Country-Level Costs vs. Benefits of Improved Fishery Management

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Introduction

While analyses of fisheries often demonstrate the potential biological, economic, and social benefits of fisheries recovery, few studies have incorporated the costs associated with the design and implementation of the management systems needed to achieve recovery. Available data and anecdotes suggest that the current cost of fishery management may be quite substantial and that additional costs arising from major upgrades in management could be prohibitive in some countries. A careful analysis comparing the country-level benefits of fishery management improvements to the additional costs of doing so has never been undertaken. Therefore, a study focusing on the current and incremental costs of fishery management upgrades could have important implications for policy design to efficiently rebuild global fisheries.

This analysis has three objectives. The first is to estimate the current cost of managing fisheries in the top fishing countries of the world. The second is to estimate, for a range of alternative management approaches, the concomitant change in cost, also at the country level. Finally, we combine these cost estimates with recent estimates of the economic benefits of fishery recovery to arrive at a cost-benefit calculation of improved fishery management around the world. This comparison determines if the expected economic benefits of a suite of fishery management reforms are greater than the management costs associated with those reforms. The analysis is decidedly practical – our goal is to derive ballpark estimates of these values to ultimately inform the question of whether the potential benefits can justify the likely increase in management costs.

There are five major steps to completing this analysis. First, we estimate the cost of managing fisheries for all major fishing countries in the world and standardize by the cost per metric tonne (MT). This step is accomplished by developing a cost database including as many countries as possible and then imputing cost, based on the available data, for countries with limited data. We then focus on the 25 countries with largest fish catch. Second, we categorize the landings in each country by management type. The third and fourth steps are developing and implementing a model of incremental management cost parameterized with cost data, fishery management data, and a survey of global fishery management experts to estimate the future costs of alternative management interventions using. Finally, using projected profits in the year 2050 associated with different management interventions (these are extracted from a companion study[1]), we compare the economic benefits of management reform with the estimated costs associated with the new management in each country.

We find substantial variation in current management costs across countries (approximately an order of magnitude difference in management cost per MT) and that incremental costs of upgrading fishery management can be quite substantial (in some countries, this could involve a doubling or tripling of management cost). Despite these results, our overall finding is that in every country examined, the benefits of reform substantially outweigh the incremental costs in management. This result holds across a wide range of assumptions and is consistent with empirical data, new case studies, and ad hoc interviews conducted with fishery managers in countries that have already undergone these welfare-improving transitions.

Discussion of the Literature

Although data on fishery management costs are hard to come by, there have been a handful of very useful studies on the topic; we compile data from these studies, draw on them, and collect and incorporate new data. Existing studies suggest that, while extremely heterogeneous across countries, the cost of fishery management can be quite substantial compared to the revenue of landed fish (Arnason et al. 2000, OECD 2003, Wallis and Flaaten 2003).[2] A detailed study of management costs in Newfoundland, Iceland, and Norway revealed that annual management costs in the 1990s in each region ranged between 3 and 28% of the value of landings (Arnason et al., 2000). Wallis and Flaaten's analysis of 26 OECD countries in 1999 found that, on average, countries spent 6% of the value of landings on management costs – however, there was a substantial range among countries, with costs ranging from 0 to 70% of landed value (Wallis and Flaaten 2003). Studies on specific developed countries have found that management costs for countries such as Australia, the UK, and the United States have been 7% to 30% of landed value (Arnason Theoretical and Practical 2000). Other studies reveal that annual management costs for Thailand ranged between 0.7 and 1.64 percent of landed value from 1991-1999 (Schrank et al. 2003), and costs in Namibia ranged between 3.7 and 5.9 percent of landed value over the five year period of 1994-1999 (Cunningham & Bostock 2005). While these studies are helpful to provide a ballpark figure for the cost of management as a fraction of revenue, they neither provide global coverage of costs, nor a generalized model that can be used to estimate management costs in the rest of the world's fisheries under alternative management regimes.

1. Costello et al., 2015. Have your fish and eat them too. Under Review.

2. Some authors scale management cost by landed value, others do so by raw landings. We have also used insights from the literature to parameterize a regression that models management cost as a function of various country-level characteristics. Perhaps due mostly to data limitations, those regressions provided only weak evidence of systematic relationships. For the remainder of this paper, we focus on calculations that scale management cost by landings, but we also repeat the analysis by scaling by landed value.

A first order of business is to determine the scope of "management costs," for which we follow the existing literature. Existing studies are careful to include the following discrete set of fishery management activities in this definition: (1) administration (or management), (2) research, and (3) surveillance and enforcement; we will conform to this definition. Sumaila et al. characterizes these three services, among others, as beneficial subsidies, which they found amount to USD 7.94 billion globally in 2003, or about USD 97/MT (Sumaila et al., 2010; FAO 2007). The majority of these subsidies (USD 5.16 billion) were spent in developed nations – we also found that developed nations tend to spend more on fisheries management services than do developing nations (Sumaila et al., 2010).

Administrative services include administration activities such as monitoring licenses and permits and adjusting management settings such as an annual total allowable catch (TAC). Research services generate information about the fishery, which is used to inform the design and implementation of fisheries management systems and regulations, such as an appropriate TAC, appropriate gear, and closures. Examples of research services include stock assessments, data collection, and data analysis. Finally, surveillance and enforcement services include activities that monitor the fishery and enforce relevant regulations. An at-sea example of enforcement services includes patrolling with vessels, airplanes, or onboard observers. Fisheries enforcement also takes place on land, for example, when officers inspect vessels, catches, and gear at landing ports. Costs associated with surveillance and enforcement services are typically the most expensive because they are labor and equipment intensive (OECD 2003, Arnason et al. 2000). While costs of these categories vary significantly among countries in absolute terms, Arnason et al. 2000 found that the relative size of these components were similar in Iceland, Newfoundland, and Norway – on average, enforcement services were the most expensive, representing 59% of management costs, followed by research services at 34%, and finally administration services, representing 7%.

Though there are several theories regarding the relationship between type of fisheries management and cost, there have been few empirical studies to test them, largely because cost data at the fishery level are rarely available. Using country-level data from OECD countries, an OECD study in 2003 found that countries that employed predominately output controls had substantially lower costs per MT than those that predominately used input controls, but due to the small sample size the results are not conclusive (OECD 2003). This study also suggests that the regulatory framework can significantly affect costs (OECD 2003) – a sentiment that was repeated in a number of personal interviews conducted with fishery managers from across the United States. They indicated that management type (e.g., catch-shares, output controls, etc.) per se does not drive management costs, but that costs tend to be driven by the complexity of the fishery and fisheries regulations; more complex systems are typically more expensive to implement than simpler systems, regardless of the management regime (Personal Communication). Examples of fishery complexities include the number of species, number of stocks, and number of participants in the fishery, while institutional or regulatory complexities include things like number of regulations, number of gear restrictions, reporting requirements, and enforcement methods.

Methods

To evaluate the costs associated with global fisheries reform and determine if projected economic benefits exceed incremental management costs, our approach involves the following five steps: 1) Estimate the current cost of management, normalized by landings (i.e. total management cost per MT landed), at the country level;[3] 2) determine the current management approaches in each country by categorizing current landings by management category; 3) develop and parameterize a model of incremental costs with country-level data; 4) apply the model to determine the future costs of management under different management scenarios at the country-level; and 5) evaluate management reform options by comparing the difference in profits and management costs under different management interventions.

Step 1. Determine the current cost of management per MT at the country level

To complete this step, we first compiled a management cost database from existing data. Our study follows the tradition of earlier work by defining management costs as expenditures on administration, research, and enforcement services, and normalizing per MT. For each country, we collected the annual costs of administration, research, and enforcement fisheries services for the most recent year for which data were available. Since we focused on national reports, the data for some counties such as the United States only includes information on federally managed fisheries. Where appropriate, reported costs were converted and inflated/deflated into 2012 US dollars (USD). Only countries for which we were able to find values for at least two out of the three management cost categories were included in the cost database. Using government reports, the OECD's Fisheries Database, and personal communications as sources, 21 countries with values for all three management costs were identified. For the 21 countries with complete data, on average, the percentages of total management costs attributed to administration, research, and enforcement services were 32%, 25%, and 43% respectively. Using these averages, we imputed the missing cost category (and thus total annual cost of management) for countries for which we were only able to find values from two categories (Figure 1). The costs were then scaled to match the percentage of landings accounted for in our fishery database for each country (on average, the benefit database covers 77% of catch). For example, the global fisheries database that we use captures 91.6% of 2012 FAO reported harvest for the United States. Therefore, we scale the total cost value to match this percentage. For the remainder of this paper, the term total cost represents the scaled total cost. Finally, to determine the cost per MT of landings in each country, the total annual cost of management was divided by 2012 harvests.[4]

In order to determine the current management cost in major fishing countries for which we did not have adequate data, we imputed the value from "similar" countries for which we do have data. We split countries in the cost database into two groups: (1) "Group 1" includes Australia, New Zealand, the United States, Canada, and European countries, and (2) "Group 2" includes countries in Latin America, Africa, Asia, the Caribbean, and Oceania. Next, the average cost/MT of each group was calculated. Management cost in countries for which we did not have sufficient data were imputed as the average cost (per MT) in Group 1 or Group 2: European countries

3. We recognize that some costs may be fixed, and thus should not be normalized. Our interviews indicate that this breakdown varies greatly across countries. For the remainder of this analysis, we will scale all costs by MT (and also report values scaled by landed value).

4. In practice, to ensure consistency across benefits and costs of reform, we used the estimate of 2012 harvest from the model from which economic benefits were extracted.

missing data were assigned the average from the former group ($240 /MT) and countries in Latin America, Africa, Asia, the Caribbean, or Oceania that were missing data were assigned the average from the latter group ($52/MT) (see Figure 2).

Step 2. Determine current management approaches in each country by categorizing current landings by broad management categories

In order to determine how changes in management type will affect management cost, it is essential to have some information about the current approaches used to manage fisheries in each country. No comprehensive global database of fishery management is available, so we created an approach for assigning landings in each country into broad categories that the literature suggests are correlated with specific management approaches. This approach classifies the 2012 landings in each country into different categories that match the different management reform scenarios modeled in the analysis from which the benefits of reform are drawn. Landings were divided into the following three categories: 1) Catch share (CS); 2) Strong output controls (OC); and 3) A broad “other” category of open access (OA).

To do this, we used the fishery database containing fishery level data for fisheries around the world (Costello et al, 2015). Landings from fisheries classified by Environmental Defense Fund as being managed under a catch share regime (e.g., individual quotas, individual vessel quotas, individual transferable quota, and TURFs) were counted as CS landings; landings from fisheries contained in the RAM database that were not also managed under catch shares were counted as OC landings, and everything else in a country was categorized as other landings (broadly, “Open Access”) (Figure 3). The RAM Legacy Stock Database contains detailed stock assessment information for 331 stocks, including both fish and invertebrate stocks. The information was collected from 21 national and international management agencies (Ricard et al. 2011). Because implementing informed regulations that control harvest requires a stock assessment, we consider fisheries in the RAM legacy to have strong management. Therefore, the OC category is meant to represent the broad range of management that can be classified as strong biological management without catch shares. Tuna and billfish fisheries were excluded from this analysis due to the fact that they are highly migratory species.

Figure 1. **Breakdown of current management costs into management service categories.**

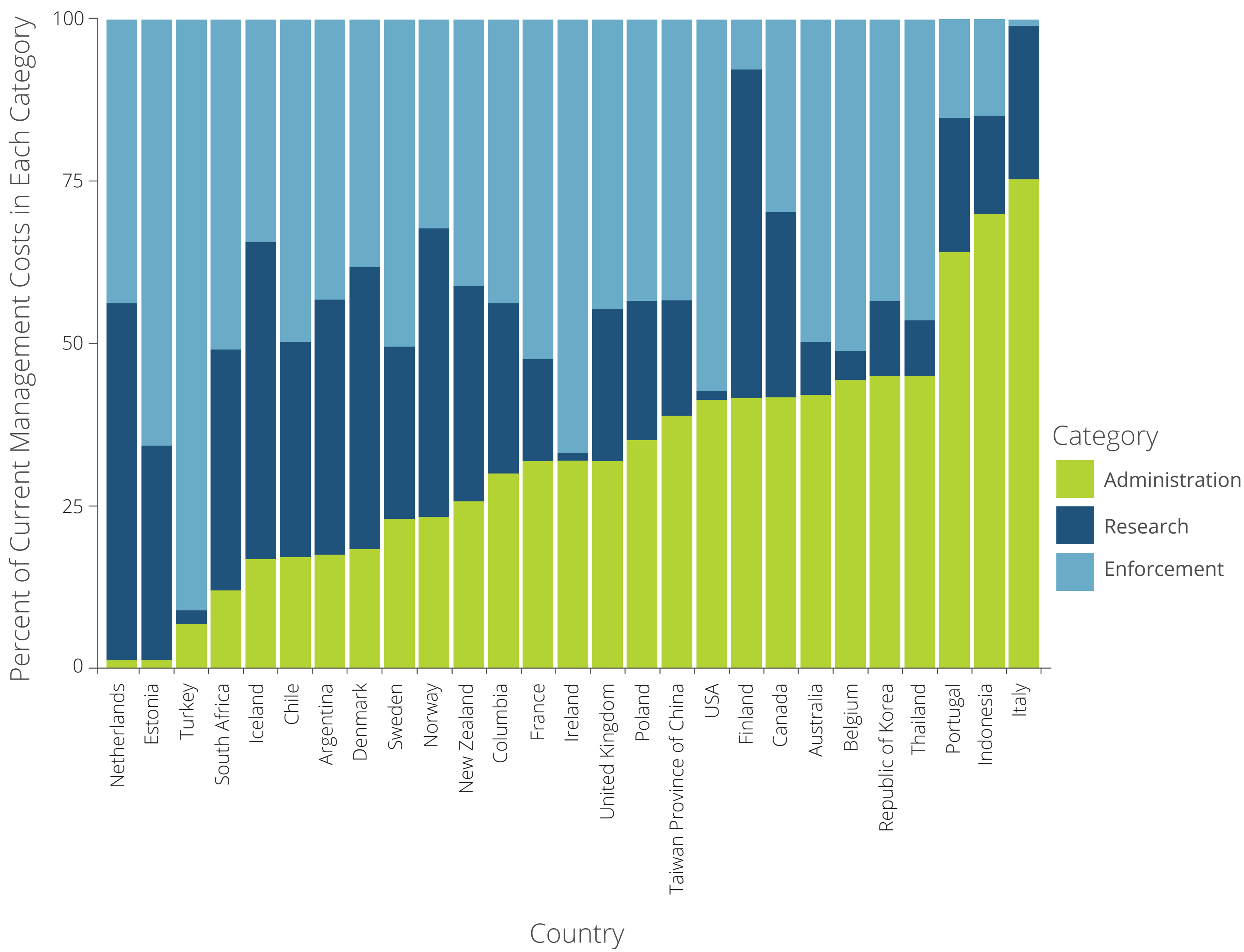


Figure 2. **Total management cost divided by landings represented in our database for the top 25 countries in terms of total volume landed in 2012. Blue bars indicated costs that were estimated, while green bars indicate costs from raw data.**

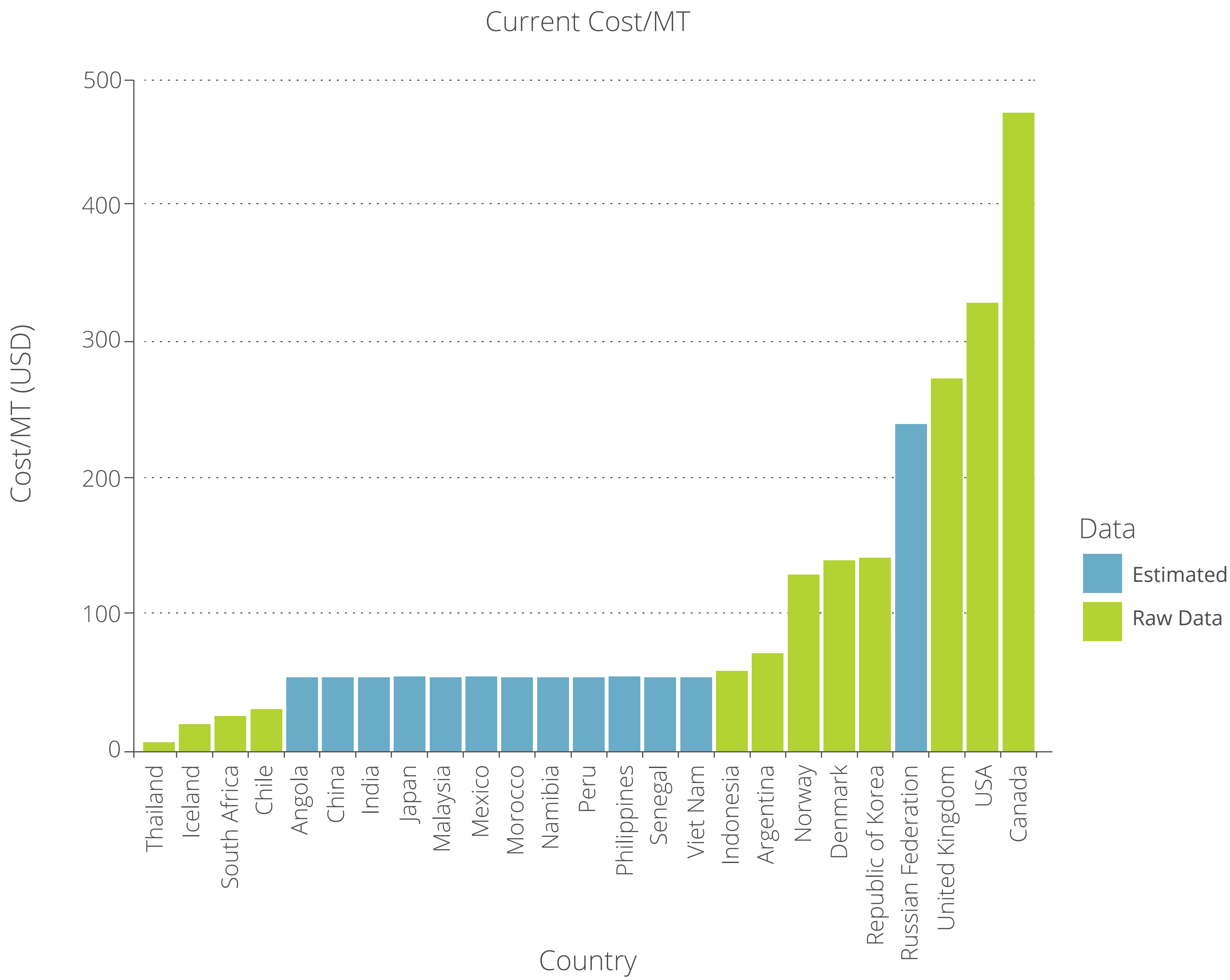
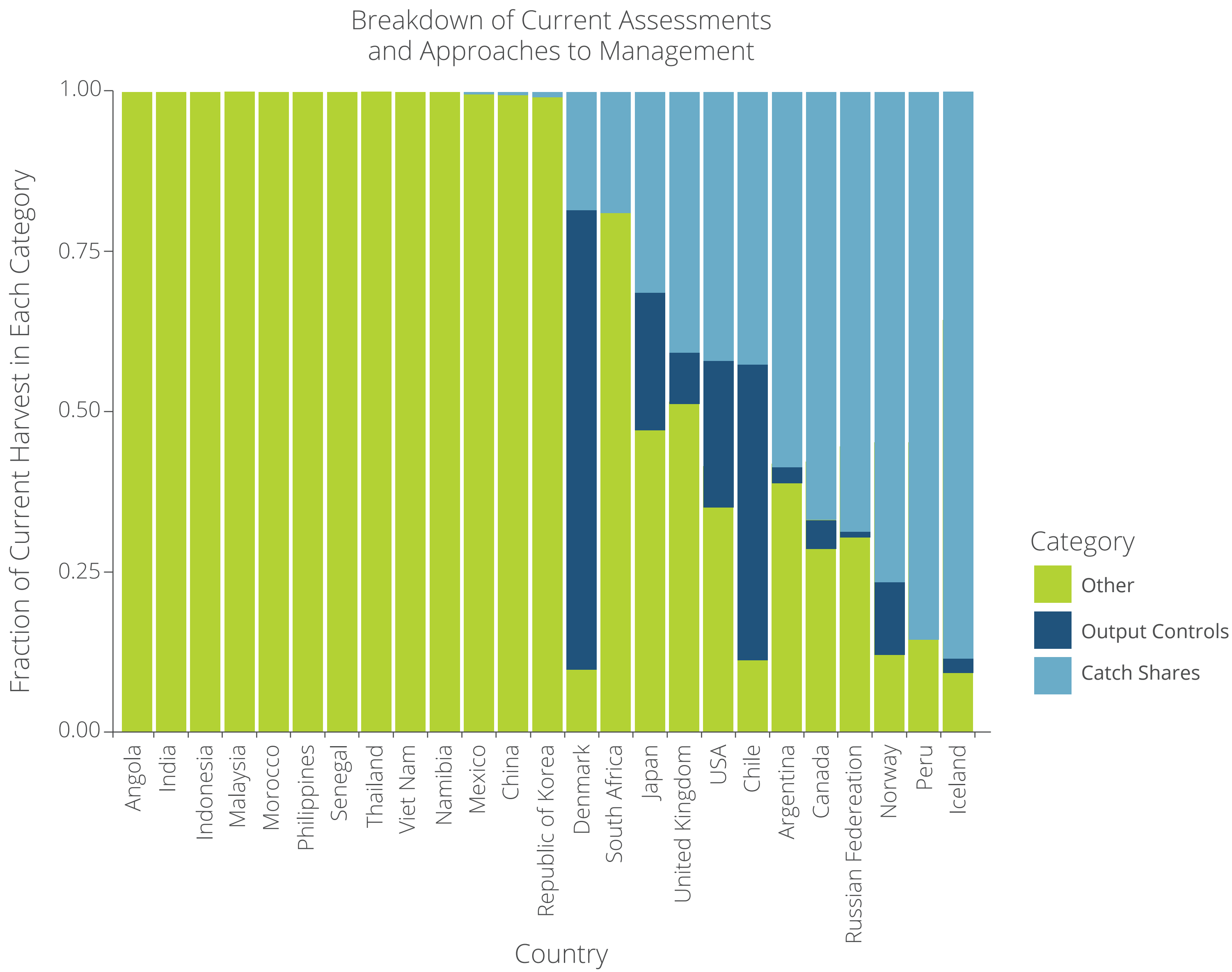
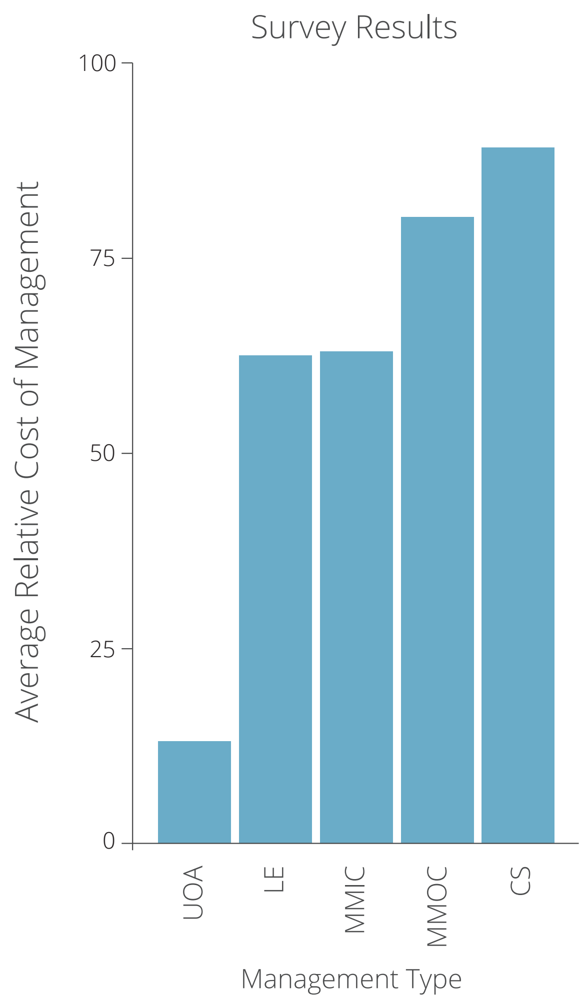


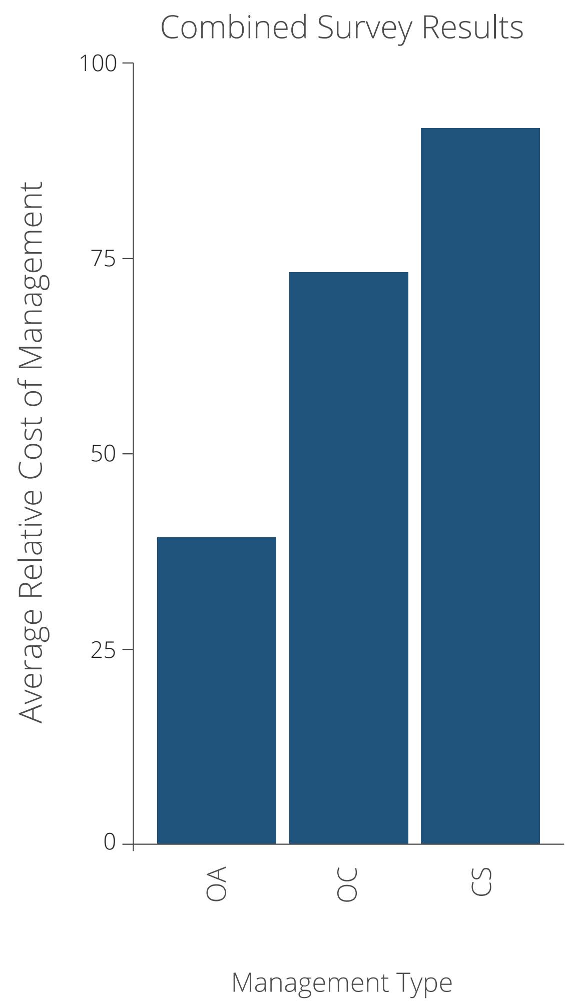
Figure 3. **Breakdown of current assessments and approaches to management in the top 25 countries in terms of 2012 total landings. The "Other" category represents landings from fisheries managed under input controls and/or open access.**



Step 3. Develop a model of incremental costs

In order to explore how management costs will change as a result of various management reforms, we developed a model of the incremental costs of management. This model was parameterized using survey responses from a group of nine fishery management experts from around the globe. First, a group of twenty experts were given a simple pre-survey. A more detailed survey was later administered to experts with the aim of collecting more detailed information.





Experts were asked to rank five different management types (unregulated open access, limited entry, mortality management with input controls, mortality management with output controls, and catch shares) in order from least expensive to most expensive. Then, the respondents were asked to determine the relative cost of each management strategy. Scores for each type of management were averaged across respondents (Figure 4, first panel). Finally, in order to match modeled management reform scenarios with the breakdown of current management approach categories, the average values for unregulated open access and mortality management with input controls were averaged (OA), and the average values for mortality management with output controls and limited entry were averaged (OC). The average for catch shares was not changed (Figure 4, second panel). The results suggest that the cheapest category of management is the category that contains open access fisheries and fisheries for which input controls are used to regulate mortality (labeled "OA" in the second panel of Figure 4). The next most expensive category is the group of fishery management approaches that employs direct output controls or limited entry (labeled "OC"). This category requires about 80% higher cost than the former category. Results suggest that the most expensive category contains approaches with formal catch shares (labeled "CS") – this category costs about 25% more than the "OC" approach.[5] For the remainder of this analysis, we will use the fishery management categories identified in the second panel of Figure 4. missing data were assigned the average from the former group ($240 /MT) and countries in Latin America, Africa, Asia, the Caribbean, or Oceania that were missing data were assigned the average from the latter group ($52/MT) (see Figure 2).

Step 4. Apply model to determine the future costs of management under different management scenarios at the country level

We developed a simple model to inform the incremental costs of managing fisheries using OA, OC, and CS approaches in each country. We assume that the aggregate total cost of managing all fisheries in a country will depend on the fraction of landings that are managed under each category of management, the relative costs of those management categories, and on a country-specific constant.

Equation 1

$$TC_i = s_i (H_{1i}c_1 + H_{2i}c_2 + H_{3i}c_3)$$

where s_i is a country-specific constant, ***Hji*** is the harvest in management category ***j*** in country ***i***, and ***cj*** is the relative cost of management type ***j***. We will also make use of the harvest shares for a given management type in a country, as follows: ***Hji=Hihji.*** Henceforth, since each country is handled independently, we will suppress the country subscript, so Equation 1 becomes:

Equation 2

$$TC = s (H_1c_1 + H_2c_2 + H_3c_3)$$

Equation 2 is used to calculate the total cost of management in a given country using the total harvest, the

[5] Keeping in mind that all costs are costs per MT, and that new management approaches may alter the raw landings. Thus, two separate mechanisms affect management cost: The cost of a management regime per MT, and the raw tonnage.

percentages of harvest in each management approach, the cost parameters for each management approach, and a country-specific constant, ***s***, which scales the costs for each country. The ***s*** constant is included to capture differences between countries that might affect the cost of and/or the expenditure on fisheries management, such as the different labor and fuel costs among countries. While we assume that the relative cost of each management type is the same across countries, we allow the absolute cost of management to vary across countries for three reasons. First, the country may employ different management approaches – this has a direct effect on the total cost of management. Second, the country may have different harvest in each category of management. Finally, the country may have a different cost parameter ***(s)***. Each of these effects is handled in the approach that follows. To back out a country's cost parameter ***(s)***, we simply re-arrange Equation 2 as follows:

Equation 3

$$s = \frac{TC/H}{h_1c_1 + h_2c_2 + h_3c_3)}$$

Thus, we have all the information required to calculate a cost parameter ***s*** for all countries in our database. The numerator is simply the current cost of management per MT. The denominator is the sum of the product of the fractions of landings in each management category multiplied by the relative cost of each management category (obtained from the survey). The cost parameter ***(s)*** can be interpreted as follows: The cost/MT of managing all fisheries in a country under a particular management approach (say CS) is simply ***s*** times the relative cost of catch shares, ***ci*** (this is shown in Figure 5).

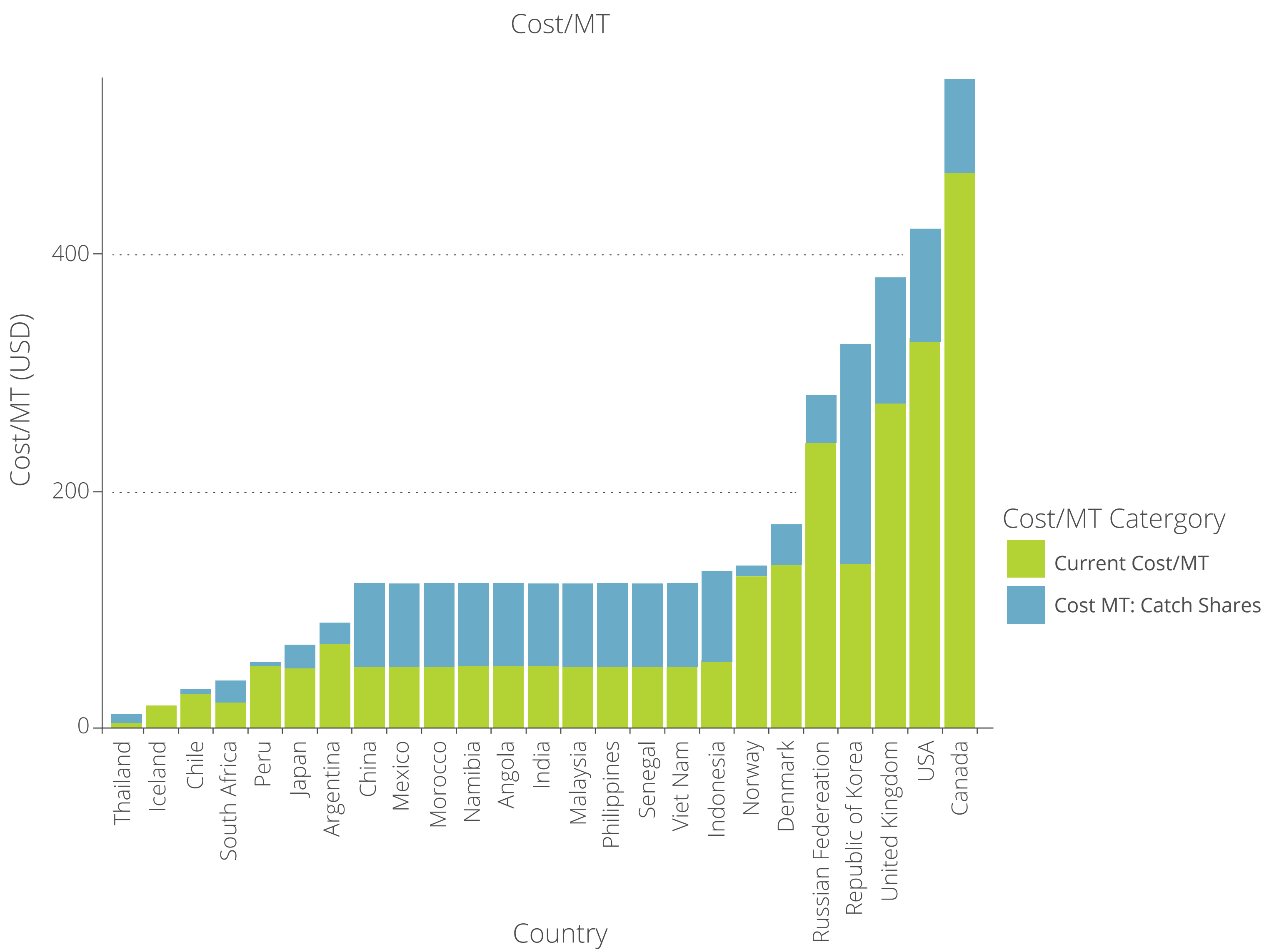
With an estimate of ***s*** for each country, we are in a position to approximate the future cost of management in a country, as follows. The results in Costello et al. (2015) provide estimates of the future catch in each country under different management scenarios. For example, one of the scenarios we examine is to adopt Catch Shares in all fisheries in a country. If ***H*** is the projected future catch (in 2050) under that scenario, then the total cost of fishery management in that country would simply be: $TC=sHc_3$. The more general scenario is when each fishery in a country adopts a different management approach. In that case, the total cost of management is simply found by manipulating Equation 2, as follows:

Equation 4

$$TC = sH\,(h_1c_1 + h_2c_2 + h_3c_3)$$

Where ***H*** and h_1, h_2, and h_3 are the future total harvest and percentages of total harvest in each management category, which are determined by the modeled total harvests and reform scenarios. The two reform scenarios that we focused on are 1) managing all fisheries that are not already managed using catch shares with strong output controls (OC Scenario); and 2) managing all fisheries using catch shares (CS Scenario). These will both be compared to a BAU scenario, described on the following page.

Figure 5. **Current cost per MT (green bars) and anticipated incremental cost under catch shares (blue bars), gives the anticipated cost per MT when all fisheries are managed under catch shares (green plus blue bars).**



Step 5. Evaluate management reform options by comparing difference in profits and management costs under different management interventions.

The final step is to determine whether the benefits of a given reform effort exceed the incremental costs of adopting that reform. In order to evaluate management reform options, we compared the future trajectory of harvest under a business as usual (BAU) scenario[6] to the outputs of the CS Scenario and OC Scenario. Future management costs under the BAU scenario are calculated for each country by multiplying the modeled 2050 harvest (for each category of management) under the BAU management scenario by the cost/MT, according to Equation 4. Future management cost under the OC Scenario is calculated for each country using Equation 4, and substituting the modeled 2050 harvest under the OC Scenario for H, and setting h1 = 0, h2 = (1-percentage of harvest already under catch shares), and h3 = the percentage of harvest already under catch shares. Again, OC is meant to represent strong management without catch shares. Finally, management costs under the CS Scenario are calculated for each country using the same procedure, but where H is the modeled harvest under the CS scenario, and h1 = 0, h2 = 0, and h3 = 1. Thus, for each country we have estimates of: The current cost of management, the future cost of management under BAU, the future cost of management if all fisheries not already managed by catch shares adopt OC, and the future cost of management if all fisheries adopt CS. The final step of this analysis is comparing the incremental cost (of adopting OC or CS, relative to BAU) to the incremental benefits. Since all of our data are on a per year basis, all benefit calculations are also made per year. In our analysis, we compare the annual profit in 2050 with the total management cost in 2050 for each country. Fishery profits under each scenario are determined in Costello et al., 2015 by subtracting fishing costs (management costs are not included in this cost) from revenue generated by harvests. Profits under catch share management are higher than those under output control for a number of reasons, including the reduction in fishing costs and the improved product quality often experienced in CS fisheries.[7]

Results

OC and CS Scenarios Compared to BAU, 2050

Figure 6 shows the incremental cost vs. the incremental benefit of fishery management reform, where each country is represented by a single point. The size of the point indicates the size of the fishing sector in that country measured in total harvest (in MT) for 2012. Therefore, larger dots represent counties with higher annual landings in 2012. The top panels provide results for CS vs. BAU and the bottom panels provide results for OC vs. BAU. Three results immediately pop out. The first is that when considering reforming all fisheries in a country to some form of CS, we find that the cumulative benefits always exceed the costs (all dots are above the 1:1 line on the top left panel and all benefit cost ratios exceed 1.0 on the top right panel). Indeed, the benefit cost ratios range from just over 1.0 up to 82 or more, averaging at about 29. The global benefit cost ratio average for catch share management is 34.[8]

6. The BAU scenario assumes that: (1) all fisheries currently managed as CS or OC will remain managed as CS and OC, and (2) all other fisheries are managed as OA.

7. There is even a debate about the extent to which OC could retain any profits in the long run; we return to this later in the report.

8. As an alternative to our assumption that management cost scales with raw landings, we also repeated the entire analysis assuming that management cost scales with fishery revenue. Under that alternative assumption, benefit cost ratios for the top twenty five countries were qualitatively similar: Under the CS scenario all countries had a benefit cost ratio exceeding one; under the OC scenario, all countries (except Chile) had a benefit cost ratio exceeding one.

These results are at the country level and do not necessarily imply that the benefits of switching to catch share management will outweigh the costs in each fishery. Instead, this result compares the aggregate benefits of moving to CS against the aggregate costs of doing so. The second result is that the large fishing countries tend to also have the largest benefit cost ratios – it turns out that the larger a country's catch, the more it stands to gain from aggressive fishery management reforms.[9] The third result is that while the numerical results are somewhat muted when moving from BAU to OC, most countries would still benefit from such a shift. The global cost of managing all fisheries in our database under catch share management in 2050 is about USD 11.09 billion, which is not quite double the global cost of BAU (USD 6.21 billion) and 2012 current global management costs (USD 5.76 billion). The global costs under each scenario are listed in Table 1.

Extreme Analysis

Thus far our results have strongly suggested that even though upgrades in fishery management often entail additional costs, and that these costs may even be quite substantial, the benefits of these reforms are economically worthwhile. This analysis has necessarily relied on a number of assumptions. One test of the robustness of our results is to make an extreme assumption about the changes in management cost in a country. Here, we undertake the following experiment. Suppose that we assume that any country wishing to upgrade its management will have to incur costs equal to the costs currently borne in the best-managed fishery countries of the world. To stack the deck against reform, we make the following assumptions in this "extreme" analysis:

- The current cost of management in a country is 0.
- The future cost of management (per MT of landings) will equal the current cost (per MT) in Iceland, New Zealand, and the USA (averaged), which is $167/MT.

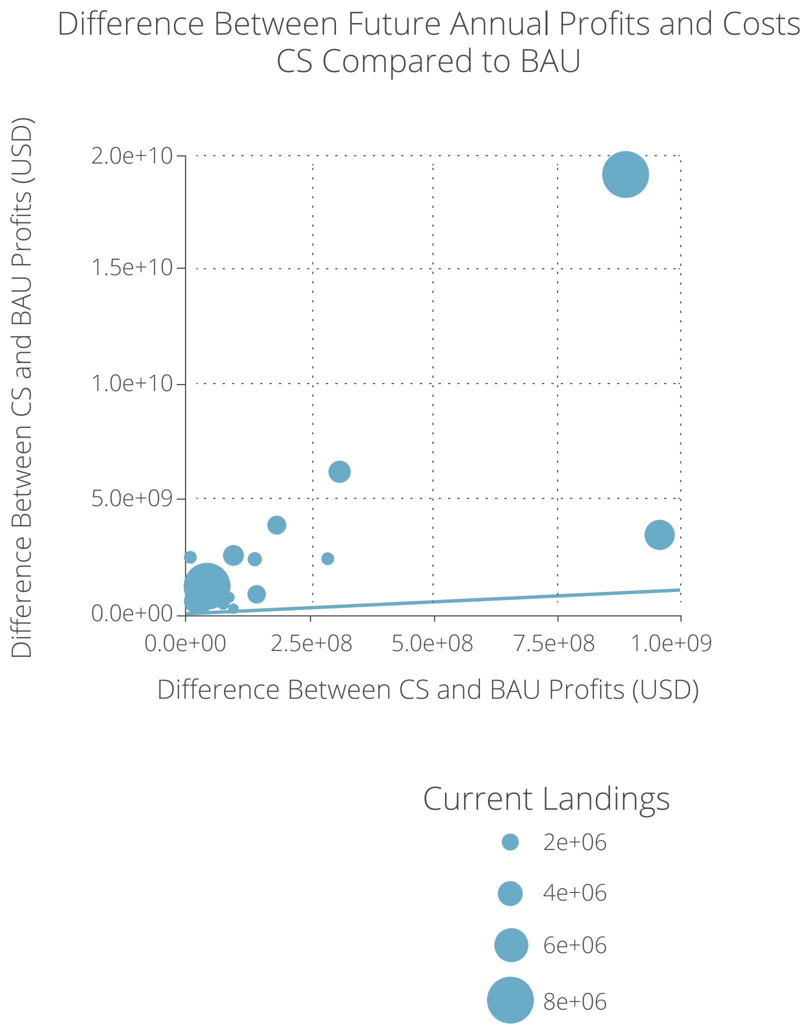
Effectively, then we are assuming that the incremental cost of the management upgrade is $167/MT. We multiply this value by the modeled 2050 harvests under the CS Scenario and OC Scenario to calculate the (extreme version of) the future annual cost of management. The future annual profits from adopting CS are unchanged. Again, the future annual profits and costs of the BAU, CS, and OC Scenarios are compared (Figure 7).

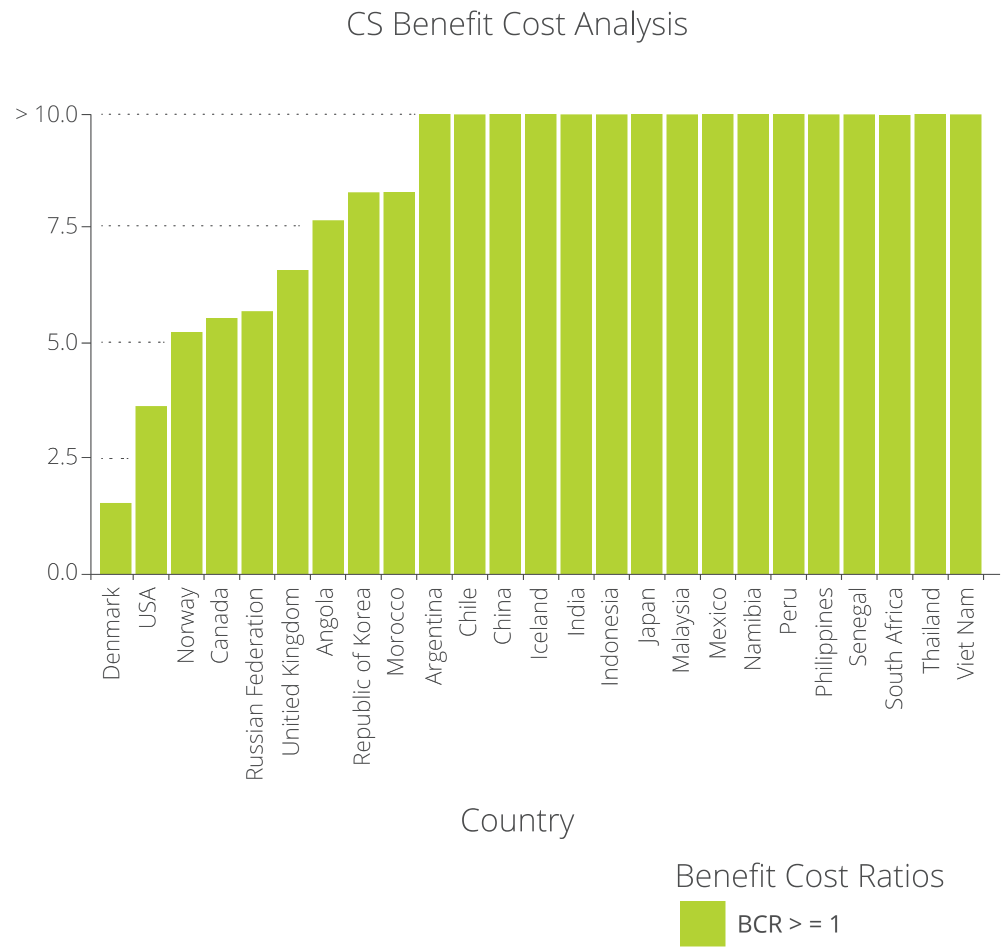
Under this extreme scenario, catch share reform is still a better option for most of the top 25 countries – the countries that have a benefit-cost ratio less than one are Iceland, Norway, and Denmark. Even under this extreme scenario, the average benefit-cost ratio globally is about 17. The countries with a benefit-cost-ratio less than one under the extreme OC scenario are Iceland, Norway, Denmark, Peru, and Chile.[10] The average benefit-cost ratio under this scenario is about 13. In this scenario, the global cost of management would be USD 23.5 billion.

[9] This result is not a foregone conclusion – it could easily have turned out that benefit cost ratios showed no, or an inverse, relationship with fishing volume.

[10] The benefit-cost-ratios in this example are lower than those in the previous analyses, with BCRs under the CS Scenario ranging between 1 and 13 for most countries, and 1 and 10 under the OC Scenario.

Figure 6. **Difference between future profits and management costs: CS Scenario and OC Scenario compared to BAU. Benefit-cost-ratios are capped at 10 in the figures on the right.**





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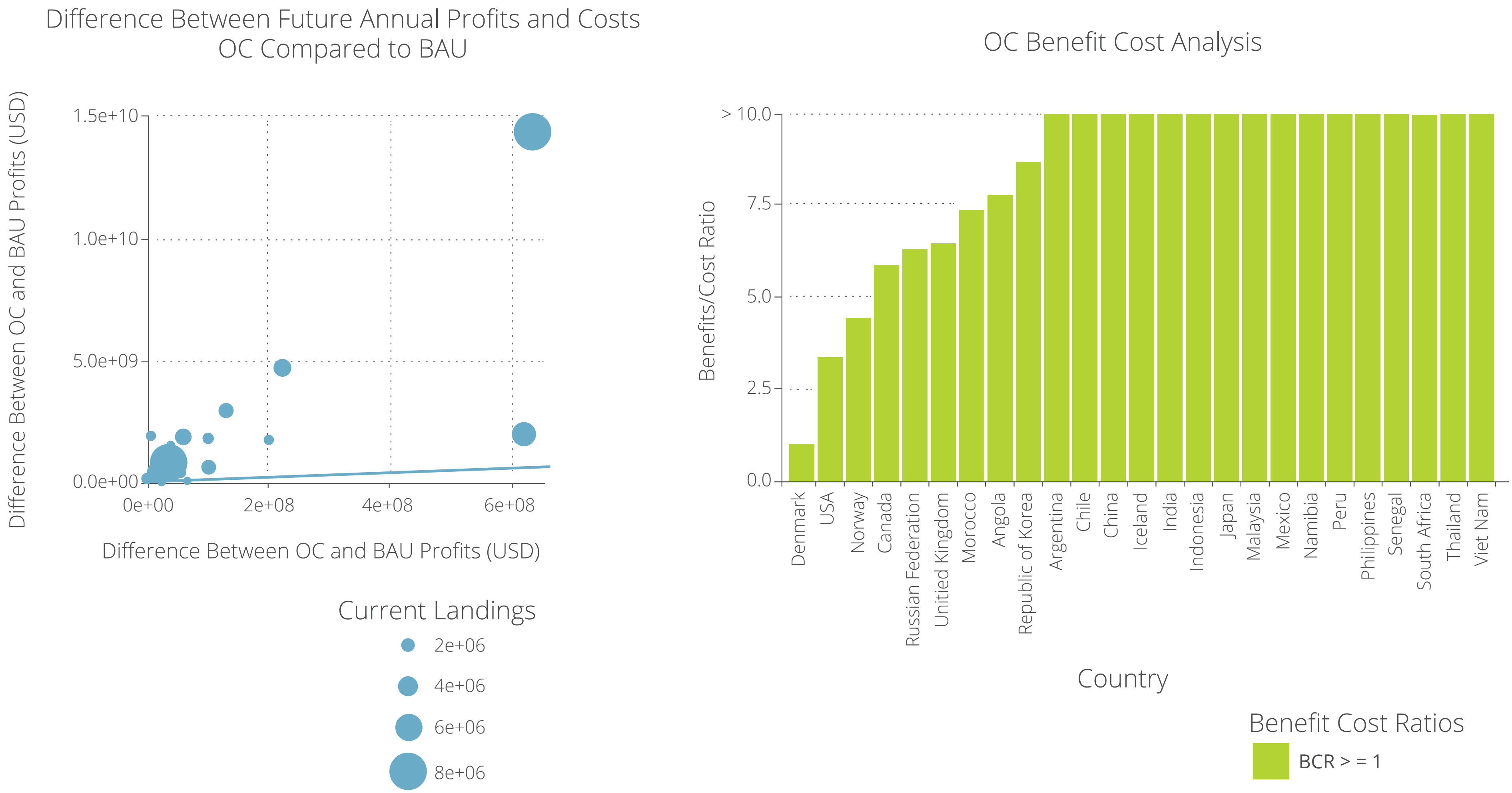
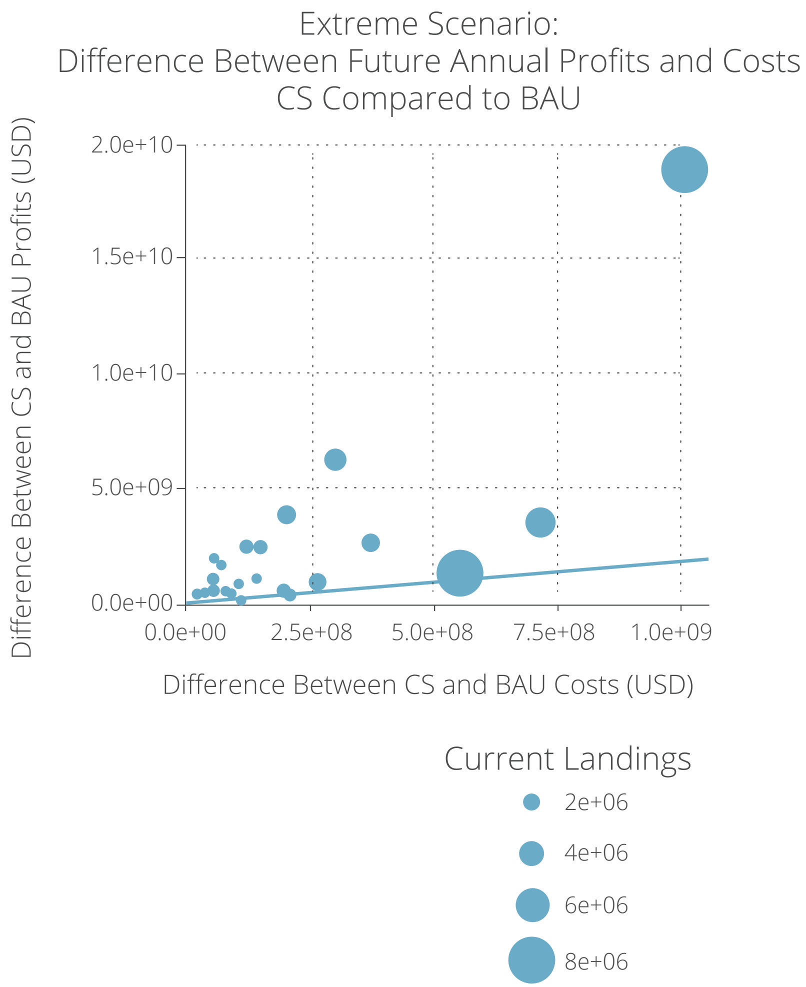
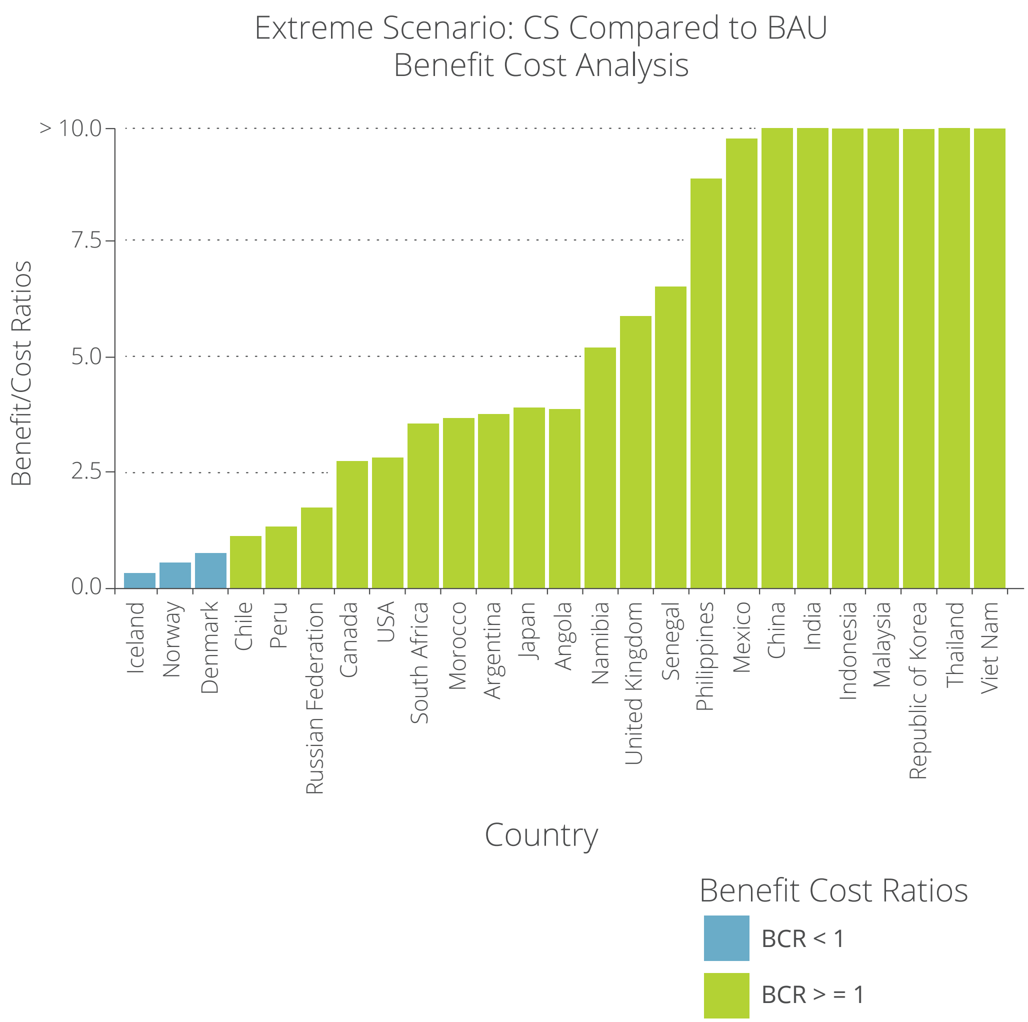


Figure 7. **Difference between future profits and management costs: CS Scenario and OC Scenario compared to BAU. According to the results, the CS Scenario is worse than BAU for Iceland, Norway, and Denmark, and the OC Scenario is worse than BAU for these countries, Chile, and Peru.**





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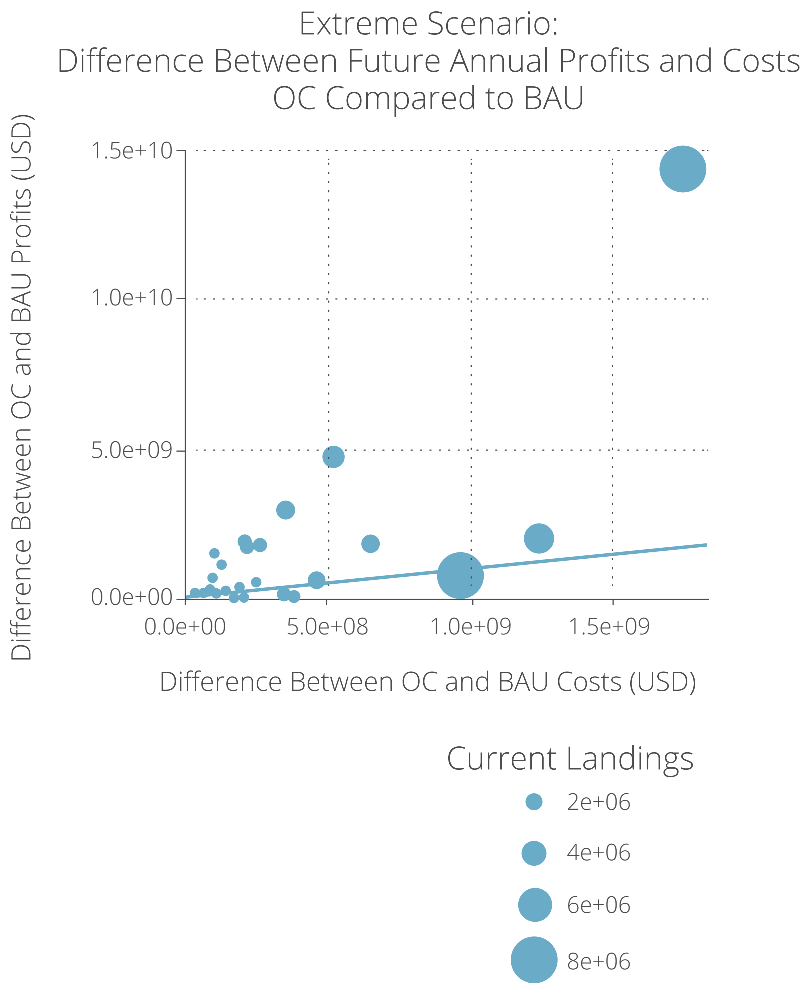

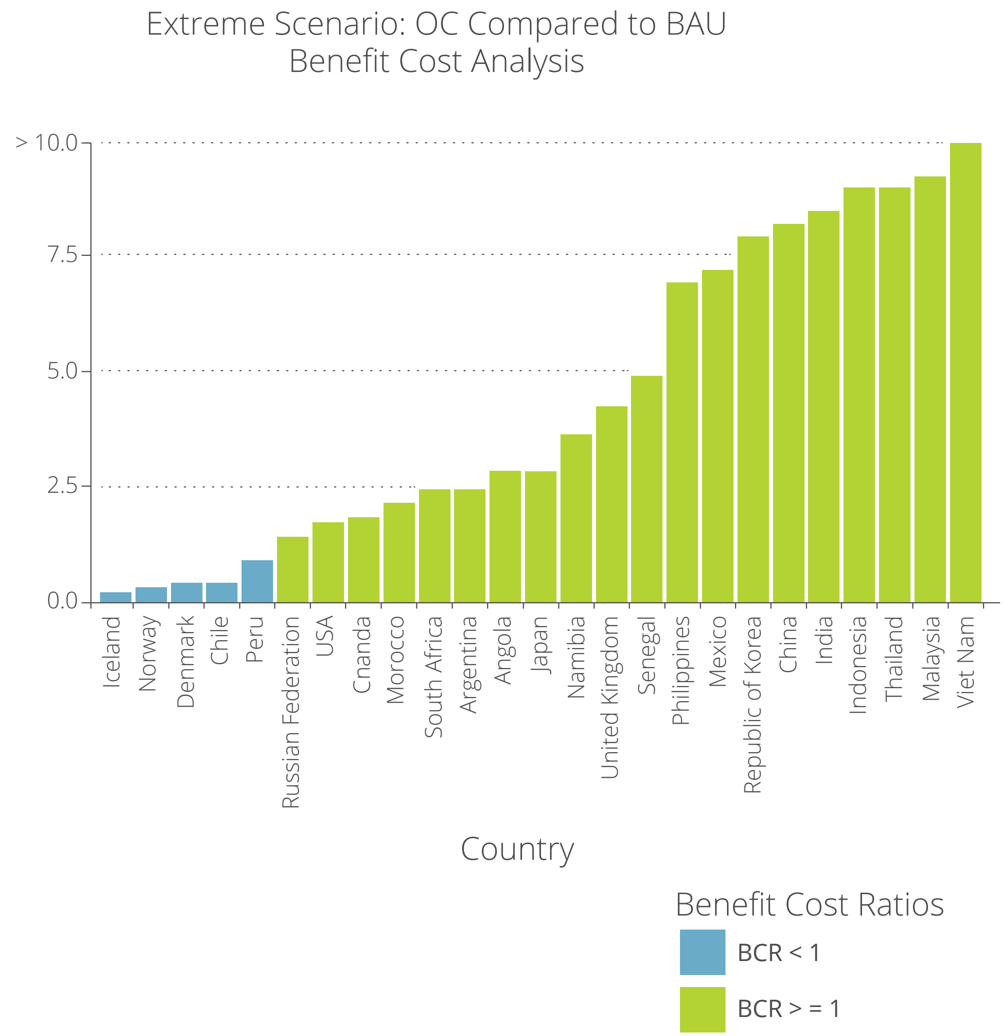

Table 1: Global management costs to manage the 77% of global fish catch represented in our database under different management scenarios.

Management Scenario	Global Cost Management (USD)
2012 Current Cost	5.76 billion
2050 Business as Usual	6.21 billion
2050 Output Control	9.62 billion
2050 Catch Share	11.09 billion
2050 “Extreme” Scenario	23.52 billion

Discussion

Our overall objective was to develop and implement a framework for estimating whether the benefits of fishery management reform exceed the incremental management costs from doing so. Our framework for estimating costs of fishery management upgrades incorporates existing data on management costs, survey data on incremental costs, data on existing management in each country, and synthesizes and makes use of these data in a simple model. Employing that model, we find that the incremental benefits of fishery management reforms are, in every single country examined, larger than the incremental costs. This result holds when comparing “business as usual” management in a country to adopting some form of rights-based management (or “catch shares”) in the country. When considering a less-ambitious move from BAU to output controls (stopping short of adopting rights based approaches), the result still holds, but is much weaker.

Two interpretations emerge: First, while adopting effective catch shares is likely to entail the largest incremental increases in management cost, it is also likely to lead to even more significant increases in economic rent or profit. In fact, expert opinion suggests that depending on how well fisheries are already managed, the cost of switching to catch share management might even lower costs relative to BAU, which would further strengthen our main results. Still, we might expect to see the larger cost increase seen in this analysis for countries with relatively poor or ineffective management. If some of that increase in profit can be captured to pay for the change in management cost (indeed, only a small fraction of it would be required in most countries), then the policy reform would be win-win. For countries with benefit-cost ratios greater than 2 (which is the case for most under both CS and OC management), less than half of the economic gains from management reform would be needed to cover the additional costs of management.

Recovering funds from the fishery to pay for services to the fishery sector, or cost recovery, is already employed by a number of countries such as Canada, New Zealand, Australia, the United States, and Indonesia, and is typically accomplished through fees and taxes within the industry. A key question that comes up when considering management costs is who should pay. It has been argued because the fishing industry benefits from management services, it should pay the costs associated with that management. Generally, taxpayers end up paying for these services, which are in turn provided by the government. Cost recovery programs in fisheries seek to recover at least a portion of the costs associated with management from those who benefit from the services. These programs also have the potential to minimize government efficiencies and improve management effectiveness because fishers, once responsible for paying for management, will have stronger incentives to employ efficient and cost effective management (Kauffman & Geen 1997; Cox 2002). Cost recovery also has the potential to increase industry involvement and improve cost accounting (OECD 2003). For example, in Australia cost recovery has led to increased industry involvement in management decisions, a more transparent decision making process, and detailed accounts of management costs (Cox 2002).

Importantly, the benefits depicted in these results do not reflect individual fisheries, but the generalized benefits at the national level. Specific fisheries might benefit differently from management changes, and effective catch shares will surely require careful design tailored to each fishery. For example, challenges to implementing effective catch share systems might arise in countries that do not measure catch reliably and in fisheries with large and diverse fleets that are hard to monitor. This suggests that other management changes might have to occur before catch shares can be successfully implemented.

In addition, while this study suggests that those directly employed by the fishing industry could experience an increase in profits with a shift from less effective management to catch shares, and to a lesser extent, strong output controls, it does not investigate the implications of management reform down the supply chain. The value of this sector could potentially decrease with management that requires decreases in harvests. More research is needed to determine the economic implications of improved management on other related sectors.

The finding that adopting OC is still beneficial, but not as beneficial as adopting CS, is not too surprising, particularly given our assumption that securing long-run economic profit is still possible under OC. While output controls alone can be effectively implemented to regulate catch and achieve conservation objectives, there is a strong theoretical argument that they cannot ensure significant long-run profits, because rents will be dissipated by excessive effort on unregulated margins. That is, even if catch is perfectly managed (e.g., to achieve MSY), without a rights-based structure, there will always be margins of adjustment that lead to some rent dissipation. Thus, we regard the OC scenario as an intermediate case between open access and fully rent-capturing catch shares. As such, the profit upside from OC will always be lower than the profit upside from CS. While it is also true that our results suggest lower management costs under OC (than CS), they are not sufficiently low to make OC more attractive than CS.

Future work

There are a number of ways in which this study could be built upon to further examine the relationship between costs and fisheries management. First, while this study focused on the annual cost of management after management reform has been implemented, studies and interviews indicate that transition costs can be significant. During the transition period, the reform is designed and planned. This stage can be labor intensive and take a substantial amount of time, thus incurring significant fixed costs. In addition, it may require expensive research efforts to guide reform design. Including this expense would capture a more comprehensive cost of fisheries management.

Second, future studies could expand on this work by developing a more precise model for determining changes in management cost. In this study we chose to scale relative costs of management with management approaches. It is unlikely that management approach alone affects the cost of management. Complexities within the fishery such as number of species, geographic size, number of participants, and number of landings facilities likely affect the cost of managing them. Similarly, complexities in rules and regulations such as bycatch regulations, limits on days at sea, gear restrictions, and required reporting and analysis likely influence the costs of administration, research, and enforcement services. For example, a fishery for which a decision has been made to implement onboard observers as a part of the enforcement program may have higher costs than one that does not, regardless of the management approach. This approach would require data at a finer resolution than used in the current study. At a much coarser scale is the problem of illegal fishing, which we implicitly fold into monitoring and enforcement costs. But in practice, combating illegal fishing is one of the fastest, and perhaps most lucrative, approaches to enhance legal rent capture in a fishery. Coupling monitoring and enforcement of illegal fishing with catch shares to manage the legal sector may be a highly efficient path forward for many of the world's fisheries.

Third, a component that could be incorporated more completely into this type of study is the idea of management efficacy. Although we were able to find management cost data for a number of countries around the world, it is not clear from these numbers alone if the expenditures lead to successful resources management or if the funding is being spent efficiently. This is important because inefficient spending (a common critique of government spending in particular) might make it appear that effective fisheries management is much more expensive than it actually needs to be.

Finally, while the country-level approach used in the current study is useful for making decisions at the national level, a fishery level-approach might provide key insights for managers working on the reform of individual fisheries. This approach would require fishery-level data on the cost associated with management attributes specific to fishery type. Importantly, improved data on the cost of managing fisheries at both the country and fishery level would facilitate more precise analyses.

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Cover: Fishermen thrashing nets.
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