THE SHARK AND RAY MEAT NETWORK

A DEEP DIVE INTO A GLOBAL AFFAIR

2021

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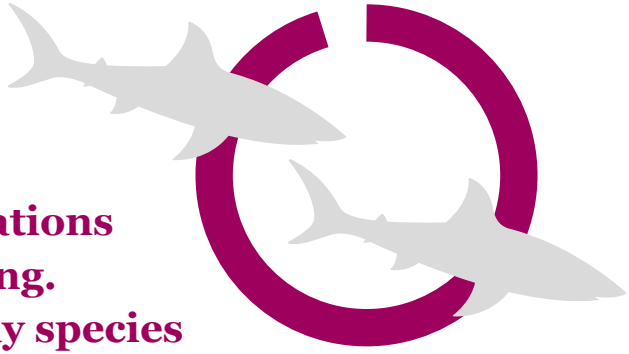
SHARKS AND RAYS ARE IN CRISIS GLOBALLY

Up to 100 million are killed each year, and some populations have declined by more than 95% as a result of overfishing. Today, 36% of the more than 1,200 known shark and ray species are threatened with extinction.



-95%

OF SOME SHARK POPULATIONS

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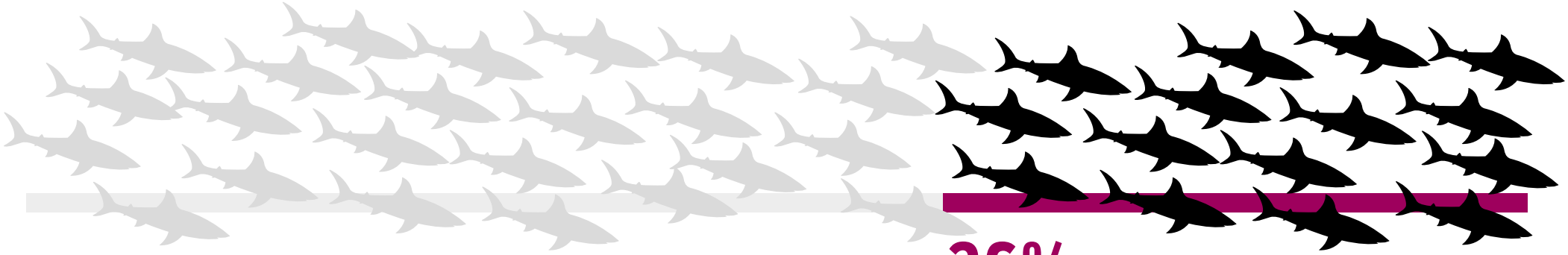


36% OF THE MORE THAN 1,200 KNOWN SHARK AND RAY SPECIES ARE

THREATENED WITH EXTINCTION

The decline of sharks and rays is a contributing factor to the deterioration of our ocean, and symptomatic of much wider marine overexploitation. In order to deal with the situation before it's too late, we need a much better understanding of the opaque and complex global trade of their products.

WWF contracted a team of scientists to develop the first ever analysis of the global shark and ray trade network using graph theory, to give as clear a picture as possible of the key players, relationships and networks properties that drive flows in this niche but highly traded seafood product.

Even though fins are generally much more expensive than meat and the global fin trade has received far more attention to date, global trade in shark and ray meat is actually larger than trade in fins by both volume and by value. The total value of shark and ray trade in the period 2012-2019 exceeds US$4.1 billion. The value of shark and ray meat combined (US$2.6 billion) exceeds the value of shark fins (US$1.5 billion). Prices can range from US$0.1/kg for meat to more than US$100/kg for fins. Of the top traders Italy pays on average the highest price for imports of shark meat at US$4/kg, while Hong Kong pays the highest price for fins at US$30/kg.

Spain dominated the highly complex global trade in fresh and frozen shark meat, appearing in the top three traders by value, volume, and number of trading partners. In the last decade, the trade routes where the largest volumes of shark meat moved have been from Uruguay to Brazil; from Portugal to Spain; from Spain to Italy, Portugal and Brazil; and from Ecuador to Peru. Nevertheless, the most important trade bridges for shark meat network stability have been between Japan, Portugal, the UK and Spain , Japan and Panama, and China and Japan. The EU has established itself as the main supplier to Southeast and East Asian markets, its own exports and imports accounting for about 22% of the total global shark meat trade.

The global trade network for ray meat is less diversified than for shark meat, with trade between Argentina as an exporter and South Korea as an importer dominating the market. The US and Brazil are also important suppliers to the South Korean market. South Korea's exports to the USA, although not large, are important for the structure of the network; while several of the most important bridging traders for network stability come from within the EU.

This analysis has identified not only major importers and exporters of shark and ray meat but also traders playing an essential role as intermediaries, providing useful information on how and where best to focus international efforts to reverse the decline of shark and ray populations. It has also exposed a need for far more detailed international trade data.

Leading national players in the global trade must step up as global champions for conservation and sustainable fishing, adopting precautionary measures and science-based management. Extra resources should be devoted to controls and surveillance.

Internationally, far more detailed trade and tariff codes are required, in particular for ray meat. Species-specific reporting must become the norm globally, including for bycatch, so populations can be effectively managed.

Transparency and traceability are needed from point of capture through every stage of the supply chain, to ensure the trade remains legal and manageable, to keep protected species off the market, and to allow consumers to make informed purchases. Where food security does not depend on shark and ray products, consumers should avoid buying or eating such products unless they are from sustainable and traceable sources. Consumers should be aware that currently very few products available in the market meet these requirements.

SHARKS AND RAYS IN CRISIS

Sharks and rays are in crisis globally. Up to 100 million are killed each year in fisheries of all kinds,[1] and some populations have declined by more than 95% as a result of overfishing.[2]

Overfishing due to a lack of regulation and/or proper management measures for targeted and non-targeted catches is the biggest threat for shark and ray species.[3] A lack of proper reporting of catches and landings not only hinders effective fisheries management but also opens the door to illegal activities. The lack of sustainability and traceability of shark and ray products (meat and fins) in international trade obscures the data and further hinders measures urgently needed for fisheries and trade to become sustainable. Trade analysis can therefore provide meaningful information to complement available fisheries data, and shed light on the drivers of overexploitation.[4]

At the time of writing, 36% of the more than 1,200 known shark and ray species are threatened with extinction.[5] The global community recognized the seriousness of the situation 20 years ago, with the release of the UN FAO International Plan of Action for Sharks (IPOA) based on a resolution from CITES[6] (Convention on International Trade in Endangered Species of Wild Fauna and Flora). The aim of this voluntary international agreement was to ensure the conservation and management of sharks and rays and their long-term sustainable use. However, 20 years later the plan has made little impact in reversing trends in most shark-fishing actors, and population declines have largely continued unabated due to the continued increase in trade (Davidson *et al.* 2016). Currently 14 species of shark and 29 species of ray are listed on CITES Appendices I and II, which states that their trade should be forbidden or closely controlled.

Why does this matter? The decline of sharks and rays is a contributing factor to the deterioration of our ocean, and symptomatic of much wider marine overexploitation.[7] As top predators, these animals have existed for more than 400 million years[8] and play essential roles in marine ecosystems, from maintaining balanced food webs and habitats, to controlling population sizes, and helping nutrient exchange through the ocean layers. Their role in carbon capture and storage – when they die of natural causes, their carcasses sink to the ocean floor and take their carbon with them – is also increasingly acknowledged as a factor to mitigate climate change.[9]

But to fill their vital and varied ecological niches and contribute to ocean health, shark and ray populations need conservation and management of their fisheries and trade – and in order for that to happen, we need a much better understanding of the opaque and complex global trade of their products.

1 Worm et al. 2013 https://doi.org/10.1016/j.marpol.2012.12.034

2 Dulvy et al 2014 https://elifesciences.org/articles/00590, Tremblay-Boyer et.al. 2018 https://www.wcpfc.int/node/42932

3 Dulvy et al 2014 https://elifesciences.org/articles/00590

4 e.g. Dent and Clark 2015 http://www.fao.org/3/i4795e/i4795e.pdf. Okes and Sant 2019 https://www.traffic.org/publications/reports/an-overview-of-major-shark-and-ray-catchers-traders-and-species/

5 https://www.iucnredlist.org/

6 https://cites.org/sites/default/files/document/E-Res-12-06-R18.pdf

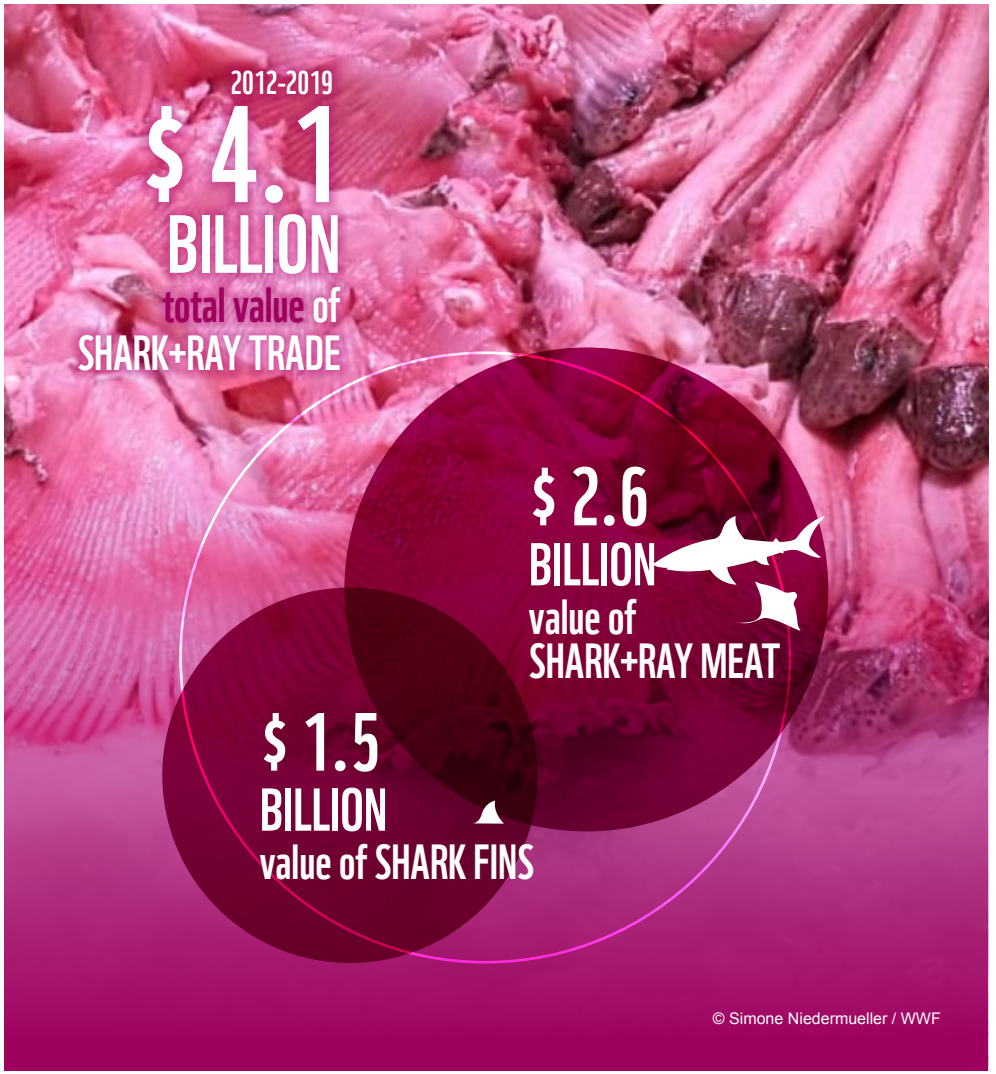
7 Dulvy et al. 2017 https://www.sciencedirect.com/science/article/pii/S0960982217304827

8 Kriwet et al 2008 https://doi.org/10.1098/rspb.2007.1170

9 Mariani et al. 2020 https://advances.sciencemag.org/content/6/44/eabb4848.abstract

THE OVERALL TRADE VALUE

Even though fins are generally much more expensive than meat and the global fin trade has received far more attention to date, global trade in shark and ray meat is actually larger than trade in fins by both volume and by value.



The total value of shark and ray trade in the period 2012-2019 exceeds US$4.1 billion. The value of shark and ray meat combined (US$2.6 billion) exceeds the value of shark fins (US$1.5 billion). Depending on the species and product types being traded, prices can range from US$0.1/kg for meat to more than US$100/kg for fins,[10] with the latter reaching some of the highest prices in Asia. Price can vary widely depending on species, product and trader, among other factors that influence price. Of the top traders[11] Italy pays on average the highest price for imports of shark meat at US$4/kg, while Hong Kong pays the highest price for fins at US$30/kg.

Although shark meat products appear relatively cheap, and they're often fraudulently passed off as more expensive elasmobranch or bony fish species, they in fact contain hidden costs: these animals are worth more alive as key parts of in the ecosystem than dead in a boat, their true value as a carbon sink is only now becoming understood, and their meat often contains high levels of mercury and other toxic substances.

[10] Clark and Dent 2015 http://www.fao.org/3/i4795e/i4795e.pdf, Okes and Sant 2019 https://www.traffic.org/publications/reports/an-overview-of-major-shark-and-ray-catchers-traders-and-species/ , Fowler et al. 2021(BFN)

[11] The term "trader" refers to a country, territory or other political entity reporting trade data. For consistency the terms "importer," and "exporter" have been used in the same way.

GLOBAL NETWORK ANALYSIS

WWF contracted a team of scientists[12] to develop the first analysis of the global shark and ray trade network using graph theory,[13] to give as clear a picture as possible of the key players, relationships and properties of the networks that drive flows in this highly traded seafood product.

The scientific team used graph theory, the main tool of network science, to extract the meaning of shark and ray trade networks composed of import and export relationships for more than 250 traders. Their analysis is based on official information from the UN Comtrade, using a wide range of commodity codes for shark and ray products. None of these codes give species-specific information due to the lack of disaggregated data by species, but collectively they capture the reported global trade in sharks and rays in its entirety.

Along with looking at the number of trade relations of the network participants, i.e. how many traders each trader exports to and imports from, the flow of imports and exports was examined both in volume and in value. The sum of these imports and exports determines the 'strength'[14] of each trader in the network. But regardless of volume and value, many traders have a high 'betweenness'[15] that identifies them as important trade bridge makers, key players in the global system.

Trading networks, like many real-world networks, have emergent properties that only come to light through analyses that attempt to describe the structure of the network and not just the quantities or values and their flows. The new approach allows us to identify not only major importers and exporters but also traders playing an essential role as trade funnels or facilitators, providing key information on how and where best to focus international efforts to reverse the decline of shark and ray populations. Many of these emerging properties of the global trade network cannot be revealed by more conventional trade analysis.

The main results of the analysis and more details on the methods are available on **a free interactive online portal**,[16] where users can also configure their own searches by choosing one or more commodity codes, time periods and measures of centrality and trade influence.

A full peer-reviewed report will be released later in the scientific literature. In the meantime, some of the key findings about the shark[17] and ray meat[18] trade are detailed below.

[12] Sebastián Villasante (1), Silvia de Juan (2), Gill Ainsworth (1), Pablo Pita (1), Andrés Ospina-Alvarez (3) Affiliations:
1. Cross-Research in Environmental Technologies (CRETUS)-Department of Applied Economics, University of Santiago de Compostela, Campus Sur, Santiago de Compostela, A Coruña, Spain.
2. Institute of Marine Sciences ICM (CSIC), Passeig Marítim de la Barceloneta 37, CP 08003, Barcelona, Spain.
3. Mediterranean Institute for Advanced Studies IMEDEA (UIB-CSIC), C/ Miquel Marques 21, CP 07190 Esporles, Balearic Islands, Spain.

[13] https://www.britannica.com/topic/graph-theory

[14] Also named weighted degree. It is the number of relations (edges) of the traders(nodes), but also considers the weight of each edge. The degree is the number of other traders with which a trader has trade relationships. Strength indicates if a trader is involved in important (by weight) trades with other traders. Hence the volume or the total value of trade is combined with the number of trade relationships to give a measure for the importance of the trader in the network. Traders with high strength can be acting as keystones since they are connected by imports and exports to many neighbouring traders.

[15] Imports and exports are important, but they are not the whole picture. Traders with high betweenness centralities have been called 'bridges' and prevent network fragmentation. A trader that acts as a bridge between two well differentiated groups of traders usually has a high Betweenness.

[16] https://aospina.shinyapps.io/SRGTN_WWF/

[17] Shark meat UN COMTRADE (https://comtrade.un.org/) commodity codes: 030265; 030281; 030447; 030375; 030381; 030456; 030488 and 030496); N.B. 030488 is a combined code and also includes rays; we assume across all codes chimaeras (now called ghost sharks) are included as they have no separate code

[18] Ray meats UN COMTRADE commodity codes: 030282; 030448; 030382; 030457 and 030497; N.B. that ray fins are currently not possible to be detected as they might be reported as shark fins (see also Dent & Clarke 2015 FAO report)

IMPORT AND EXPORT RELATIONSHIPS FOR MORE THAN 250 TRADERS

The application of graph theory to global seafood trade

Graph theory is the mathematical study of a network of interacting elements. This approach provides a quantitative but simplified view of the multiple factors involved in the connection (edges) among elements (nodes) contained in a network. In a network of traders, graph theory provides insights into the trading relationships' properties and identifies critical nodes (traders) with high centrality that are connected to many other traders, or clusters of well-connected traders. In plain words, it goes beyond the mere interchange between network elements, by considering the network as a whole, where a node might play a crucial role independently on the dimension of the individual connections (i.e. transactions in a trading network). These emerging properties are measured through different centrality measures.

In-degree

indicates the number of connections coming into each trader (imports). This metric does not take into account the weight or strength of the edges.

Out-degree

indicates the number of connections going out from each trader (exports). This metric does not take into account the weight or strength of the edges.

Strength

is the number of relations (edges) between the nodes. Strength indicates if a node is involved in many important (by weight) interactions with other nodes. Nodes with high strength can act as keystones, since they are connected to many neighbouring nodes.

Betweenness

is a measure of the influence of a node over the flow of products between every pair of nodes. While the volume of transactions is important, it is not everything. Nodes with high betweenness have been termed 'bottlenecks' or 'bridges', and they prevent the fragmentation of the network.

Eigenvector

is a measure of the influence of a node in a network, as it takes into consideration not only how many connections a node has, but also the centrality of the nodes that it is connected to. High eigenvector indicates those nodes that are well connected to other highly connected nodes.

SHARK MEAT TRADE

Shark meat trade was analysed between 2009-2019 and shows a **highly complex global trade network**. The top exporters and importers as well as trade flows are listed in tables 1 and 2. We analysed the trade links (figure 1) as well as the strength and betweenness to identify key players and important intermediaries and trade bridges (figures 2 and 3). Some of the main findings include:

- The lucrative trade in shark fins is a well-known global issue – however, in economic terms the trade in shark meat is also significant but to date has received far less attention. The link between trade in shark meat and overfishing for threatened shark species needs to be more highly prioritized in public communication campaigns, as well as among those directly involved in shark fisheries.
- Spain dominated world trade in fresh and frozen shark meat from 2009 to 2019, appearing in the top three traders by value (approximately US$536 million and US$289 million in exports and imports, respectively), volume (approximately 184,000 t and 149,000 t in exports and imports, respectively) and number of trading partners (85 export links and 65 import links). It is by far the world's largest exporter, and it is also a significant importer: it could play a stronger role in monitoring the flow of shark products, and support the introduction of more refined trade and tariff codes that identify products at a species level to improve traceability.
- Over the last decade, the most important trade bridges[19] for shark meat have been between Japan and Spain (and vice versa), Portugal and Spain, the UK and Spain, Japan and Panama, and China and Japan. These traders have the greatest influence on how shark meat flows around world markets, and should be the primary focus for where to implement future regulatory measures such as better traceability systems and a stricter control of illegal, unregulated and unreported (IUU) fishing activities.
- During the same decade China's influence has diminished, replaced by a few Southeast Asian players (Singapore and Hong Kong), all of which are mainly importers. The EU has established itself as the main supplier to these markets, its own exports and imports accounting for about 22% of the total global shark meat trade – which therefore makes it a key actor.

[19] Imports and exports are important, but they are not the whole picture. Traders with high betweenness centralities have been called 'bridges' and prevent network fragmentation. A trader that acts as a bridge between two well differentiated groups of traders usually has a high betweenness. Because they are so important they can also act as important bottlenecks. They connect many different partners in the network which would 'fall apart' if the trader's trade flow was impaired. On the other hand any regulatory measure implemented in these traders can influence the network significantly.

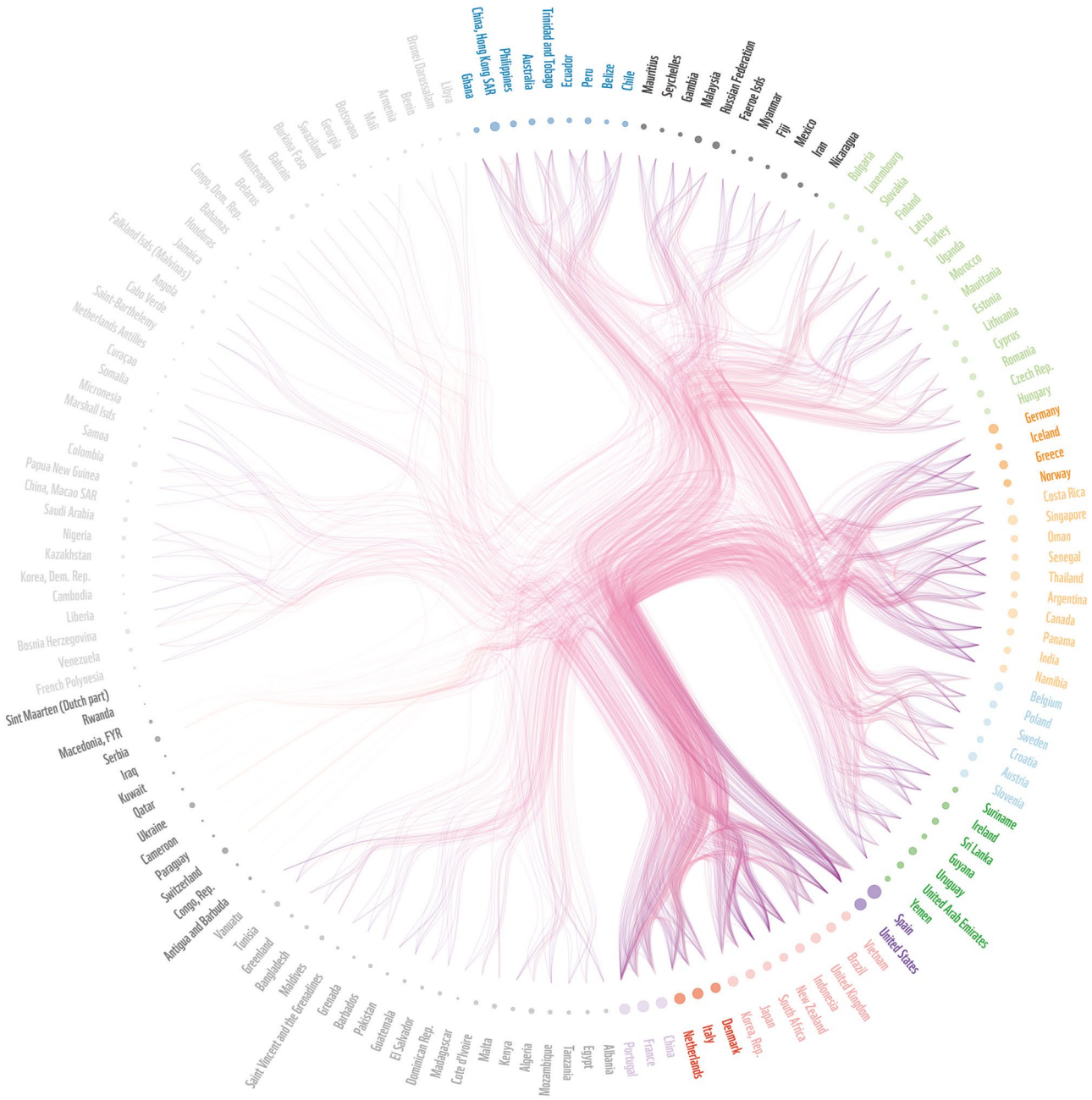


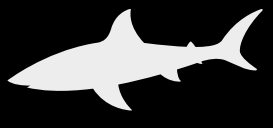
FIGURE 1.

Trade links between traders of shark meat by volume

Trade links between traders of shark meat by volume (UN Comtrade commodity codes: 030265; 030281; 030447; 030375; 030381; 030456; 030488 and 030496). The top 220 traders of shark meat network as nodes (circles) and their links as lines. The size and colour of the nodes represent the cluster membership and relative importance of the trader in the network, estimated from the number of trade links with other traders (i.e. degree): warm colours represent a high number of trade links (i.e. high degree) and cold and grayscale colours represent a small number of trade links (i.e. low degree). The thickness and colour of the edges represent the sum of trade links for all years between each pair of traders.

TABLE 1.

Ranking of the most important traders in the network of shark meat trade (2009-2019) in volume for top exporters, top importers, and top trade flows.



Export

TOP EXPORTERS	VOLUME (t)
Spain	183,884
Portugal	104,758
Uruguay	72,839
Japan	59,117
USA	49,422
Namibia	37,492

Top flows between traders

EXPORTER	IMPORTER	VOLUME (t)
Uruguay	Brazil	71,750
Portugal	Spain	70,571
Spain	Italy	49,014
Spain	Portugal	31,613
Spain	Brazil	30,441
Ecuador	Peru	21,176

Import

TOP IMPORTERS	VOLUME (t)
Brazil	149,484
Spain	136,144
Italy	88,876
Portugal	60,316
Uruguay	56,963
China	34,809

Number of trade links

TRADERS	EXPORT LINKS	IMPORT LINKS
Spain	85	65
USA	81	34
France	54	52
China	53	42
Portugal	56	33
Italy	48	40

TABLE 2.

Ranking of the most important traders in the network of shark meat trade (2009-2019) by value for top exporters, top importers, and top trade flows.

Export

TOP EXPORTERS	VALUE (USD)
Spain	536,339,368
Portugal	232,967,950
USA	192,719,619
Uruguay	177,983,226
China	165,072,476
Singapore	128,347,782

Top flows between traders

EXPORTER	IMPORTER	VALUE (USD)
Uruguay	Brazil	174,322,699
Portugal	Spain	157,595,128
Spain	Italy	149,156,246
France	Italy	76,829,172
Spain	Hong Kong SAR	65,660,084
Spain	Portugal	62,463,253

Import

TOP IMPORTERS	VALUE (USD)
Italy	344,401,467
Brazil	327,864,620
Spain	288,814,173
Hong Kong SAR	183,680,756
Portugal	118,860,422
Japan	115,390,016

Number of trade links

TRADERS	EXPORT LINKS	IMPORT LINKS
Spain	85	65
USA	81	35
France	54	52
China	53	42
Portugal	56	33
Italy	48	40

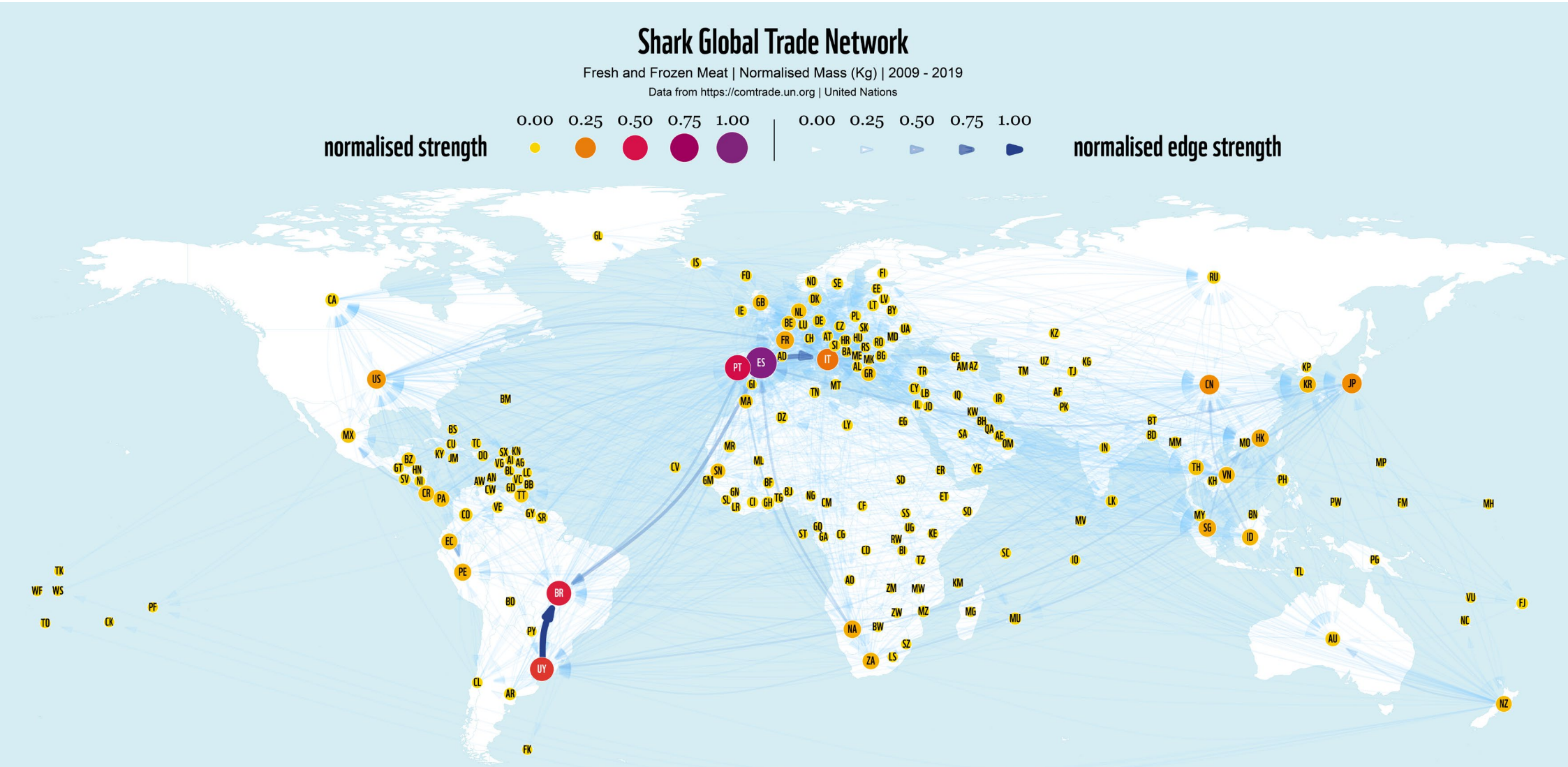
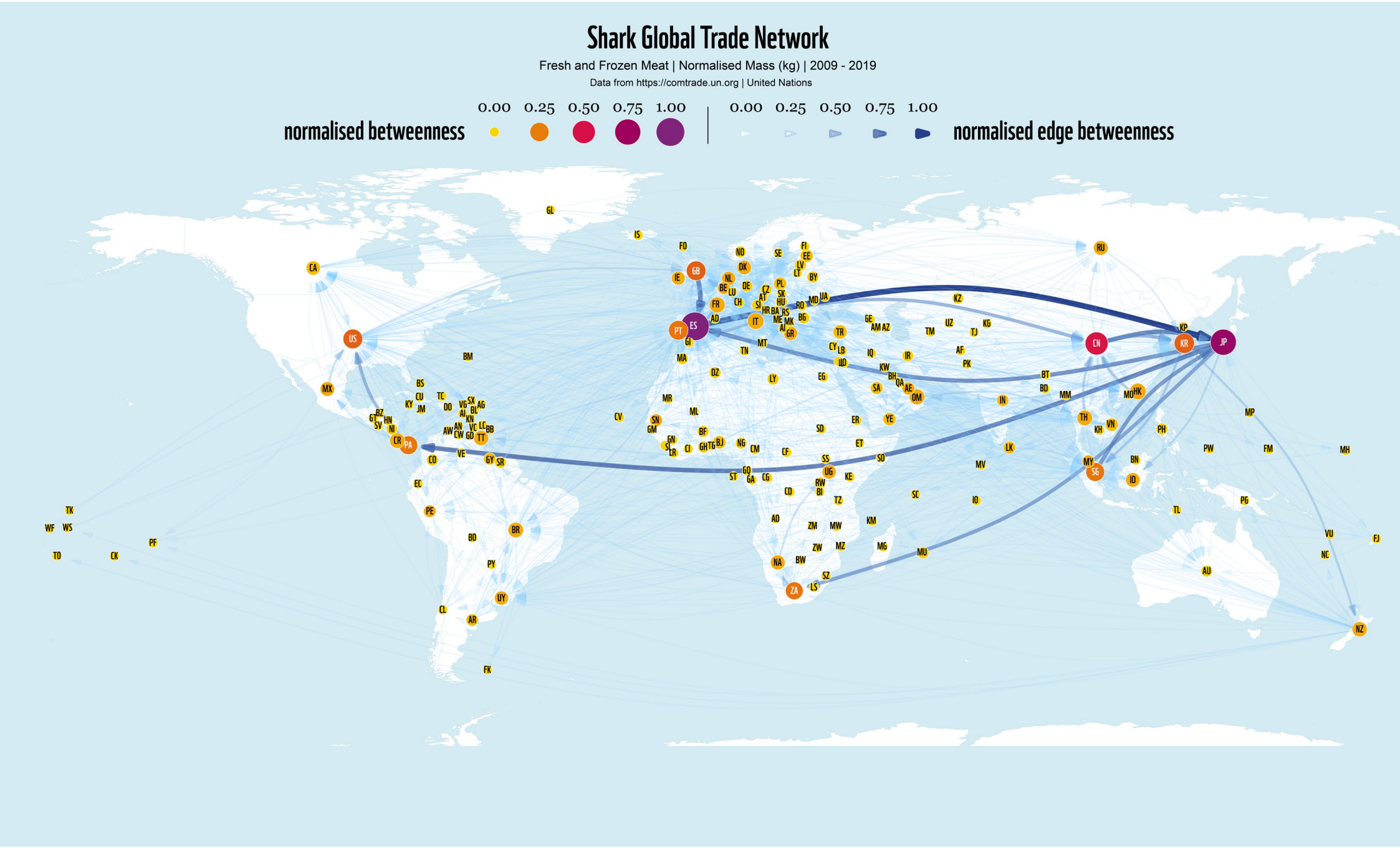


FIGURE 2.

Global trade network for shark meat (2009-2019). The quantities correspond to the normalised amount of mass (kg) traded. Each node represents a trader and each edge represents the relationship between two traders. The size and colour of the node represent the relative importance of the trader in the network in terms of its strength above and betweenness below. The width and intensity of the color of the edge represents the relative importance of the relationship between two traders in terms of their edge strength above and edge betweenness below, with each arrow representing the direction of the trade flow from an exporter to an importer. This graph is based on UN COMTRADE commodity code(s): 030265; 030281; 030447; 030375; 030381; 030456; 030488 and 030496.


Shark Global Trade Network
Fresh and Frozen Meat | Normalised Mass (kg) | 2009 - 2019
Data from https://comtrade.un.org | United Nations
normalised betweenness
0.00 0.25 0.50 0.75 1.00
0.00 0.25 0.50 0.75 1.00
normalised edge betweenness
US
CA
MX
GB
ES
PT
FR
IT
DE
NL
BE
LU
IE
NO
SE
FI
EE
LV
LT
DK
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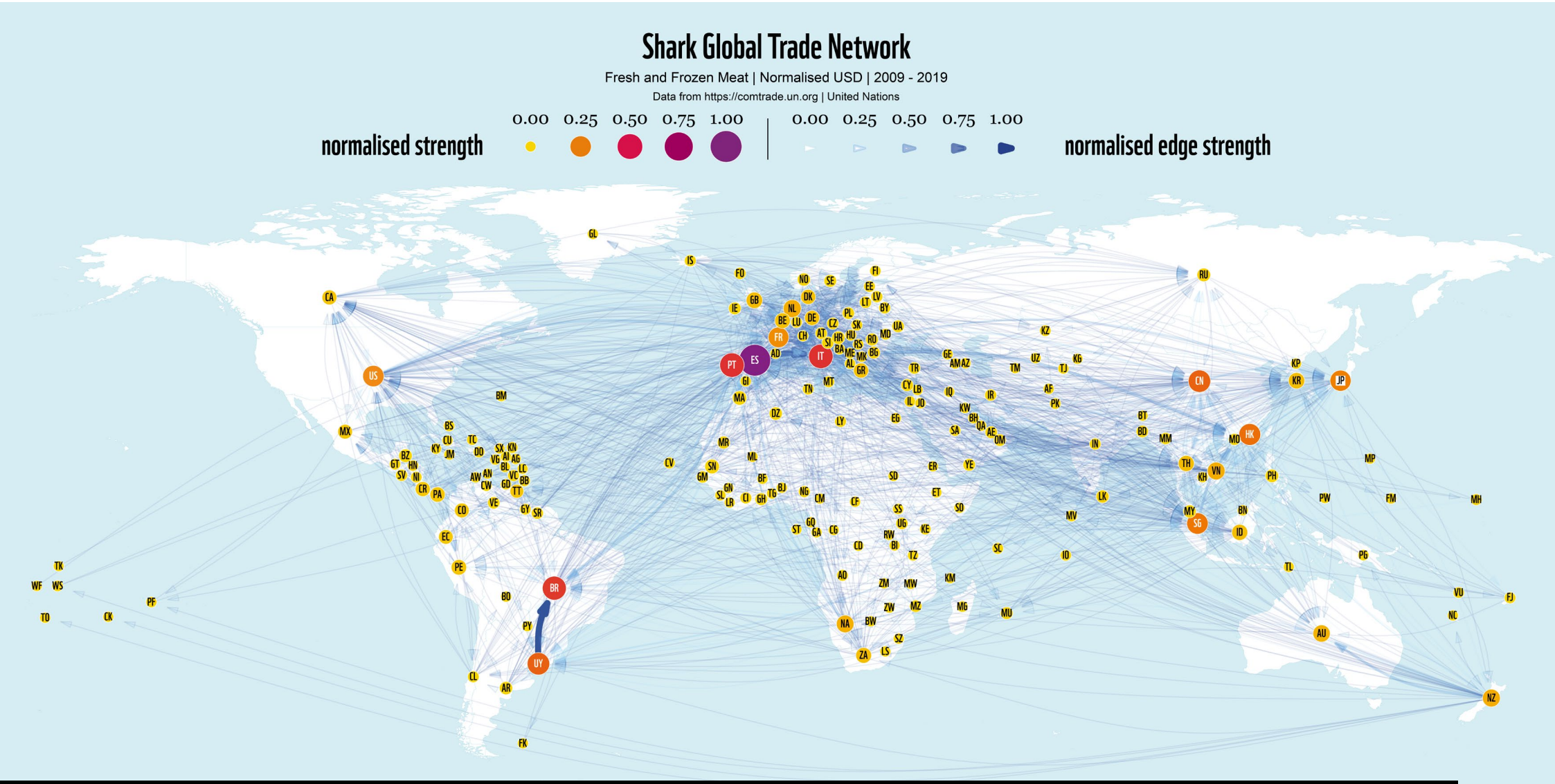
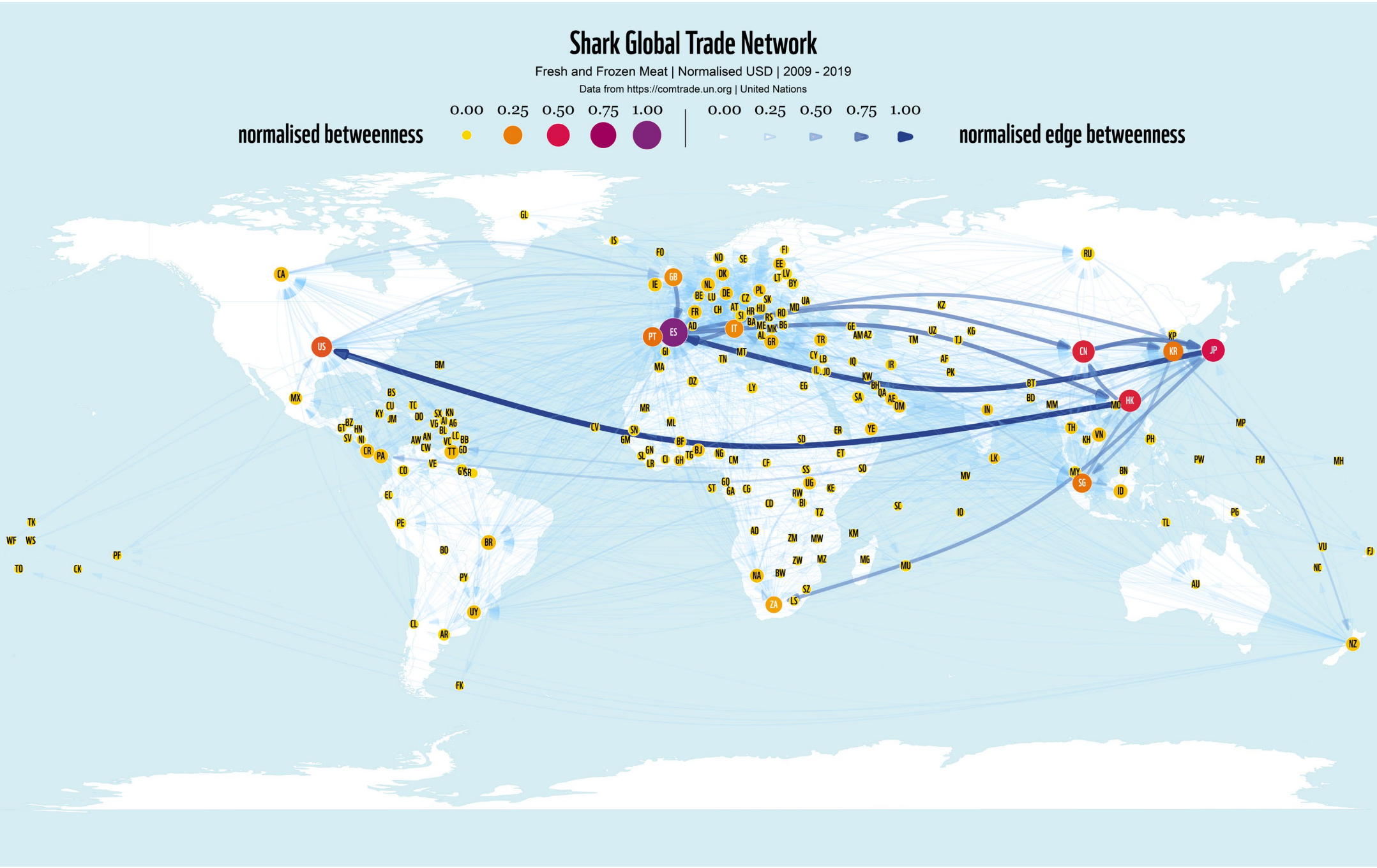


FIGURE 3.

Global trade network for shark meat between 2009-2019. The quantities correspond to the normalised amount of value (US$) traded. Each node represents a trader and each edge represents the relationship between two traders. The size and colour of the node represent the relative importance of the trader in the trade network in terms of its strength above and betweenness below. The width and intensity of the colour of the edge represents the relative importance of the relationship between two traders in terms of their edge strength above and edge betweenness below. These graphs are based on UN Comtrade commodity code(s): 030265; 030281; 030447; 030375; 030381; 030456; 030488 and 030496.


Shark Global Trade Network
Fresh and Frozen Meat | Normalised USD | 2009 - 2019
Data from https://comtrade.un.org | United Nations
normalised betweenness
0.00 0.25 0.50 0.75 1.00
0.00 0.25 0.50 0.75 1.00
normalised edge betweenness
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RAY MEAT TRADE

Ray[20] meat trade was analysed between 2012-2019[21] and shows a less complex global trade network. The top exporters and importers as well as trade flows are listed in table 3 and 4. We analysed the trade links (figure 4) as well as the strength and betweenness to identify key players and important intermediaries and trade bridges (figure 5 and 6). Some of the main findings include:

- The global trade network for ray meat follows different directions and features different actors to those underpinning the shark meat trade. This network should therefore be treated separately from the shark meat network, with attention being focused on its unique characteristics.
- The ray meat trade is less diversified, with trade between Argentina as an exporter and South Korea as an importer dominating the market in both monetary and volume terms over the last decade. The USA and Brazil are also important suppliers to the South Korean market. Attention should be focused on these (and other important) trade connections with South Korea as any impacts (e.g. implementation of regulations, trade sanctions etc.) could potentially reverberate across the entire global trade network.
- South Korea's exports to the USA, although not large in volume or value, are important for the structure of the network. The USA is the first non-Asian trader to which South Korea exports processed ray products. This intercontinental bridge is key to the stability of the network and thus presents an important focal point for future ray conservation and management activities. Furthermore, this emerging property is not identifiable by conventional analysis, which demonstrates the importance of the graph theoretical method to understanding the role of bridges in complex trade networks.
- Perhaps surprisingly, while most of the high-volume movement of ray meat products involves traders outside the EU, several of the most important bridging traders in the network (those with a high 'betweenness' score) come from within the EU: the top three are France, Spain and the Netherlands. Elsewhere the USA, Indonesia, Canada and New Zealand are also prominent. Any efforts to regulate or manage the ray meat trade need to include a focus on these key traders, since measures they put in place would have the greatest impact on the network as a whole.

[20] For simplicity "rays" in the following includes rays and skates

[21] The categories for rays only exist since 2012 in Comtrade data

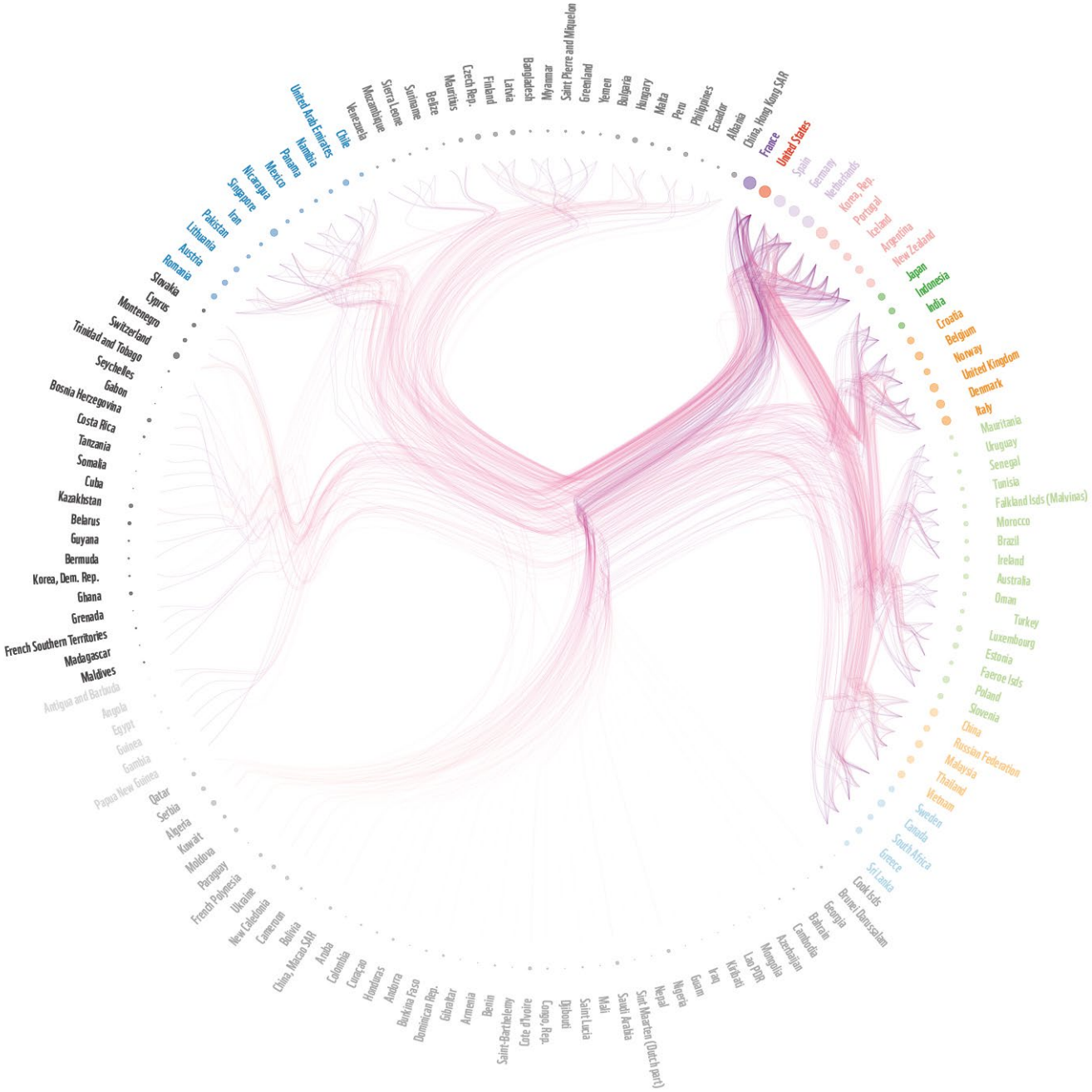


FIGURE 4.

Trade links of ray and skate meat

Trade links of ray and skate meat (UN COMTRADE commodity codes: 030282; 030448; 030382; 030457 and 030497; in the years 2012-2019). The top 150 traders of the ray meat trade network as nodes (circles) and their trade links as lines. The size and colour of the nodes represent the cluster membership and relative importance of the trader in the network, estimated from the number of trade links with other traders (i.e. degree): warm colours represent a high number of trade links (i.e. high degree) and cold and grayscale colours represent a small number of trade links (i.e. low degree). The thickness and colour of the edges represent the sum of trade links for all years between each pair of traders.

TABLE 3.

Ranking of the most important traders in the network of ray meat trade (2012-2019) by volume for top exporters, top importers, and top trade flows.

Export

TOP EXPORTERS	VOLUME (t)
Argentina	81,601
Sierra Leone	55,818
USA	41,524
Indonesia	18,049
Spain	16,188
Japan	9,752

Top flows between traders

EXPORTER	IMPORTER	VOLUME (t)
Argentina	Korea	67,065
Sierra Leone	Ghana	55,787
USA	Korea	19,904
USA	France	11,170
Indonesia	Malaysia	10,084
Brazil	Korea	9,252

Import

TOP IMPORTERS	VOLUME (t)
Korea	141,655
Ghana	55,788
France	26,131
Malaysia	18,231
China	15,600
Portugal	9,471

Number of trade links

TRADERS	EXPORT LINKS	IMPORT LINKS
France	58	35
USA	66	18
Netherlands	43	33
Spain	39	35
Korea	29	43
Germany	39	24

TABLE 4.

Ranking of the most important traders in the network of ray meat trade (2012-2019) by value for top exporters, top importers, and top trade flows (US$).

Export

TOP EXPORTERS	VALUE (USD)
Argentina	221,230,213
USA	144,779,396
Spain	53,640,864
Japan	43,234,144
China	41,428,758
Indonesia	34,872,536

Top flows between traders

EXPORTER	IMPORTER	VALUE (USD)
Argentina	Korea	195,064,464
USA	Korea	68,412,749
USA	France	44,874,924
Japan	Korea	41,897,976
Spain	Portugal	31,688,484
Brazil	Korea	29,634,366

Import

TOP IMPORTERS	VALUE (USD)
Korea	449,614,966
France	97,772,005
Malayisa	38,220,861
Portugal	33,146,065
Japan	31,654,899
Belgium	21,584,838

Number of trade links

TRADERS	EXPORT LINKS	IMPORT LINKS
France	58	36
USA	65	18
Netherlands	43	33
Spain	39	35
Korea	29	43
Germany	39	25

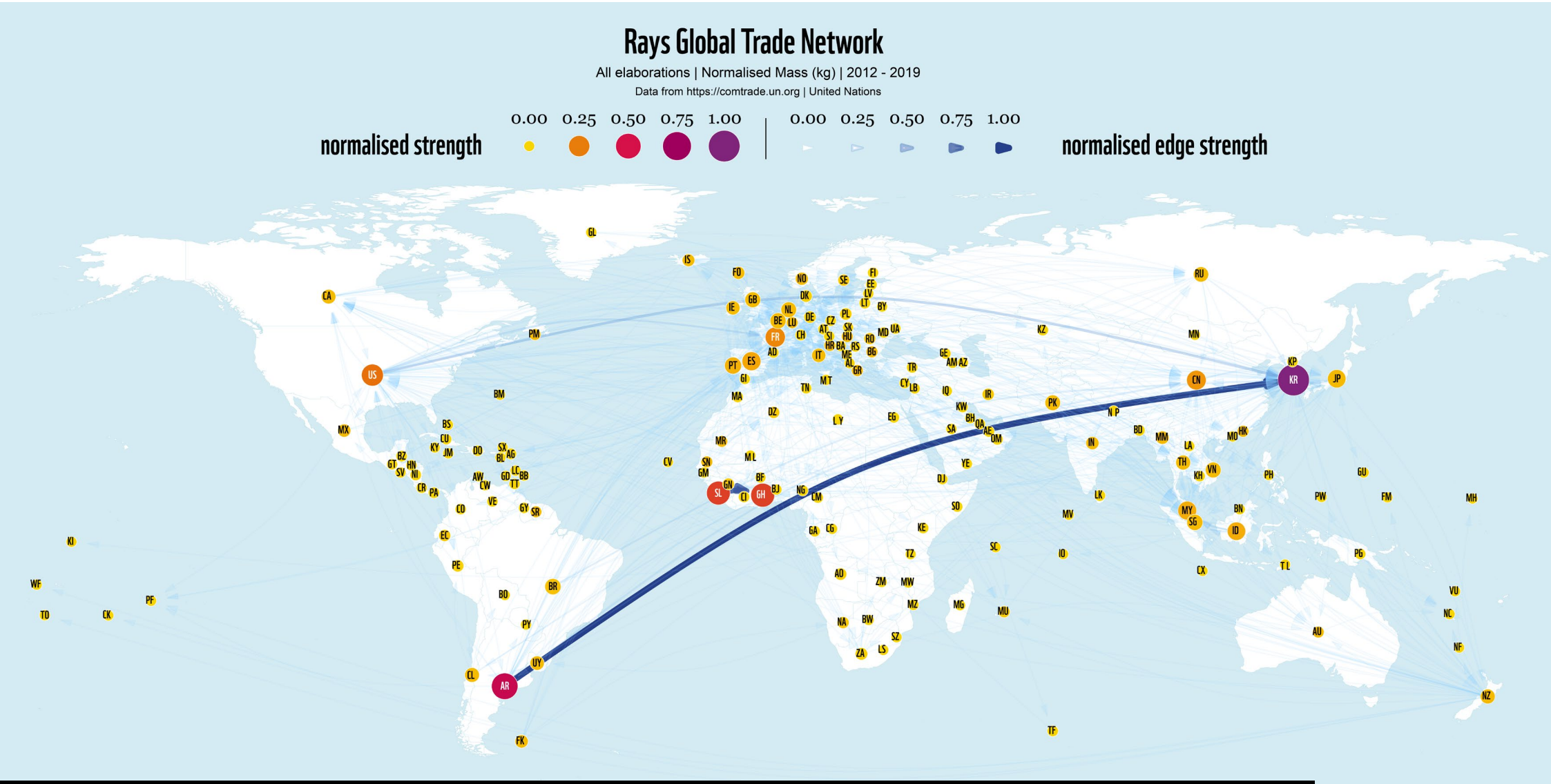


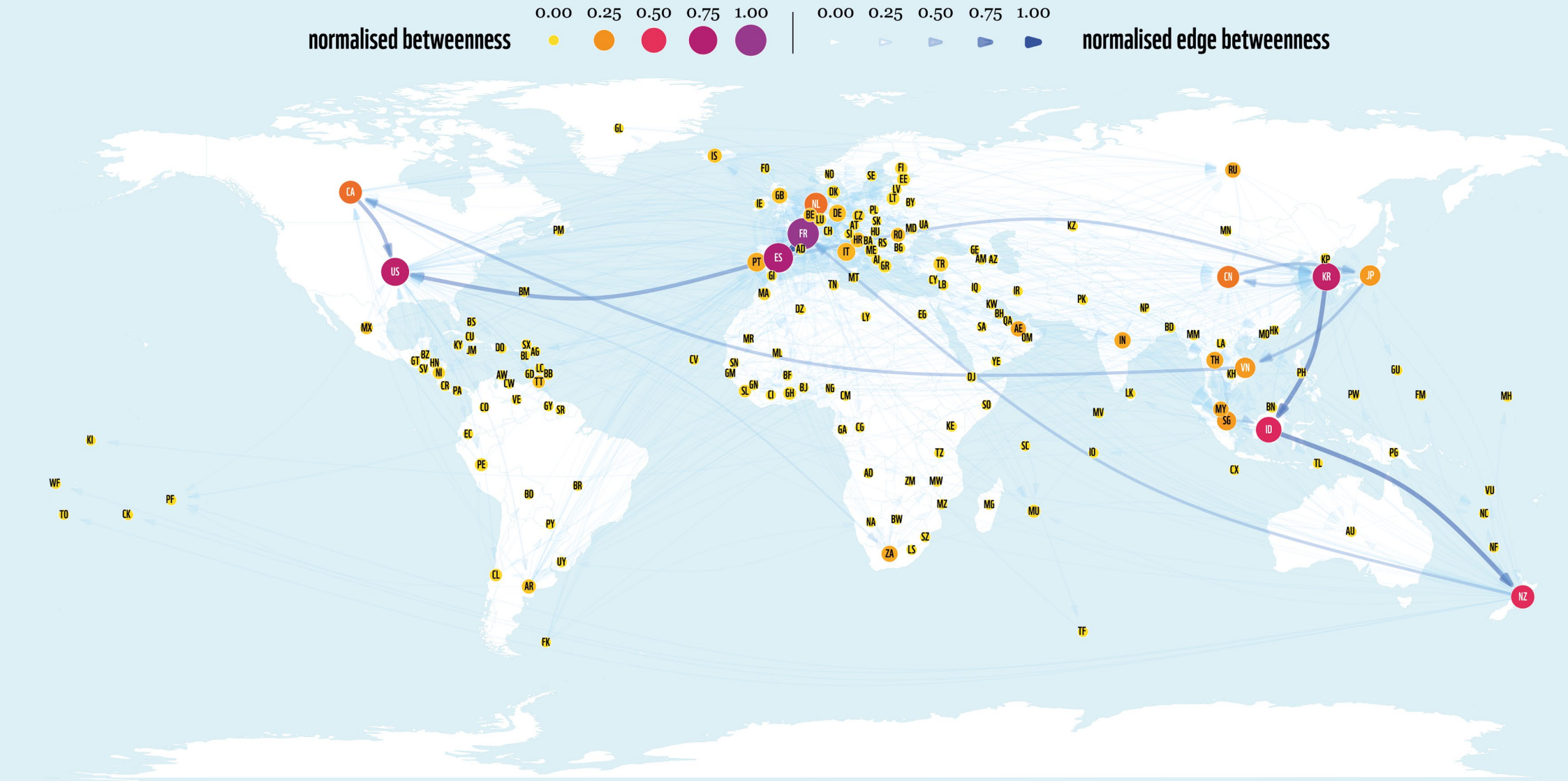
FIGURE 5.

Global trade network for ray and skate meat between 1 January 2012 and 31 December 2019. The quantities correspond to the normalised amount of mass (kg) traded. Each node represents a trader and each edge represents the relationship between two traders. The size and colour of the node represent the relative importance of the trader in the network in terms of its strength above and betweenness below. The width and intensity of the color of the edge represents the relative importance of the relationship between two traders in terms of their edge strength above and edge betweenness below, with each arrow representing the direction of the trade flow from an exporter to an importer. This graph is based on UN COMTRADE commodity code(s): 030282; 030448; 030382; 030457 and 030497.

Rays Global Trade Network

All elaborations | Normalised Mass (kg) | 2012 - 2019

Data from https://comtrade.un.org | United Nations



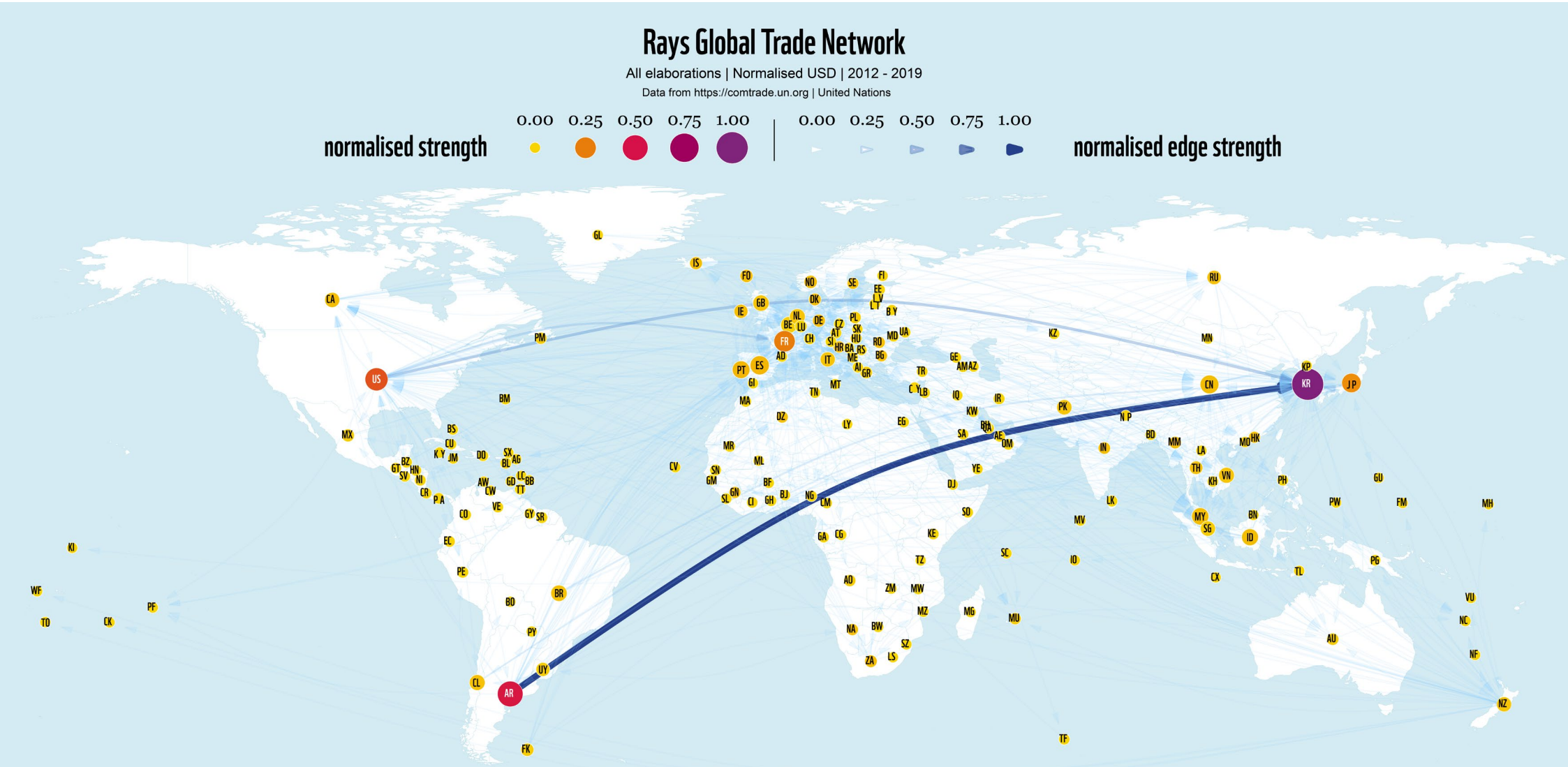


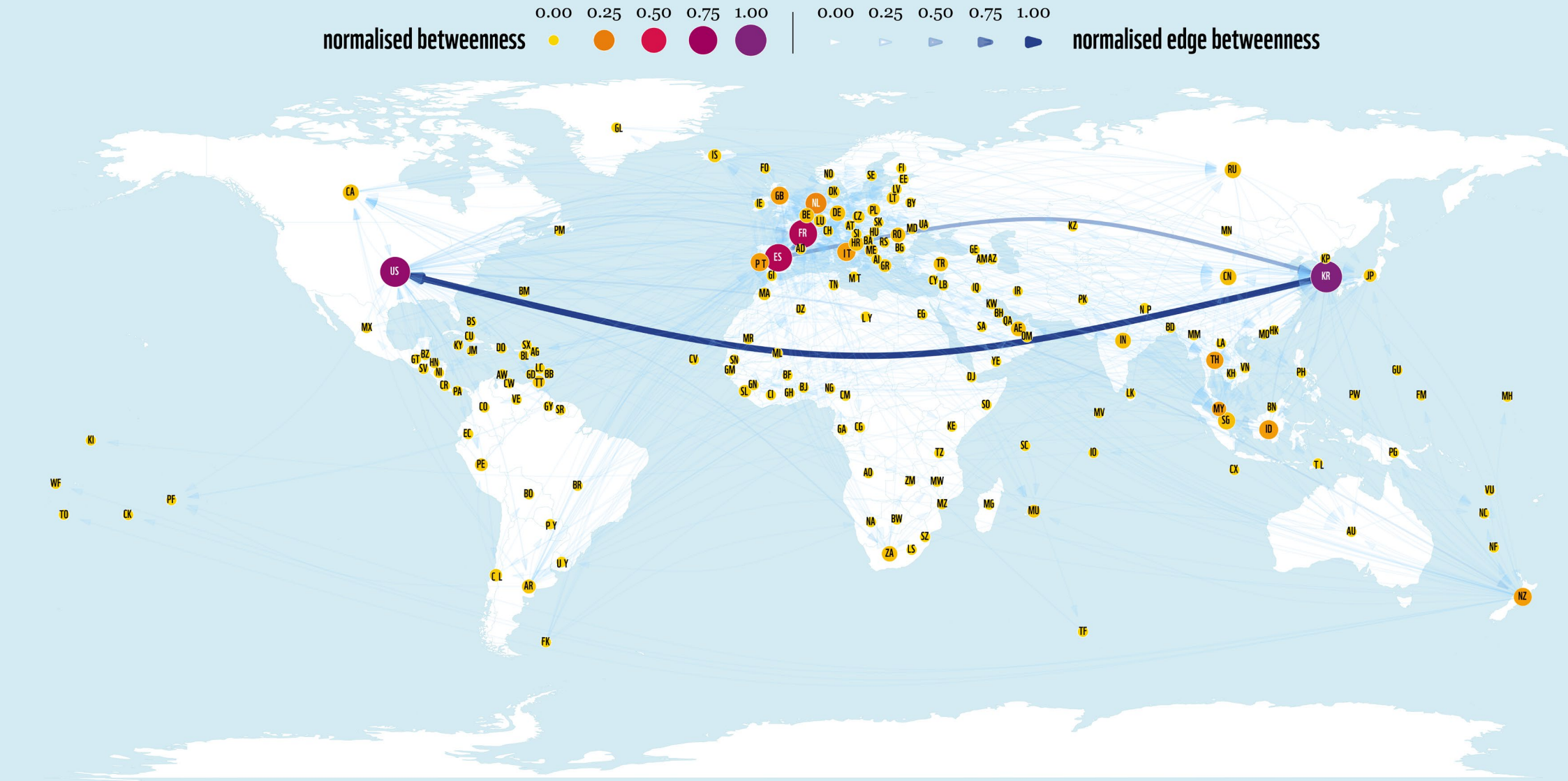
FIGURE 6.

Global trade network for ray and skate meat between 1 January 2012 and 31 December 2019. The quantities correspond to the normalised amount of value (US$) traded. Each node represents a trader and each edge represents the relationship between two traders. The size and colour of the node represent the relative importance of the trader in the network in terms of its strength above and betweenness below. The width and intensity of the colour of the edge represents the relative importance of the relationship between two traders in terms of their edge strength above and edge betweenness below, with each arrow representing the direction of the trade flow from an exporter to an importer. This graph is based on UN COMTRADE commodity code(s): 030282; 030448; 030382; 030457 and 030497.

Rays Global Trade Network

All elaborations | Normalised USD | 2012 - 2019

Data from https://comtrade.un.org | United Nations



Although shark meat products APPEAR RELATIVELY CHEAP,
and they're often fraudulently passed off
as more expensive
elasmobranch or bony fish species,
THEY IN FACT CONTAIN HIDDEN COSTS.

The role of the European Union in the shark and ray trade

The EU plays a significant role in the global trade of shark and ray products. EU Member States not only include some of the most important traders in volume and value terms, but they also act as important trade bridges between key parts of the global network. This means that these traders could have a major impact on prices and the flow of traded volume.

The EU's imports account for 17.3% of total transactions in the global network since 2000. It is a key player with important market regulatory tools such as the EU control regulation[22] and the EU IUU regulation[23] with the potential to improve traceability of sharks and rays, and prevent and deter IUU fishing of sharks and rays. However, to date EU shark fisheries have no comprehensive management framework either at European or Regional Fisheries Management Organization (RFMO) level, and the European Action Plan for Sharks is outdated and lacks SMART targets.[24]

One area in which EU legislation has had some success in conservation terms has been the introduction of the 'Fins Naturally Attached' regulation[25] in 2013, which prohibits vessels in EU waters, as well as EU vessels outside EU waters, from removing valuable shark and ray fins at sea and then discarding the carcasses (or the fatally injured animals while still alive) to leave room in the hold for more lucrative species such as tuna or billfish.

Other states would do well to follow the EU's lead on 'finning'. The practice of finning not only has ethical objections made against it, it's also contributing to dramatic declines in shark and ray populations largely driven by overfishing. Even so, the EU continues to be a major source of legally obtained fins, and by fuelling the global market it contributes to the worsening of the overall situation.

[22] EU Regulation 1224/2009

[23] EU Regulation 1005/2008

[24] https://stecf.jrc.ec.europa.eu/documents/43805/2570959/STECF+19-17+-+Shark+Finning.pdf/0356b56d-78b1-4a98-bf78-9772eef3bbbf

[25] Regulation (EU) No 605/2013

SHARK AND RAY ON THE MENU

A GLOBAL SELECTION OF DISHES WITH SHARK AND RAY MEAT

Germany & Austria

- **Schillerlocken** (smoked belly flaps of Spiny dogfish/Spurdog *Squalus acanthias*):
  Eaten as a snack in a bread roll (Fischbrötchen) or for cold dinner for at least a century in northern Germany. Can be bought at fishmongers, at fish bread roll stands at fairs or at touristy harbour places
- **Hai-Steak** formerly marketed as **Kalbsfisch** (*veal-fish*):
  Fillets of porbeagle (*Lamna nasus*) eaten with potatoes, salad, and sauce. Vanished largely due to prohibition of Porbeagle catches in NE Atlantic waters in 2010

Portugal

- **Raia alhada**:
  ray *Raja* sp. wings cooked with garlic
- **Caldeirada de pata roxa**:
  stewed nursehound *Scyliorhinus stellaris* and potatoes in sauce

France

- **Aile de raie au beurre noir**:
  ray wings cooked in black butter

Spain

- **Cazón adobado**: a traditional dish made with marinated and battered tope shark (*Galeorhinus galeus*)

Peru

- **Tortilla de raya** (ray omelette):
  traditional dish from northern Peru, specially Lambayeque region, consumed by locals and tourists
- **Chinguirito**:
  a traditional ceviche-style dish from northern Peru prepared with cured and dried meat from a species of ray called pacific guitarfish (*Rhinobatos planiceps*)

DISHES WITH SHARK AND RAY MEAT

- Porridge
- Stew
- Grilled steak
- Fish and chips
- Ceviche
- Skewers
- Omelette

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Singapore

- **Barbequed Sambal Stingray**:
  a prominent product tourists will encounter if they visit Singapore. Almost every food centre has a stall serving this and Singapore import rays in large volumes to feed this demand

Malaysia

- **Sinagol**:
  a traditional Bajau dish in Sabah, commonly uses small sharks (juvenile) cooked with turmeric and other spices. Sometimes, the dishes are also cooked with shark liver, which is more an authentic recipe rather than with the shark fillet alone
- **Gulai Ikan Yu Perejang** (Perejang shark curry):
  curry-like dish that uses wedgefishes, observed to be a growing demand dish particularly in the Eastcoast of West Malaysia
- **Cui zha sha yu pian** (crispy fried shark fillet) and **Sha yu zhou** (shark porridge):
  both dishes are quite popular delicacies, usually served in restaurants near coastal areas

Australia

- **Shark fish and chips**:
  meat from tope shark (also called “school shark”, *Galeorhinus galeus*) is sold in Australian fish and chips shops as “flake”

Indonesia

- **Fish Satay**:
  a popular and relatively affordable dish in East Java that often included shark meat, in some cases thresher shark (*Alopias* spp.) as revealed by DNA analysis
- **Sliced shark meat**:
  often used as substitute for snapper. Prepared mostly deep fried with sweet and sour sauce. Popular at weddings or other events
- **Salted fish**:
  often done with meat of shark or ray. The meat is soaked in salt and then dried. Often used as gift or handout

Ecuador

- **Ceviche de tollo** (shark ceviche, smooth-hound ceviche):
  a type of ceviche most commonly prepared from “tollos” - smooth-hound sharks from the genus Mustelus

Mozambique

- **Shark meat samosas** (Chamuças de tubarão)
- **Raia frita**:
  Fried ray meat with garlic and coconut milk (or lemon)
- **Tocossado de tubarão**:
  Shark stew

Consumers should AVOID BUYING OR EATING ANY SHARK OR RAY PRODUCTS unless they are from sustainable and traceable sources: currently very few products available in the market meet these requirements

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RECOMMENDATIONS

This analysis of the global shark and ray trade network has revealed a highly complex network of international actors. It has identified not only major importers and exporters of shark and ray meat and fins but also traders playing an essential role as trade funnels or facilitators, providing useful information on how and where best to focus international efforts to reverse the decline of shark and ray populations. Many of these emerging properties of the global trade network have not been revealed to date. Building on the findings, we make several recommendations for how different trade actors should support the conservation and management of shark and ray fisheries and associated trade.

STATES AND TERRITORIES

- The leading players in the global trade of sharks and rays must step up as **global champions** for conservation and sustainable fishing, accelerating fishery management and recovery plans at national level and in RFMOs. This is a pragmatic commercial consideration as well as an ecological one: without precautionary measures and science-based management, shark and ray populations will not remain viable as economic and ecological resources. The number of species for which sustainable fishing is still possible is dwindling over time.
- They should put in place **legislation** to harmonize landing, market and trade categories, and to drastically improve traceability systems.
- They should **follow regulations** to which they're signed up. In the EU for example, regulations on seafood labelling[26] – which specify species, gear and origin – should be fully implemented so consumers can make informed choices about their purchases.
- Regional and National **Plans of Action** for Sharks should be formulated where they do not exist, and updated every four years in line with the FAO's IPOA for Sharks. These Plans should include detailed consideration of market issues, and include strict regulation of shark and ray products intended for trade.
- They should fully support and facilitate **collaboration between fisheries and environmental bodies** to ensure the implementation of Shark Plans of Action, and the implementation of relevant agreements and conventions such as the Port State Measures Agreement,[27] the Convention on Migratory Species,[28] and CITES at regional and national level.
- Traders **should ensure sufficient resources for controls, monitoring and surveillance** of shark and ray fisheries and markets. This includes capacity building for fishers and control authorities regarding species identification and understanding existing legislation.
- **Trade and tariff codes** need to be refined and made far more detailed. Species-specific reporting needs to be improved globally, including for bycatch: accurate reporting of catches at species level is as important for trade data as it is for sustainable management, not to mention to avoid illegal landings. Commodity coding systems could also be modified to include product categories from threatened species, as a gesture of support for improved management.
- Trade and tariff codes for **ray meat** in particular need urgent attention, and should be improved to differentiate between ray products, including fins and gill plates, and ray species. The trade in ray fins and rostra – often of highly threatened species – is significant but is poorly understood and often overlooked, making effective monitoring of the trade almost impossible. Capacity-building in species identification for fishers and port and control authorities would improve landing and trade data.
- The widespread categorization of sharks and rays as '**bycatch'** is highly problematic, and needs to be resolved. Today, many deliberately caught sharks and rays are recorded under the general code 'bycatch' when landed with primary target species like tuna, lowering expectations that sharks and rays require the same kind of management measures that would be expected in targeted fisheries (which they do). This also makes species-specific data far harder to gather, and contributes to population declines. Our figures show, for example, that while in Argentina directed fisheries for rays are prohibited, its ray trade flow with South Korea is the largest in the world. France, meanwhile, exports rays from mostly Atlantic fisheries to 58 other traders but proper fisheries management is hindered by the absence of species-specific EU Total Allowable Catches (TACs) of rays. All fisheries taking significant numbers or species of sharks and rays need management that clearly separates incidental catches from secondary target catches that are regularly landed, marketed and traded: this would reduce the risk of the latter remaining unmanaged, and overfishing occurring.

[26] EU Regulation 2013/1379

[27] The Agreement on Port State Measures (PSMA) is the first binding international agreement to specifically target IUU fishing. Its objective is to prevent, deter and eliminate IUU fishing by preventing vessels engaged in IUU fishing from using ports and landing their catches. www.fao.org/port-state-measures/en/

[28] The Convention on Migratory Species is the global convention aimed at the conservation of migratory species, their habitats and migration routes https://www.cms.int

TRADE AND SUPPLY CHAIN ACTORS

- **Transparency and traceability** are critical to ensure that the trade in sharks and rays remains legal and manageable, and to keep protected species out of the market. Best practice guidance from CITES and other bodies should be followed, while new tools such as TRAFFIC recently released SharkTrace[29] can be used to tag sharks and rays at point of capture and then to trace them throughout the supply chain.

[29] www.traffic.org/SharkTrace

CONSUMERS

- When buying fish in restaurants, markets or grocery stores, ask where the fish comes from and how it was caught, and what kind of species it really is. Shark and ray is often sold under vernacular names that disguise the species: skate fillets are sold as 'pollo de mar' (sea chicken) in Argentina; while South Africa sells shark meat (shortfin mako shark) labeled as "ocean fillets" or "skomoro", shark meat is sold as "saumonette" in France, "Palombo" in Italy, or "rock salmon" in the UK. Do not buy or eat seafood without a clear answer. Restaurants, fishmongers and retailers often claim to have a sourcing policy, so perseverance in asking the question will bring more transparency. Local sustainable seafood guides often provide information to help identify the common names of shark and ray species, what cuts of meat may look like and whether products from these species are sustainable or not.
- Where food security does not depend on shark and ray products: consumers should avoid buying or eating any shark or ray products unless they are from sustainable and traceable sources. Be aware that currently very few products available in the market meet these requirements.

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