Abstract
This essay explores the persistence of the concept of maximum sustainable yield (MSY) in global multilateral fishing law. It argues that MSY has contributed to the unsustainable governance of fishing activities by focusing on open access and catch-based management, instead of effort-based management. In response to the dire state of world fish stocks, it has been proposed to cut subsidies to the sector, restrict trade in endangered fish species, install marine protected areas and mainstream the Food and Agriculture Organization’s (FAO) ecosystem approach to fisheries (EAF). This essay proposes that the FAO’s EAF, which links in to social-ecological resilience thinking, suggests a new philosophy for fisheries management that offers a basis for introducing the aforementioned measures.

Keywords
ecosystem approach to fisheries; freedom of fishing; maximum sustainable yield (MSY); subsidies; overexploitation

Introduction
A 2009 study co-sponsored by the World Bank and the Food and Agriculture Organization (FAO) of the United Nations reported that, in addition to depleted stocks, marine fisheries incur a loss of about US $ 50 billion annually.1

The report also stated that:

The focus on the declining biological health of the world’s fisheries has tended to obscure the even more critical deterioration of the economic health of the

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fisheries, which stems from poor governance and is both a cause and a result of the biological overexploitation.\(^2\)

The FAO in its 2010 Report on the State of World Fisheries estimates that, in 2008, 53% of marine fish stocks were fully exploited and 32% were either overexploited (28%), depleted (3%) or recovering from depletion (1%).\(^3\) Moreover, 25% of tuna stocks are overexploited and 5% are depleted, and 55% of straddling stocks are overexploited and 8% are depleted.\(^4\) These figures mark a trend in which the percentage of overexploited, depleted and recovering stocks continues to increase and the percentage of underexploited (3%) and moderately exploited (12%) stocks decreases.\(^5\)

While it is clear that these trends are attributable to deficient fisheries governance in general and the prevalence of subsidies to the fishing sector in particular, global multilateral fisheries agreements do not address subsidies; instead, they continue to reflect a theme: open access is fine for we will not be able to deplete, let alone exhaust, marine fish stocks. That theme can be linked to concepts that continue to be part of multilateral fisheries law: the freedom of fishing and maximum sustainable yield (MSY).

The freedom of fishing conceptualizes fish stocks on the high seas as open-access resources that are available to all, and dates back to 1609 when Grotius published *Mare Liberum*. Grotius held that marine fisheries resources of the oceans should be available to all because of their abundance, even though he conceded that in theory fish might be exhaustible.\(^6\) The problematic nature of this conceptualization became evident first in the late 19th century and again during the 1930s, and after the Second World War, when stocks were found to be depleted in the North Sea and in North American waters. Fisheries management based on MSY was proposed as the solution. Illustrative are the provisions in the United Nations Convention on the Law of the Sea (LOSC) that summon fisheries managers “to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors” and stock interdependence,

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\(^5\) FAO, *supra* note 3, at 8.

\(^6\) Robert Feenstra (ed.), *Hugo Grotius, Mare Liberum 1609–2009* (Brill, Leiden & Boston, 2009) at 60–63, 93.
both for the exclusive economic zone (EEZ) and the high seas. This essay explores the origins and persistence of MSY in multilateral fisheries law.

**Maximum Sustainable Yield, Effort and the Economics of Fishing**

The concept of MSY finds its origins in an over-simplified translation of the work of, in particular, Beverton and Holt, and their yield-per-recruit model which sought to address fishing effort. Beverton and Holt found that a level of fishing effort per stock could be determined at which the total weight of fish caught would be optimal, taking into account stock recruitment, the size of individual fish and fish mortality. Their findings were translated, in particular by the United States, into MSY. MSY-based management does not necessarily seek to manage fishing effort; instead, it seeks to manage catches. MSY-based management is based on total allowable catches (TAC), often in tandem with (individual) quotas and technical measures, such as mesh-size regulations. Addressing fishing effort, in terms of the number of boats and fishers, is not part and parcel of MSY-based management.

Factors that informed the development of fisheries policies after the Second World War include the need for fish as a source of protein, the confidence in science typical of the times and the desire to maintain open access to the oceans. In addition, the belief that the economics of the fishing industry would result in diminishing fishing effort long before stocks start to decline played a prominent role. For fisheries management this belief implied that the open-access nature of fisheries need not be addressed because the laws of economics would regulate access and prevent overexploitation. Subsidies to the sector were not factored into the equation, resulting in over-capacity, economic loss, and illegal, unreported and unregulated (IUU) fishing, as well as declining stocks.

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7 1833 UNTS 3. LOSC Arts. 61(3) and 119(1)(a), respectively.
8 Ray Beverton, “Fish, Fact And Fantasy: A Long View” and Sidney J. Holt, “Fifty Years On” (1998) 8 Reviews in Fish Biology and Fisheries (RFB&F) at 229–249 and 357–366, respectively.
9 Carmel Finley, All the Fish in the Sea (University of Chicago Press, Chicago, 2011).
10 Ibid.
Maximum Sustainable Yield and Multilateral Fishing Law

Neither MSY as such, nor the preference for catch-based fisheries management was explicitly included in the 1958 Convention on Fishing and Conservation of the Living Resources of the High Seas (1958 Fishing Convention).\(^{13}\) It provides instead that the high seas are to be regulated by “the aggregate of measures rendering possible the optimum sustainable yield from those resources so as to secure a maximum supply of food”.\(^{14}\) While the term ‘optimum sustainable yield’ implicitly refers to MSY, the 1958 Fishing Convention remains silent on the type of measures or management system that should be used to conserve the fisheries resources of the high seas.

The LOSC embraced MSY and catch-based, instead of effort-based, fisheries management, both for the high seas and the EEZ.\(^{15}\) It requires the determination of TACs, reflects trust in fisheries science and, to the extent that it refers to economic factors, points to those that are likely to increase pressure on fish stocks, i.e., the special requirements of developing states and fishing patterns.\(^{16}\) Developing states are likely to wish to increase their access to fishing resources, and fishing patterns, also in the 1980s, were not necessarily sustainable. The LOSC does address some of the criticism levied at MSY, e.g., by incorporating the need to address stock interdependence.\(^{17}\)

The central position of MSY in the LOSC is remarkable, given the criticism that it had incurred from fisheries economists and biologists, starting in the 1960s. Economists advocated the introduction of the concept of maximum economic yield to rationalize marine fisheries,\(^{18}\) and Larkin, a fisheries biologist, wrote an epitaph for MSY. Larkin summarized the literature criticizing the concept and captured its consequences: “[i]t advocated yields too high, [a]nd didn’t spell out how to slice the pie.” However, he also conceded that “[w]e don’t know yet what will take its place.”\(^{19}\)


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13 559 UNTS 285.
14 1958 Fishing Convention, Art. 2.
15 See supra at note 7.
16 LOSC, Art. 61(1), (2) and (3), and Art. 119(1)(a).
17 LOSC, Art. 61(4) and Art. 119(1)(b).
the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement) repeats the MSY-based provisions of the LOSC. It requires states “to take measures to prevent or eliminate overfishing and excess capacity and to ensure that levels of fishing effort do not exceed those commensurate with the sustainable use of fishery resources.” However, the need to eliminate subsidies to the sector remains unmentioned and the much improved management system based on precautionary reference points remains a catch-based management system, with one small exception. This exception applies to new and exploratory fisheries and requires states to, inter alia, set catch and effort limits for those fisheries, measures that “shall remain in force until there are sufficient data to allow assessment of the impact of fisheries on the long-term sustainability of the stocks”, after which conservation and management measures based on those assessments shall be adopted.

The approach to fisheries management in multilateral fisheries law appears to be that we are managing fish and fish stocks. This approach goes back to Beverton and Holt’s model, as well as to models that further develop it. These models suggest that if we understand stock recruitment, the growth of individual fish, and fish mortality, we are in a position to determine optimal levels of fishing. That I suggest is only one side of the problem that needs to be addressed. The other side concerns managing human conduct and our knowledge that we will over-invest and over-fish if access to the sector or the resource remains under-controlled, let alone stimulated by subsidies. This is not to be taken to imply that we do not require fisheries science. Of course we do; however, we also must manage fishers and in particular fishing effort.

Beyond Maximum Sustainable Yield

Several responses to the dire situation of marine fish stocks and the fisheries sector have been advanced. They include cutting subsidies, restricting trade in endangered fish, installing marine protected areas and FAO’s ecosystem approach to fisheries. The first response directly addresses fishing effort, the second and third responses do not address fishing effort as such, and the last response suggests a new philosophy for fisheries management. Each response is briefly discussed below.

20 UN Fish Stocks Agreement (2167 UNTS 3), Art. 5(b).
21 Ibid. Art. 5(h).
22 Ibid. Art. 6(6).
The logical response to the status of fish stocks and the fishing sector would be to gradually reduce and subsequently severely restrict subsidies to the sector, as required by the Johannesburg Plan of Implementation adopted at the 2002 World Summit on Sustainable Development and reiterated in the Rio+20 Declaration.\textsuperscript{23} Negotiations on the topic were included in the World Trade Organization’s (WTO) Doha Round; however, no progress has been attained, even though the effects of fisheries subsidies, including their relationship to IUU fishing, have been well documented.\textsuperscript{24} A draft text addressing subsidies to the fishing sector was presented in November 2007. Its discussion was marked by disagreement—disagreement that continues to prevail, as demonstrated by a 2011 communication from the chairperson of the relevant Doha negotiating group.\textsuperscript{26} It states that “at present there is too little convergence on even the technical issues, and indeed virtually none on the core substantive issues, for there to be anything to put into a bottom-up, convergence legal text”.\textsuperscript{27}

Another step forward would be to control trade in endangered fish species, and initiatives have been taken to list marine species in the appendices of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES).\textsuperscript{28} Although some marine species have been listed, listing commercially fished species remains controversial, with some states arguing that the protection of these species is within the remit of the FAO and regional marine fisheries organizations and not CITES.\textsuperscript{29} A 2006 Memorandum of Understanding concluded between the FAO and the CITES secretariat, and a 2010 joint expert meeting concluding that “harvest-related and trade-related measures could and should be used in tandem”\textsuperscript{30} so far have not been able to

\textsuperscript{24} See supra note 12.
\textsuperscript{27} Ibid., at 46, para. 3.
\textsuperscript{28} 993 UNTS I-14537.
\textsuperscript{30} For the text of the MOU see http://www.cites.org/eng/disc/sec/FAO-CITES-e.pdf. Also
overcome this controversy, as shown by negotiations in 2010 at the latest conference of the parties to CITES. At that meeting six species of marine fish were proposed for listing, but none were listed.31

Based on precautionary and ecosystem management approaches, it has been proposed that large marine areas be closed to fishing activities so that fish stocks can recuperate. Proposals to this effect have been developed under the Convention on Biological Diversity (CBD),32 in the form of Marine Protected Areas (MPAs).33 However, MPAs are controversial because they do not converge with the freedom of the high seas and open access, which are implicit in MSY-based fisheries management and the stock assessment models developed by Beverton and Holt.34 Moreover, MPAs alone do not suffice to protect fish stocks. They may result in the displacement of fishing activities to other areas, unless accompanied by measures that regulate fishing effort. MPAs have been established in EEZs, but are rare in high seas areas. The latter include the South Orkney Islands Southern Shelf, established under the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR),35 and high seas enclaves in the western Pacific, established under the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (WCPFC).36 The former is closed to all fishing,

32 1760 UNTS 79.
33 See COP 2, Decision II/10 (1995), adopting the so-called Jakarta Mandate on Marine and Coastal Biological Diversity. Also see, e.g., COP 4, Decisions VII/5 (1997) (advocating the adoption of ecosystem and precautionary approaches, as well as the establishment of MPAs) and COP 10, Decision X/29 (also advocating the introduction of MPAs). COP decisions related to marine and coastal biodiversity are available at http://www.cbd.int/marine/decisions.shtml. Also see 27 (2) IJMCL 2012, which contains a number of contributions relevant to the topic.
35 1329 UNTS I-22301.
36 2275 UNTS I-40532.
the latter to fishing for highly migratory fish stocks. Currently efforts are ongoing to establish an MPA for the Sargasso Sea.

The FAO has developed the so-called Ecosystem Approach to Fisheries (EAF), based on the Code of Conduct for Responsible Fishing (Code of Conduct). The EAF postulates that the “fishery system is a social-ecological system, and consists of linkages between people and the environment, also outside the actual fishing operations”. It thereby introduces the concept of social-ecological systems into fisheries policy. This concept implies that “social-ecological systems are linked systems of people and nature”; it “emphasizes that humans must be seen as a part of, not apart from, nature—that the delineation between social and ecological systems is artificial and arbitrary.” Furthermore, the FAO relates this approach to the resilience perspective, albeit cautiously. In so doing, the EAF introduces a new philosophy for fisheries management based on “a shift in mental models toward human-in-the-environment perspectives, acceptance of the limitation of policies based on steady-state thinking and design of incentives that stimulate the emergence of adaptive governance for social-ecological resilience of landscapes and seascapes.” This perspective might well be what Larkin was looking for when he sought to find a replacement for MSY. The EAF provides a rational for, \textit{inter alia}, restricting subsidies to the fisheries sector, regulating trade in endangered species of fish and introducing MPAs.

\begin{footnotesize}
39 Available at: http://www.sargassoalliance.org/.
40 Available at: http://www.fao.org/docrep/005/v9878e/v9878e00.HTM.
41 FAO, \textit{Technical Guidelines For Responsible Fisheries} No. 4, Suppl. 2 Add (FAO, Rome, 2009) at 15.
44 Folke, \textit{ibid.}, at 263.
\end{footnotesize}
Conclusion

MSY has been a more than resilient concept in multilateral fisheries law, even though it has been criticized since the late 1960s. Sidney Holt has suggested that “somehow, some time, the conditional MSY-objective embedded in the UN Law of the Sea Convention has to be either amended or creatively re-interpreted.” The precautionary reference points introduced in the UN Fish Stocks Agreement engage in some re-interpretation, even though catch-based management remains the point of departure. Might the EAF offer a basis for further reinterpreting our fisheries management policies? I suggest that it could and should. Whether it will make it into multilateral fisheries law remains to be seen.

This essay also illustrates that concepts once introduced into international law may be difficult to replace. The freedom of fishing, now around for four centuries, and MSY provide relevant examples. Might a heritage mindset as proposed by Russ and Zeller offer a viable alternative? This is the mindset which, I suggest, informs the FAO’s EAF, which also offers a basis for action, as Russ and Zeller suggest is required. The heritage mindset is related to another concept in the LOSC: the common heritage of mankind, a concept that did not fare as well as the concepts discussed in this essay.

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45 Holt, supra note 9, at 365.
47 See Erik Franckx, “The International Seabed Authority and the Common Heritage of Mankind: The Need for States to Establish the Outer Limits of their Continental Shelf” (2010) 25 IJMCL 543–567.