

**POLICY PERSPECTIVE****Shark fin trade bans and sustainable shark fisheries**

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Abstract

The U.S. Congress is currently discussing the Shark Fin Sales Elimination Act to eliminate shark fin trade at the federal level. This bill was introduced in 2017 and has been proceeding very slowly in Congress because of mixed reviews from the scientific community. Debate exists on whether shark conservation and management are effectively addressed with tightened trade controls for imported shark products or blanket bans that outright end U.S. participation in the shark fin trade. Here we contribute to this debate with a review and analysis of economic, nutritional, ethical, and legal arguments, as well as of the shark fisheries status and shark fin trade. We show that the United States has a limited commercial interest in shark fisheries and contributes to the shark fin trade mainly as a facilitator. A fin trade ban has few tangible economic drawbacks but would have a considerable conservation impact. While making all shark fisheries sustainable is the ultimate goal, in practice this objective is far from achievable everywhere in the world. Conversely, banning shark fin trade is an interim measure that nations like the United States can take with negligible cost and can truly impact the biggest driver of shark exploitation globally.

KEYWORDS

fin trade bans, fisheries, management and conservation, network analysis, seafood traceability, Shark Fin Sales Elimination Act, sharks, socioeconomic value of fisheries, sustainable fishing, U.S. Congress

1 | INTRODUCTION

Shark conservation is one of the most pressing global biodiversity issues. Many shark populations are declining worldwide because of fishing (Worm et al., 2013). In the last few decades, shark exploitation rapidly escalated to satisfy an increased demand for shark fins from Asian markets (Clarke et al., 2006); between 27 and 73 million sharks are traded across global shark fin markets every year (Clarke et al., 2006).

In response, the United States has enacted laws to protect sharks. The 2000 Shark Finning Prohibition Act

prohibited catching sharks, cutting their fins, and discarding their bodies. The 2009 Shark Conservation Act closed some loopholes ensuring that sharks are landed with their fins naturally attached. However, the United States continues to trade fins with countries with no finning laws (Table S3) (Dent & Clarke, 2015). Hence U.S. Congress in 2017 considered a ban of the sale and possession of shark fins in order to extricate the United States from the fin trade (the Shark Fin Trade Elimination Act, S.793).

Scientists received this move with mixed reviews. Many believe the bill will improve enforcement of state shark fin trade bans (enacted in 13 U.S. states, Figure 1a), and

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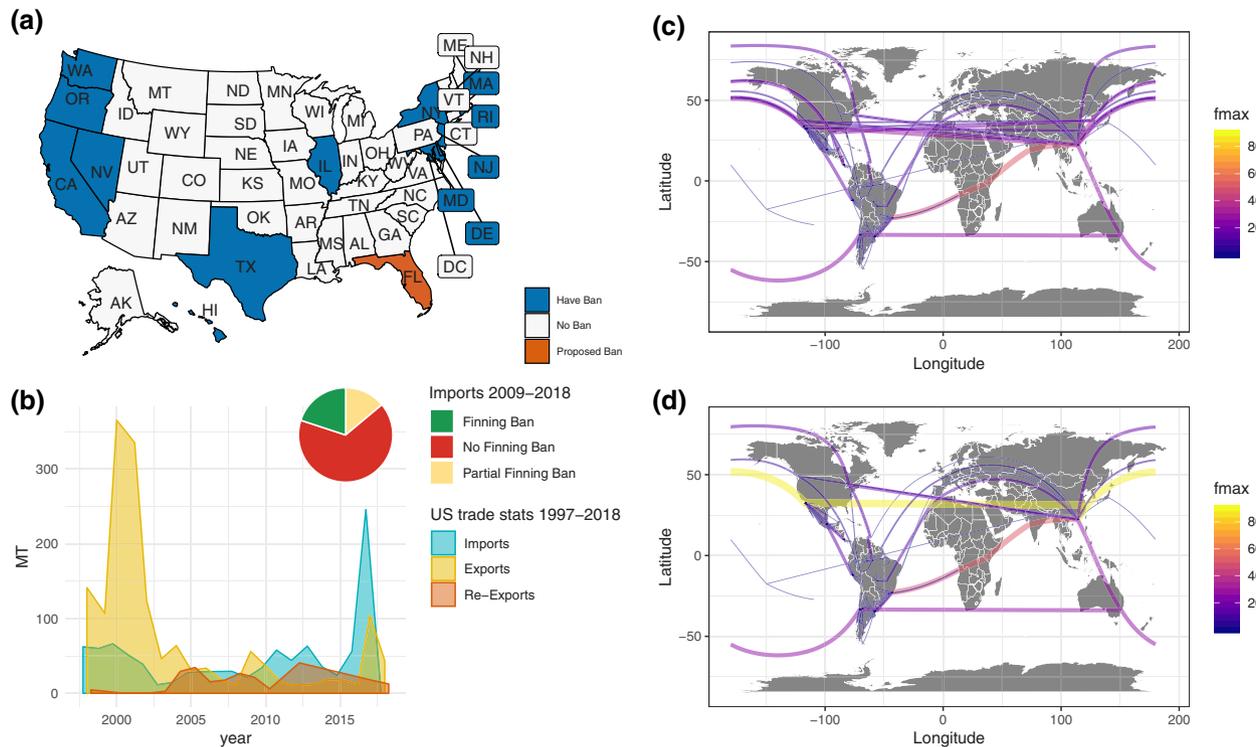


FIGURE 1 U.S. state bans, trade statistics, and aerial fin market network. (a) U.S. states with current and proposed fin trade bans. (b) U.S. trade statistics (1997–2019) for shark fins; pie chart inset indicates the average annual portion of fin biomass imported between 2009 and 2018 from countries with different anti finning laws. (c), (d) The shortest paths through the global airline network, from Latin American airports to Hong Kong, for fin trade including (c), and excluding (d), U.S. airports. The frequency, f_{max} , represents the maximum number of shortest paths that use any particular leg between two airports. The transport of fins from Latin America to Hong Kong is often facilitated by key U.S. air transport hubs. Unable to pass through the United States, trade itineraries reroute funneling through a few important non-U.S. hubs served by a lower number of carriers, increasing the logistic constraints and cost of shipments (Supporting Information and Table S4)

reinforce the role of the United States as a leader in shark conservation (Supporting Information). Others maintain this law will undermine sustainable shark fishing, have little effect on global shark conservation, and potentially divert attention from other drivers of global shark population declines (Shiffman & Hueter, 2017). After more than 2 years of discussions, this bill (now Shark Fin Sales Elimination Act H.R. 737/S. 877) has recently passed a vote in the House of Representatives (on November 20, 2019) and is being considered together with an alternative one that would create a certification process for continued fin trade in the United States (the Sustainable Shark Fisheries and Trade Act H.R. 788/S. 1008). The predominant arguments surrounding these bills have been whether it is preferable to have tighter trade controls for imported shark products (H.R. 788), or blanket bans that outright end U.S. participation in the shark fin trade (H.R. 737).

Here we clarify the socioeconomic role and conservation impact of shark fisheries in the United States and globally. Our aim is to reconcile contrasting views on shark conservation and management that have hampered enacting efficient and properly informed legislation. We show that fin trade bans

are practical interim cost-effective policies that developed nations can adopt to stop the greatest driver of global shark mortality.

2 | SUSTAINABLE SHARK FISHING

Sustainable shark fishing is possible but, in practice, has been achieved for a few relatively small and highly productive species and in a few countries (Simpfendorfer & Dulvy, 2017). The United States leads with 12 of the 16 sustainable and well-managed shark fisheries globally, which, however, are only 17% of the 71 shark stocks under U.S. management. The remaining 83% are either overfished, experiencing overfishing or both (8%), or unassessed (75%) (Table 1). Globally, 91.3% of shark catches are biologically unsustainable (Simpfendorfer & Dulvy, 2017).

A fundamental problem in sustainably managing shark fisheries is our limited understanding of the life histories and ecology of many shark species and lack of adequate fisheries data. Sharks have the highest proportion of data deficient species among marine fish (Dulvy et al., 2014) and misguided

TABLE 1 Summary of U.S. shark fisheries extracted from the 2017 National Oceanic and Atmospheric Administration (NOAA)'s Report to Congress on the Status of all Fisheries managed under the Magnuson-Stevens Act (MSA) (Supporting Information; Species names in each Species complex are listed in Table S1)

Species complex	Species #	Region	Overfishing	Overfished
Atlantic Sharpnose Sharks	1	Atlantic	No	No
Blue Sharks	1	Atlantic	No	No
Smooth Dogfish	1	Atlantic	No	No
Spiny Dogfish	1	Atlantic	No	No
Finetooth Sharks	1	Atl. & GOM	No	No
Atlantic Sharpnose Sharks	1	GOM	No	No
Blacktip Sharks	1	GOM	No	No
Smoothhound Sharks	3	GOM	No	No
Blue Sharks	1	Pacific	No	No
Spiny Dogfish	1	Pacific	No	No
BSAI Shark Complex	3	Pacific	No	Unknown
Gulf of Alaska Shark Complex	3	Pacific	No	Unknown
Porbeagle Sharks	1	Atlantic	No	Yes
Sandbar Sharks	1	Atl. & GOM	No	Yes
Aggregated LCS	11	Atlantic	Unknown	Unknown
Blacktip Sharks	1	Atlantic	Unknown	Unknown
Bonnethead	1	Atlantic	Unknown	Unknown
Pelagic Shark Complex	5	Atlantic	Unknown	Unknown
Prohibited Species	19	Atlantic	Unknown	Unknown
Blacknose Sharks	1	GOM	Unknown	Unknown
Bonnethead	1	GOM	Unknown	Unknown
Bigeye Thresher	1	Pacific	Unknown	Unknown
Common Thresher Sharks	1	Pacific	Unknown	Unknown
Longfin Mako	1	Pacific	Unknown	Unknown
Oceanic Whitetip Sharks	1	Pacific	Unknown	Unknown
Pelagic Thresher	1	Pacific	Unknown	Unknown
Salmon Sharks	1	Pacific	Unknown	Unknown
Shortfin Mako	1	Pacific	Unknown	Unknown
Silky Sharks	1	Pacific	Unknown	Unknown
Blacknose Sharks	1	Atlantic	Yes	Yes
Scalloped Hammerhead	1	Atlantic	Yes	Yes
Shortfin Mako	1	Atlantic	Yes	Yes
Dusky Sharks	1	Atl. & GOM	Yes	Yes

management can occur for even relatively well-monitored species (Byrne et al., 2017). Furthermore, determining the sustainability of fisheries requires evaluating their ecosystem impact. Ecosystem effects of fishing are challenging to detect and often ignored in stock assessments (Travis et al., 2014), but are of utmost importance for sharks and other predators whose declines can cause cascading changes down the marine food webs, with impacts on other commercial fisheries (Ferretti, Worm, Britten, Heithaus, & Lotze, 2010).

2.1 | Socioeconomic value of U.S. shark fisheries

We estimated the economic value of U.S. shark fisheries as 18.9 M\$ (Table S2), a mere ~0.4% of the 5.3 billion U.S.\$ U.S. fisheries revenue (Supporting Information). Banning the shark fin trade would impact 11 M\$ of this gross fisheries revenue. Conversely, managing shark fisheries, and certifying their sustainability for all trading partners (H.R. 788), would be much more expensive. A single fish stock assessment in

the United States costs on average 1.7 M\$ (Merrick & Methot, 2016). This translates to ~121 M\$ if all domestic caught shark stocks were assessed at least once. Ideally, these assessments should be annual to update catch limits, and be species or stock specific.

Certifying imports according to U.S. standards (H.R. 788) would greatly increase these costs and require a substantial administrative and legal effort. The shrimp import certification is a model (82 FR 21295). It requires other countries use Turtle Excluder Devices (TEDs). Compliance is ensured by the NMFS and the Department of State, which send teams abroad and source data from U.S. embassies and foreign governments. This costly endeavor is considered worthwhile because the United States imports around 6.2 B\$ of shrimp annually (NOAA fisheries, 2019), and, unlike the limited value of shark imports, can have a major impact on the shrimp market. Furthermore, TED is a relatively simple and cheap gear modification required in a particular fishery (shrimp trawl fishery). Yet it raised legal debates leading to four World Trade Organization panels and at least 10 U.S. federal court cases (Morita, 2004). A certification for sharks may require multiple gear modifications in multiple fisheries outside U.S. jurisdiction, further complicating interpretation of certification requirements and likely leading to lengthy and costly disputes.

Shark fisheries have no food security role in United States. Fins have low nutritional value and shark meat consumption is discouraged for its high concentration of heavy metals (Bornatowski, Braga, & Barreto, 2018). Most of the shark meat production is from dogfish and smoothhound sharks (74% or 5.9 M\$), which are almost completely exported (Supporting Information). And for all shark species, meat is essentially a by-product of fin production as fins' unit ex-vessel price is on average about 10.8 times the price of shark meat (Table S2). Hence, it is possible that a fin trade ban may also impact sustainable shark fisheries (Shiffman & Hueter, 2017) by removing their strongest incentive to exist. However, with no food security role, low economic and nutritional value, associated high uncertainty and cost of fisheries management, and a high risk of ecosystem impact, why should the United States continue exploiting sharks at all?

Preserving the right of fishers to sell legally caught shark fins has been justified on the grounds of preventing resource waste (Shiffman & Hueter, 2017). This reasoning often works for selling by-catch species, but when it comes to shark fins it may have perverse implications. The ability to sell highly valuable fins can generate resistance to reduce by-catch in shark fisheries, one of the most important objectives of multiple national and international shark conservation plans (de Mitcheson et al., 2018). It can also promote more shark meat production, and thus more mortality, which is necessary where fins have to be landed naturally attached, or account for a certain weight percent of landed shark carcasses. In Brazil,

in the last decade, shark meat production rapidly increased as domestic and chartered foreign fleets started targeting sharks (Bornatowski et al., 2018). The nation became the world's largest importer of shark meat despite domestic markets had no previous demand for this product and the government had to push shark meat into the national seafood distribution (Bornatowski et al., 2018). Meat production is thus suspected to bolster/laundry fin production as illegally fished fins were regularly seized by Brazilian authorities, in some cases implying shark catches 80-fold the declared landings (Bornatowski et al., 2018)

3 | U.S. SHARK FIN TRADE

While the United States has a minimal direct role in the global shark fin trade (0.3 and 0.4% of global imports and exports in U.S.\$, Supporting Information), by allowing incoming or transiting shark fin shipments, it implicitly endorses, supplies and facilitates an impactful market on global shark populations. Imports come mainly from countries with limited, inefficient or no shark conservation laws (Figure 1b, Table S3). Meanwhile, as a fundamentally important transport hub in the global airline network, the United States facilitates the movement of shark fins from the main producing nations to major international markets, especially from South America where some countries lack or cannot effectively enforce fisheries management regulations (Davidson, Krawchuk, & Dulvy, 2016) (Figure 1c, d, Supporting Information). A fin trade ban in the United States would therefore send a strong message to the international community about the need to address global impacts of shark finning, while disrupting major international market flows (Supporting Information and Table S4).

3.1 | The United States as a conservation and management leader

U.S. leadership in shark conservation (Shiffman & Hueter, 2017; Simpfendorfer & Dulvy, 2017) can influence the international community when it acts by example. Following U.S. state legislations, Canada has recently banned all imports and exports of shark fins (Bill S-238). In 2013, the European Union (EU) enacted the fins naturally attached policy (EU Regulation No 605/2013) after the United States led the way in 2010. Should the Shark Fin Sales Elimination Act pass, pressure on the EU to follow suit will increase. Given U.S. and EU's central role in the fin market trade routes, a joint fin trade ban would have a major impact on the global fin market (Figure 1c, d and Supporting Information).

There is no evidence that banning fin trade would distract from other drivers of shark decline such as incidental catches, habitat loss, and climate change (Dulvy et al., 2014; Shiffman

& Hueter, 2017). Instead, it may simplify understanding and addressing the shark conservation problem. Shark meat production, for example, is rising (Dent & Clarke, 2015) and it is unclear whether and to what extent the shark fin trade is actually driving this pattern. Improving control of the greatest driver of shark exploitation worldwide may help expose and clarify these mechanisms. Enforcement and management would be easier, especially in a market where transparency and traceability are still big roadblocks (Supporting Information). Finally, current U.S. state bans (Figure 1a) have different specifications and allow transport from ban to no-ban states. This patchwork of regulations leads to confusion in enforcement easily resolvable by a single federal bill.

Eliminating U.S. supplied shark fins in world markets would unlikely leave a hole to be filled by nations fishing sharks unsustainably (Shiffman & Hueter, 2017). The international shark fin demand has been declining globally since 2012 (Dent & Clarke, 2015) and removing U.S. fin exports would leave a gap of only 1% (or 104.121 mt in 2017, Supporting Information) in the global fin trade volume. In a shrinking global market also driven by declining resources (Davidson et al., 2016), fin harvesting nations may not increase shark exploitation profitably to fill even this minor gap.

4 | CONCLUSION

In summary, economic, nutritional, ethical, and legal aspects of shark fisheries and fin trade suggest that a ban on shark fin sale is an effective practical step to address the continued global decline of shark populations. This approach may not only work in the United States but in many other nations around the world. Globally, shark fins are not key to food security and shark depletion has ecosystem-wide consequences whose economic costs have not been quantified but are likely significant. Further, it is increasingly recognized that the economic value of sharks alive is orders of magnitude greater than when they are sold in fish markets (Campana, Ferretti, & Rosenberg, 2016). Striving to make all shark fisheries sustainable in the United States is laudable but unlikely to happen within an appropriate time frame. After two decades of management work, supported by tremendous economic and legislative effort, the United States, the leading nation in shark management and conservation, has been able to attain only 17% of its exploited shark stocks as sustainably fished. Yet, the United States can now successfully enact a shark fin trade ban at extremely low economic cost to end its active participation in the largest global threat to shark populations. This action will allow the United States to preserve a key leading role in global conservation and likely trigger similar legislative processes in other developed nations. It is time to assume a more pragmatic and decisive approach to shark conservation

and halt one of the biggest biodiversity crises the oceans are facing today.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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