a common framework for public discussion on socio-economic outcomes across multiple stakeholder groups [90,91,20,92,93].

This process marks a fruitful beginning in the effective integration of social science information into the management process in a sustained and systematic way. Apart from data issues, the challenge remains to coordinate among multiple, sometimes incompatible,

¹⁵ Beyond the Northeast, a national NMFS workshop in August 2011 (following on the 2009 workshop mentioned in the footnote to Table 1, and subsequent developments) established specific fishery performance indicators for the U.S. Some will be published in 2012; others are not yet fully developed, but will be added over time. The Northeast continues to coordinate with this effort.

¹⁶ While the NEFSC continues to improve economic data collections, the data is not sufficiently comprehensive for reliable estimation of profit. Therefore, the indicators listed under profitability and productivity in Table 1 provide information about how actual profit may be changing. Data to calculate these indicators are currently available.

¹⁷ More information on these surveys can be found at: <http://www.nefsc.noaa.gov/read/socialsci/>.

and often vaguely defined management objectives, and cope with budgetary limitations that can inhibit NMFS and council ability to maintain post implementation monitoring of regulations. Without monitoring, adaptive management is impossible. Other NMFS regions face the same problems.

Nonetheless, meaningful improvements in the indicators will only come through applying them to real-world fisheries, using both existing and new data sources. As measures are applied to additional fisheries, new challenges and opportunities will arise. The development of socio-economic 'report cards' is also being considered to provide basic, easily understood information on the social and economic health of individual fisheries on a regular basis. Efforts such as these are critical for ensuring that social and economic outcomes are integrated into adaptive ecosystem-based management regimes to improve the design of fisheries management in the U.S. Northeast Region and beyond.

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