Casting Deeper and More Widely to Perform Stock-Specific Fisheries Assessments When Data Are Sparse

Al Lanzar Más Profunda y Extensamente para Evaluar el Estado de las Poblaciones de Peces Cuando los Datos Son Escasos

Jetant Plus de Profondeur et À Grande Échelle pour Évaluer L'état des Stocks de Poissons Lorsque les Données Sont Rares

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ABSTRACT

Until recently, efforts to assess and manage fisheries have been directed primarily at a minority of stocks with relatively rich conventional data resources. In its most recent amendment, the US fisheries law clarified that all stocks need annual catch limits, prompting interest in how to manage the majority of fish stocks, which have not yet been formally assessed. These stocks are disproportionately represented in the tropics, where few formal assessments have ever been conducted. Recent proposed approaches have focused on life history correlates in the hopes of determining stock status without local data. I propose alternative approaches. We can cast deeper by supplementing conventional data with ecological and economic datasets that are not normally considered in the assessment process. We can cast more widely by considering ranges of potential status and examining them in terms of risk management. In doing so, fundamental trade-offs among performance characteristics are identified and analyzed across a range of policy options. Examples of these approaches will be provided from several stocks from the US Caribbean. The spiny lobster fishery has potential to be formally assessed using conventional techniques if data from the local fishing community are included. The red hind and yellowtail snapper fisheries lack sufficient data for a formal conventional approach. However, inclusion of non-conventional data and examination of all data in a risk management framework allow us to evaluate the likely sustainability of recent catch levels. These analyses highlight that we can give far more useful scientific advice to managers of data-poor fisheries.

KEY WORDS: Data-poor fisheries, Caribbean fisheries, spiny lobster, red hind, yellowtail snapper

INTRODUCTION

Though stock assessments have a long history, most of them focus on a few, well-studied stocks. In fact, US lawmakers found it necessary to specify that all stocks need annual catch limits, to counter a trend of assessing and setting limits for only a few. Unassessed stocks are common in nearly all regions of the world, but are especially well represented in the tropics. But how does one assess a stock for which conventional data are lacking?

CASTING MORE BROADLY ECONOMICALLY

One option is to find additional informative data. Although there is a rich history of bioeconomic modeling in fisheries (e.g., Clark 1990), stock assessments typically focus on biological constraints associated with the relationship between stock size and production. Economic constraints also operate on fisheries and can have an important effect on fishing effort. Effort is a key variable in conventional stock assessments because abundance is regularly approximated by comparing catch per unit fishing effort over time. By using the economic constraint of profitability, we can pin down the realm of possibilities for fisheries.

For example, Nowlis and van Benthem (2012) examined conditions under which the granting property rights, where fishers owned a share of future catches in their fishery, would lead to sustainable catch increases. Their analysis included studies of both biological and economic constraints to narrow the conditions under which we should expect to see certain kinds of catch histories. Without the economic analysis, the realm of possibilities would have been much broader.

In Colombia's spiny lobster (*Panulirus argus*) fishery in the Seaflower Biosphere Reserve, it was known that unregistered foreign fishing vessels made substantial catches. These catches were not reported to Colombian fishing authorities nor regulated by Colombia's management system. Nowlis and colleagues (2013) identified a strong relationship between economic conditions — especially the price of fuel and the expected revenue per unit effort (a function of lobster price and relative abundance) — and fishing effort by Colombian vessels. He then used this relationship to produce a more credible estimate of catches by unregistered foreign vessels, and thus a better stock assessment.

CASTING DEEPER ECOLOGICALLY

Though economic data provide great promise for assessments of data-poor stocks, we can also dig more deeply for ecological data. Particularly in the tropics, there can be data from the academic and fishing communities that are not officially part of government data programs. These data can be valuable. To illustrate this value, consider the red hind (*Epinephelus guttatus*) in the northern US Virgin Islands, St. Thomas, and St. John. Trip logs with sufficient detail to identify this species have a short history, going back to 2004, and port sampling of lengths covers the same recent years plus

a four year span in the mid-1980s (Figure 1a). Ecological surveys have estimated relative abundance, akin to trip logs, going back to 1997. They have also documented average fish size periodically going all the way back to 1976 (Figure 1b) (Nemeth 2005). Incorporating these data provide a much more complete picture of how abundance and average size of red hind have changed over time.

NEARLY DATALESS MANAGEMENT

Even after casting deeper and more widely, we may lack sufficient data to perform a standard stock assessment. When data are sparse, we often have to make rigid assumptions about the stock-recruitment relationship, and simple phenomenon such as variance in the biophysical conditions for recruitment can lead to unresolvable conflicts in how to interpret data. Under such conditions, there are some techniques that rely solely on catch histories (e.g., Dick and MacCall 2011). A complementary option is to perform a qualitative evaluation of a stock's history, focusing on changes in catches and any indicator of stock status over time. Such evaluations are common in conventional assessments as a way of validating assessment results and thus have promise as a reference point for stocks for which conventional assessments are impossible.

In this approach, one collects any status indicators, which might include measures of relative abundance and average length of individual fish, and graph them along with any major management actions (Figure 2). A similar exercise is then performed for catch data (Figure 3). Taking caution to recognize that management actions may have affected stock conditions, we can then consider whether the current trend in stock status is increasing, stable, or decreasing. In the case of red hind from the northern US Virgin Islands, the data are suggestive of improvements following the 1999 year-round closure (Figure 2). Then, we examine catches to see how they are trending. In our case study, catches also seem to have increased following the year-round closure (Figure 3). If catches are increasing and status decreasing, we have an indication that a fishery is either developing or becoming depleted. If catches are

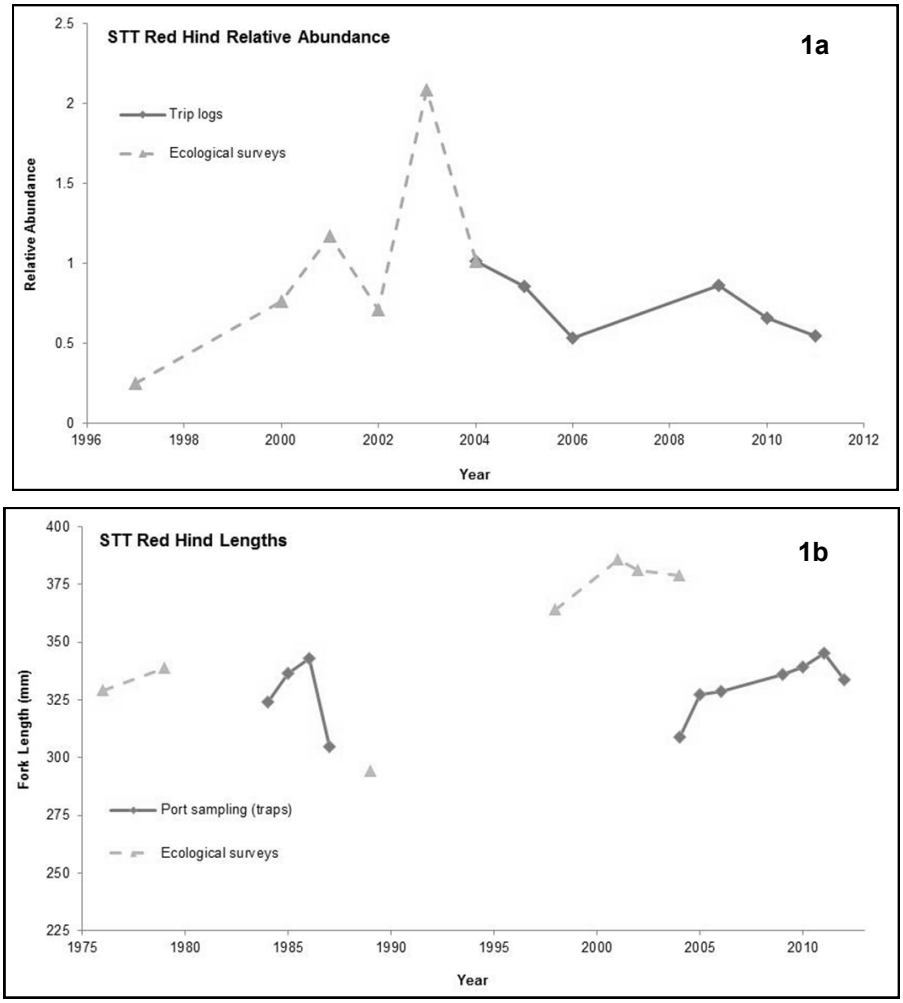

Figure 1. St. Thomas/St. John (US Virgin Islands) red hind status data before and after adding ecological surveys.

decreasing and status increasing, we have an indication that a fishery is recovering but without indication about whether the stock is currently depleted. If both catches and status are stable, the data suggest we have a sustainable fishery, but without indication about whether higher catches are possible. Any other combination (both increasing or both decreasing) suggests that more data are necessary to make a reasonable interpretation and caution should be advised.

Such an approach is poor science relative to a full-blown stock assessment, which makes similar considerations but with formal logic and mathematical constraints. However, in cases where conventional assessments are not possible, this approach can provide a reference point for management. Without knowing the full productive potential of a stock, we can still use these indicators, along with adaptive management methods, to achieve a reasonable mix of fishery production, economic stability, and sustainability (e.g., Nowlis 2004).

CONCLUSIONS

By casting deeper and more widely for data sources, and by relaxing our standards for assessments to include methods that make use of whatever data are available, we can provide scientific management advice across many more fisheries. We must do so with caution, however, and present our results with careful caveats. These caveats, that data are imperfect and the future uncertain, apply to conventional assessments as well. When it comes to data-poor fisheries, some advice, accompanied by an adaptive approach, is likely to be better than no advice at all.

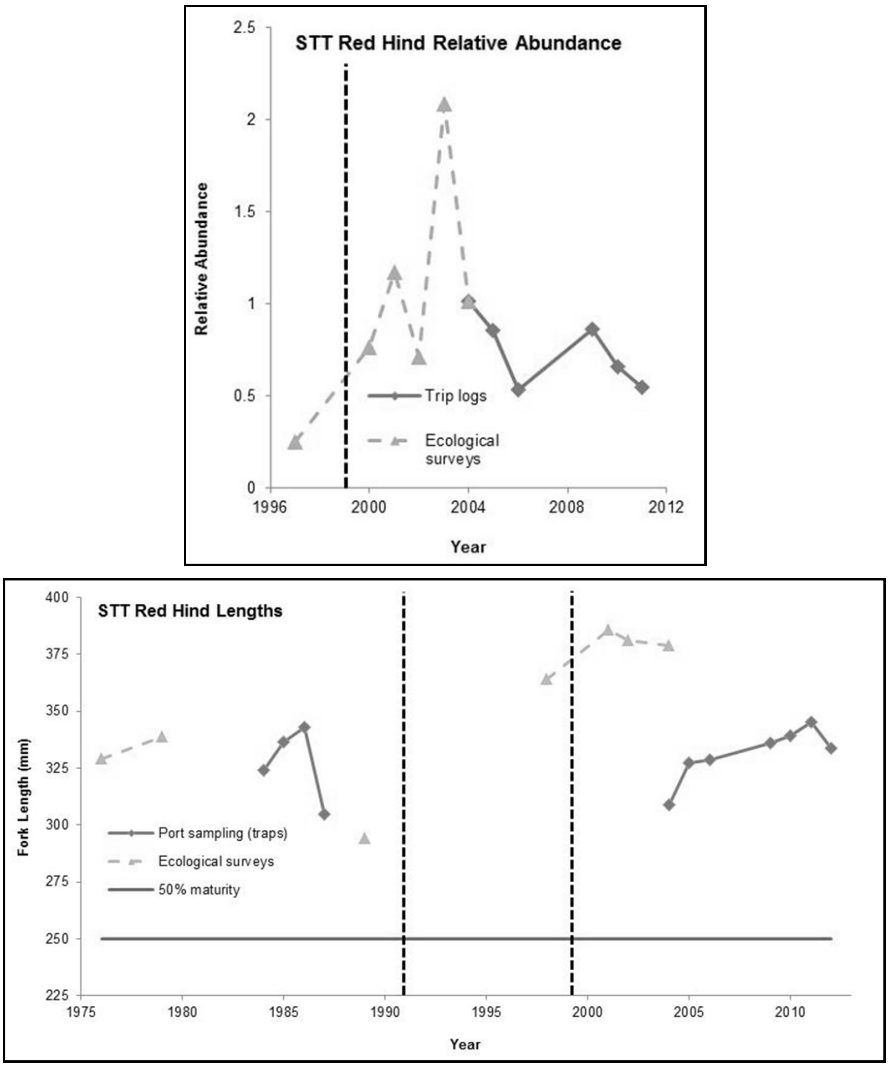

Figure 2. St. Thomas/St. John (US Virgin Islands) red hind status data, with major management actions identified. The first dashed line, in 1991, represents a seasonal closure on the Red Hind Bank Marine Conservation District. The second dashed line, in 1999, represents the year-round closure of this same area.

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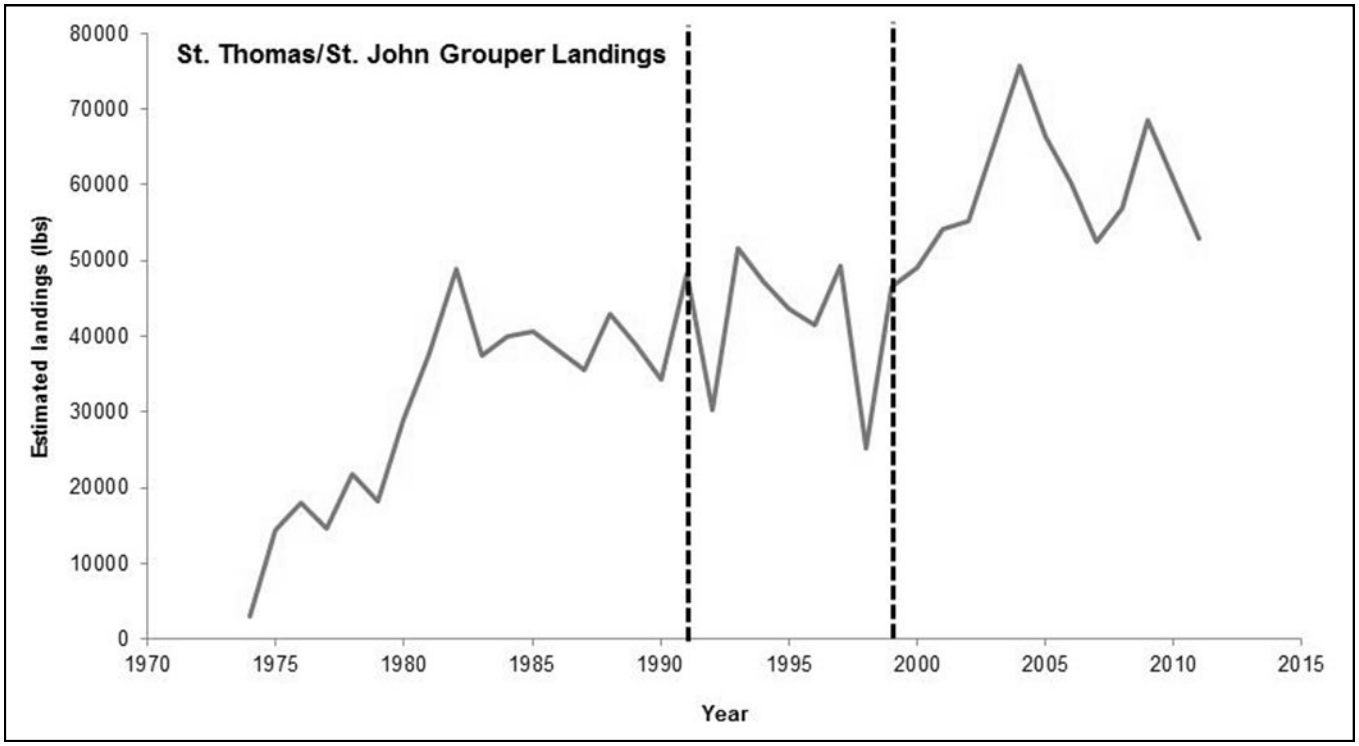

Figure 3. St. Thomas/St. John (US Virgin Islands) red hind landings, with major management actions identified. The first dashed line, in 1991, represents a seasonal closure on the Red Hind Bank Marine Conservation District. The second dashed line, in 1999, represents the year-round closure of this same area.