

# STURGEON MEAT AND OTHER BY-PRODUCTS OF CAVIAR



PRODUCTION, TRADE,  
AND CONSUMPTION  
IN AND OUTSIDE THE EU

**E U M O F A**

European Market Observatory for  
Fisheries and Aquaculture Products

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## SUMMARY

This study was carried out at the request of the Market Advisory Council (MAC) which drew attention to the need for a specific assessment of the market for sturgeon and sturgeon meat.

Sturgeons are primarily reared in aquaculture to produce caviar. However, the economic viability of a sturgeon farm relies on the existence of a meat market. Depending on the species, it takes between 8-10 years for female sturgeons to reach sexual maturity. During this period, meat from sturgeon males is the main product produced in terms of quantity by sturgeon farms. Meat is still an important product for sturgeon farms once the stock of caviar producing females has been established. Around 20 tonnes of sturgeon meat are produced for each tonne of caviar.

Of EU MS, Italy is the largest producer of sturgeon. In 2020, Italy produced 1.051 tonnes of sturgeon, which was 19% lower than in 2019, but still 5% higher than in 2016. According to FAO, the value of sturgeon production in Italy in 2020 was nearly EUR 7 million. Over the past decade, Poland and Bulgaria have succeeded Italy as the second and third largest EU producers of sturgeon, respectively.

Based on export data from CITES and production data from FAO for the period 2016-2020, Italy appeared to produce primarily white sturgeon (47%), followed by Danube sturgeon (28%) and Siberian sturgeon (23%). Poland and Bulgaria produced mainly Siberian (56% and 22 %, respectively) and Danube sturgeon (44% and 73%, respectively).

Over the past 20 years there has been a steep growth in aquaculture production of sturgeons, driven mainly by production in China. According to FAO, world production was 4.100 tonnes in 2002, half of which took place in Russia and the remainder in the EU. In 2003, world production more than tripled when China reported a production volume of over 9.000 tonnes. In 2020, China accounted for 84% of global sturgeon production, followed by Russia at 4% (4.836 tonnes) and Armenia at 3% (4.200 tonnes).

The major exporters of sturgeon meat are China, Armenia, and Italy. In 2018, these three countries made up 88% of total sturgeon meat exports. By-products and processed products from sturgeon (excluding meat, caviar, and live fish/eggs) are also traded globally and registered in CITES export data. In 2018, a total of 2.403 kg sturgeon by-products and processed products were exported. Most of these exports were extracts (38%), followed by cosmetics (20%), fins (16%), and derivatives (11%)<sup>1</sup>.

Sturgeon meat is dense and much appreciated for its firm, meaty, and boneless texture. Farmed sturgeon is a healthy product, as the meat is protein rich and low in fat. With proper management, nearly the entire sturgeon can be utilized for different purposes after slaughter.

In Europe, sturgeon meat is mainly consumed in eastern European countries such as Bulgaria, Ukraine, Serbia, and Romania. In China and Russia, it has been a part of traditional cuisine for hundreds of years and is still popular on the dinner table today.

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<sup>1</sup> CITES nomenclature defines extracts as “any substance obtained directly from plant or animal material by physical or chemical means”, cosmetics as “any product or mixture of products which is applied to an external part of the body only with the intent to clean, odourise, change the appearance or protect”, and derivatives as “any processed part of an animal or plant”.

## DEFINITIONS

<b>CITES</b>	The Convention on International Trade in Endangered Species of Wild Fauna and Flora
<b>CN</b>	Combined Nomenclature <sup>2</sup>
<b>EU</b>	The European Union as of 1 <sup>st</sup> January 2021, i.e., excluding the United Kingdom
<b>EUMOFA</b>	European Market Observatory for Fisheries and Aquaculture Products
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FEAP</b>	Federation of European Aquaculture Producers
<b>HS</b>	Harmonised System <sup>3</sup>
<b>MS</b>	EU Member States as of 1 <sup>st</sup> January 2021, i.e., excluding the United Kingdom

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<sup>2</sup> Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common Customs Tariff

<sup>3</sup> World Customs Organization <http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx>

# 1 METHODOLOGY

## 1.1 Methodology

This study is based on publicly available literature, research, news articles, and data sources. Through contact details received from FEAP, major caviar stakeholders in the EU have been contacted and asked to contribute to the study. Eight interviews were conducted, and one sturgeon farm was visited. All provided both general and specific insights regarding production, trade, and market outlets.

### 1.1.1 Brexit

This report analyses data for the years 2014-2020. The UK formally left the EU on 31<sup>st</sup> January 2020 and entered a transition period that lasted until 31<sup>st</sup> December 2020. Since February 2020, trade data reported by the UK has not been available from Eurostat. For the sake of consistency, the UK is excluded from the EU aggregate and treated as an extra-EU country throughout the whole period in all analyses in this report.

## 1.2 Data

The main data sources for this study on the production of sturgeons and caviar are FAO and Eurostat, while data from CITES are used when analysing the trade of sturgeon meat and other by-products and processed products from sturgeon.

Other sources of trade statistics such as Eurostat-Comext and IHS – Global Trade Atlas data are comprehensive, whereas the imports and exports of goods are reported in line with the Harmonised System<sup>4</sup> (HS) and the Combined Nomenclature<sup>5</sup> (CN) which do not include a trade number for sturgeon meat or other sturgeon by-products and processed products. These products are likely to be found under a broad trade number such as 03038910: “frozen freshwater fish, n.e.s.”, 03044910 “fresh or chilled fillets of freshwater fish, n.e.s.”, and 03045910: “fresh or chilled meat of freshwater fish, whether or not minced (excl. all fillets, tilapias, catfish, carp, eels, Nile perch, snakeheads, Salmonidae, swordfish, toothfish and fish of the families *Euclichthyidae*, *Gadidae*, *Macrouridae*, *Melanonidae*, *Merlucciidae*, *Moridae* and *Muraenolepididae*)”. CITES trade data provide more details in terms of species, origin, trade purpose, etc. However, the CITES data only include trade volumes and not values. Therefore, no analysis regarding values and prices can be made.

From a global point of view, the production of sturgeons and especially of by-products and processed products from caviar production is very small. Generally, as the volumes get smaller, the data deviations in relative terms increase and are consequently harder to interpret. There are large deviations both between and within the different data sources used in this study. It is not within the scope of this study to confirm one or other source, or to establish a benchmark for sturgeon markets. Instead, the data from different sources are faithfully presented.

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<sup>4</sup> World Customs Organization <http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx>

<sup>5</sup> Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common Customs Tariff

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### 1.2.1 CITES Trade Database

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments aimed at ensuring that international trade in specimens of wild animals and plants does not threaten their survival. CITES consists of 184 parties<sup>6</sup> who have all implemented the Convention. CITES provides a legal framework for regulating international trade in species threatened or potentially threatened by that trade. The framework is based on a system whereby permits and certifications are issued for international trade in specimens listed in the appendices of the agreement<sup>7</sup>.

Each party to the agreement must designate a “management authority” that is responsible for issuing permits and compiling annual reports on their international trade in the listed species. The annual reports regarding trade by countries must be submitted by October 31<sup>st</sup> the following year and are entered into the CITES Trade Database upon submission. The data can be extracted from an online database or through a bulk download of the entire database.

From the database, which includes data on all species covered by the convention (both fauna and flora), only observations where the variables “family” or “order” equalled “*Acipenseridae*” were retained. This resulted in a dataset with 257.672 observations.

Further filtration and transformation of the dataset consisted of the following:

1. Trade terms containing “caviar”, “eggs”, “eggs (live)”, “fingerlings”, “carapaces” or “unspecified” were excluded<sup>8</sup>. Jewellery, trophies, and scales were included in the dataset, but had no observations. This amounted to 139.693 observations being deleted.

**Table 1: Excluded CITES terms with descriptions.**

Term	CITES DESCRIPTION
Caviar	Unfertilized dead processed eggs from all species of Acipenseriformes; also known as roe.
Carapaces	Raw or unworked whole shells of Testudines species.
Eggs	Whole dead or blown eggs (see also 'caviar').
Eggs (live)	Live fertilized eggs – usually birds and reptiles but includes fish and invertebrates.
Fingerlings	Live juvenile fish for the aquarium trade, aquaculture, hatcheries, consumption or for release, including live European eels ( <i>Anguilla anguilla</i> ) up to 12cm in length.
Live	Live animals and plants, excluding live fingerling fish.

Source: CITES.

<sup>6</sup> List of Contracting Parties | CITES <https://cites.org/eng/disc/parties/index.php>

<sup>7</sup> Read more about the CITES regulation in the convention texts available at <https://cites.org/eng/disc/text.php>

<sup>8</sup> Bodies, bone pieces, bones, carapaces, carvings, cosmetics, derivatives, eggs (live), extract, fingerlings, fins, genitalia, jewellery, leather products, live, meat, medicine, oil powder, skeletons, skin pieces, skins, soup, specimens, swim bladders, trophies, unspecified.

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2. All units of measurement were converted to kilogrammes. Observations which could not be converted (cm, cm<sup>2</sup>, ft<sup>2</sup>, millilitres, litres, bottles, number of specimens, and blanks) were excluded. This amounted to the deletion of a further 5.406 observations.
3. Trade purpose other than “commercial” were excluded<sup>9</sup>, leading to the deletion of 150 observations.
4. The period was set to 2010-2020, excluding a further 8.540 observations. Although data from 2021 was available, these data were incomplete and therefore excluded.

The final dataset used for the analyses in this study consists of 103.883 observations.

**Table 2: Included CITES terms with descriptions.**

Term	CITES DESCRIPTION <sup>10</sup>
Body	Substantially whole dead animals, including whole fish, stuffed turtles, preserved butterflies, reptiles in alcohol, whole stuffed hunting trophies, etc.
Bone pieces	Pieces of bone, not manufactured.
Bones	Bones, including jaws.
Carving	Carved products other than ivory, bone, or horn – for example coral and wood (including handicrafts).
Cosmetics	Any product or mixture of products which is applied to an external part of the body only (e.g., skin, hair, nails, genitals, lips or teeth or the mucous membranes of the oral cavity) with the intent to clean, odourise, change the appearance or protect. Cosmetics may include the following: make-up, perfume, skin cream, nail polish, hair colourants, soap, shampoo, shaving cream, deodorant, sunscreens, toothpaste. Cosmetics which include extracts of CITES listed species. The quantity should reflect the number of CITES-listed species present.
Derivates	Derivatives (other than those included elsewhere in this table).
Extracts	Extract – usually plant extracts.
Fins	Fresh, frozen or dried fins and parts of fins (including flippers).
Genitalia	Castrates and dried penises.
Leather products (small)	Small, manufactured products of leather – e.g., belts, braces, bicycle saddles, cheque book or credit card holders, handbags, key fobs, notebooks, purses, shoes, tobacco pouches, wallets, watchstraps and trim.

<sup>9</sup> Personal, unknown, scientific, circus or travelling exhibition, breeding in captivity or artificial propagation, educational, medical (including biomedical research), zoo, law enforcement/judicial/forensic.

<sup>10</sup> <https://cites.org/sites/default/files/notif/E-Notif-2019-072-A1.pdf>

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Meat	Meat, including flesh of fish if not whole (see the term: 'body'), fresh or unprocessed meat as well as processed meat (e.g., smoked, raw, dried, frozen or tinned).
Medicine	Medicine.
Oil	Oil – e.g., from turtles, seals, whales, fish, various plants.
Powder	Powder.
Skin pieces	Skin pieces – including scraps, raw or tanned.
Skins	Substantially whole skins, raw or tanned, including crocodilian Tinga frames, external body lining, with or without scales.
Soup	Soup – e.g., of turtle.
Specimens	Scientific specimens – includes blood, tissue (e.g., kidney, spleen, etc.), histological preparations, preserved museum specimens, etc.
Swim bladders	Hydrostatic organ, including isinglass/sturgeon glue.

Source: CITES.

Trade of meat is categorized by the term “bodies”, which is described as whole fish and “meat”, which is fish that is not whole, sold as either fillets or in some other presentation.

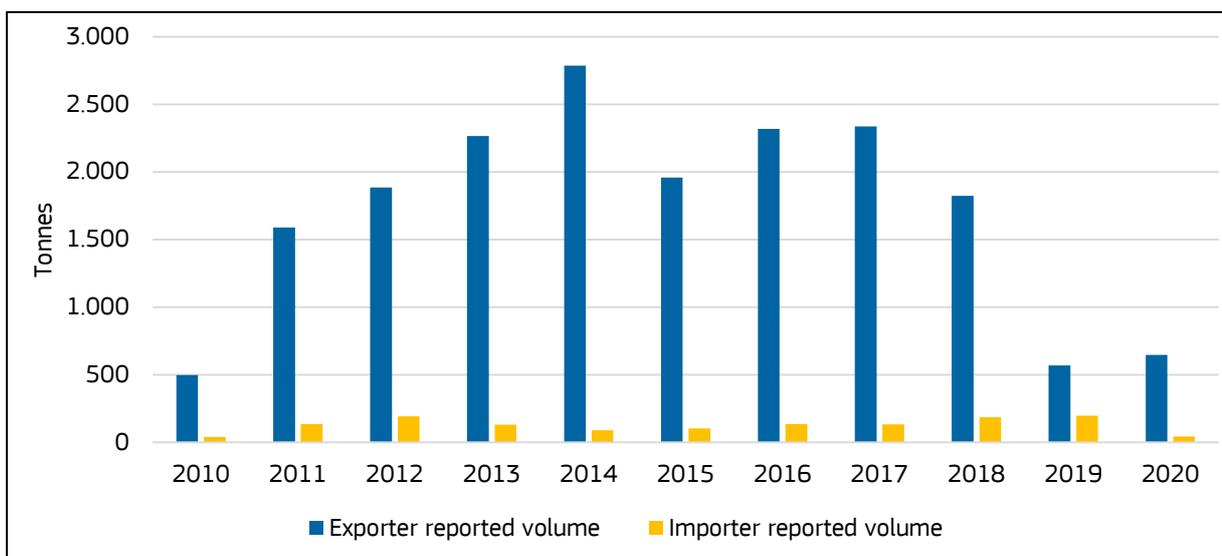
When comparing CITES trade data in terms of total volume reported by importers and that reported by exporters, there are occasional large discrepancies. One explanation may be that the volumes reported to CITES are the quantity for which the permits or certificates were issued, and not the actual trade. According to CITES, “*it is not uncommon for the quantity of specimens traded to be considerably less than the amount specified on the permits, or for permits not to be used at all*”<sup>11</sup>. Furthermore, due to delays and other reporting problems, the database is constantly updated and “*the most recent year for which comprehensive trade statistics are available is normally two years before the current year*”.

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<sup>11</sup> A guide to using the CITES Trade Database

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**Figure 1: Yearly CITES trade volumes of sturgeon meat and other by-products by reporter type.**



Source: CITES Trade Database.

For all years, reported export volumes were higher than reported import volumes. This could imply that issuing permits is only partially used, or not used at all, and occurs more often for importers than for exporters, so reported export volumes may be greater than those traded.

The largest discrepancies are found in reported export volumes to the CITES contracting party Russia. In the period 2010-2020, a total of 14.891 tonnes of sturgeon meat and other sturgeon by-products and processed products were reported exported to Russia, while Russia itself has not reported any imports of these products during that period.

Exported volumes were lower in 2019 and 2020. This is probably due to incomplete data sets. Armenia, the largest exporter of sturgeon meat has no reported exports in 2019 and 2020. The years 2019 and 2020 have thus been removed from the analysis to give as realistic a market picture as possible. Export volumes reported by Armenia in 2018 are low compared to previous years, especially when compared to Armenian production volume of sturgeons in 2018, which was on a par with production volume the preceding years. It is unknown whether this is a reporting error or if Armenia exported less sturgeon meat in 2018. Nevertheless, data from 2018 are included in trade analyses.

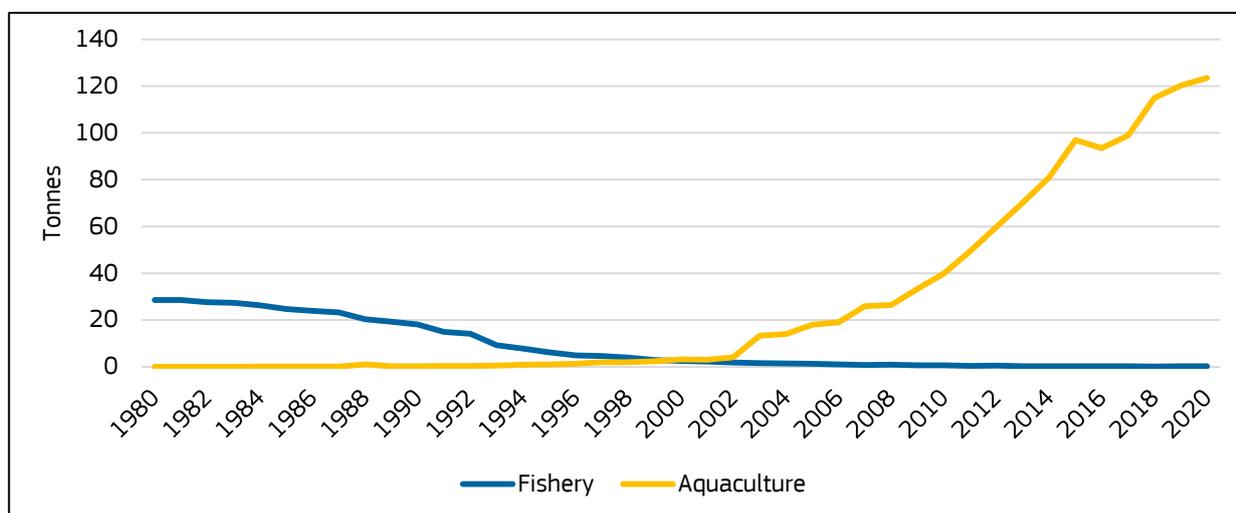
## 2 PRODUCTION

### 2.1 Sturgeons

Overfishing of sturgeons has led almost to the extinction of several of these species. Globally, the largest capture was 31.800 tonnes, recorded in 1977. Since 1998, international trade of all sturgeon species and related products has been regulated under CITES<sup>12</sup>. In 2006, Romania was one of the first countries to introduce a ban on sturgeon fishing in the Caspian and Black Sea. In 2020, a total global capture of 260 tonnes was recorded.

The first FAO-recorded harvest from aquaculture was in 1984 at 150 tonnes. Since then, there was a gradual increase in production until the early 2000s, when production started to increase rapidly year by year. In 2020, the world aquaculture production of sturgeon was approx. 123.476 tonnes. Subsequently, nearly all caviars on the market today are harvested from farmed sturgeon.

**Figure 2: Production of sturgeons from fisheries and aquaculture (volume in 1.000 tonnes)<sup>13</sup>.**



Source: FAO.

Farming sturgeons for caviar production is costly because it can take up to ten years for female sturgeons to sexually mature in captivity, although the maturation period varies between species<sup>14,15</sup>. The first three to four years, both males and females are reared together until gender can be determined by means of ultrasound, biopsy and observations, or dosage using plasmatic 11-ketotesterone<sup>14</sup>. The males are then harvested and sold, while most females are kept and grown until they can produce caviar.

Figure 3 shows the production cycle for sturgeons. Nowadays broodstock is selected from mature females and males bred in captivity, whilst previously brood fish were obtained from wild sturgeon

<sup>12</sup> See chapter 0.2.1 for more information about CITES regulations.

<sup>13</sup> FAO data show that the capture of sturgeon in 2019 was 1.178 tonnes, a notable increase compared with previous years. Upon further investigation, Denmark is reported to have captured 896 tonnes of sturgeon. This reported number is a data error as Denmark does not have any sturgeon capture, which is confirmed by the Danish Fisheries Agency, under the Ministry of Food, Agriculture and Fisheries of Denmark. Consequently, this observation has been removed from the dataset.

<sup>14</sup> FAO fact sheets on cultured aquatic species, Siberian sturgeon.

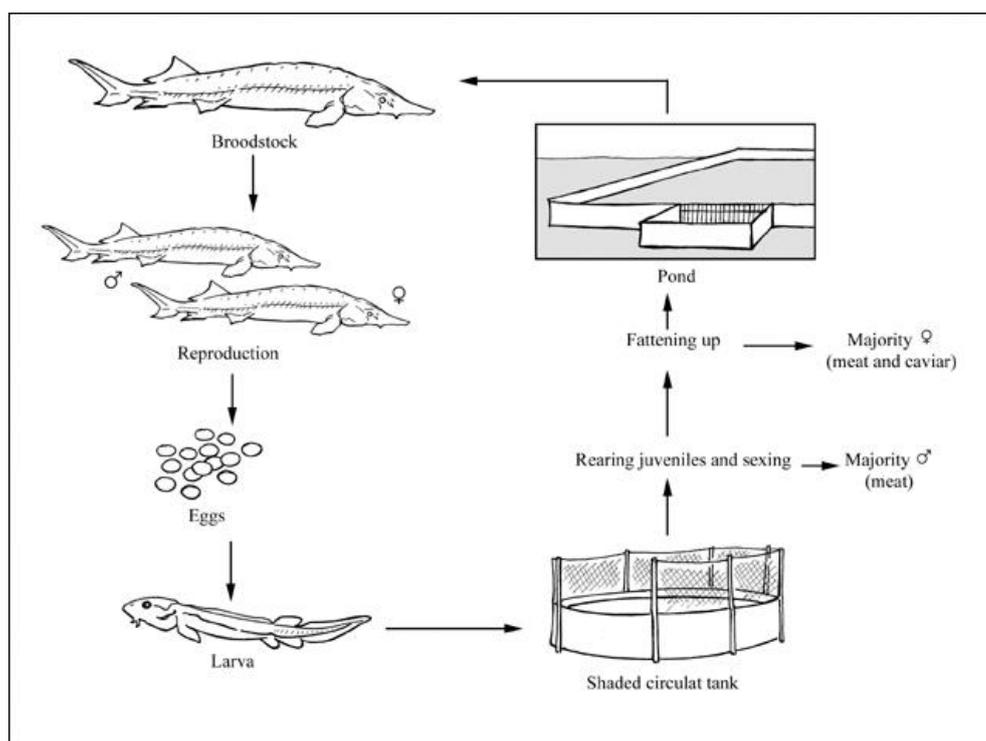
[https://www.fao.org/fishery/en/culturedspecies/acipenser\\_baerii/en](https://www.fao.org/fishery/en/culturedspecies/acipenser_baerii/en).

<sup>15</sup> SRAC fact sheets, species profile: production of sturgeon. <http://agrilife.org/fisheries2/files/2013/09/SRAC-Publication-No.-7200-Species-Profile-Production-of-Sturgeon.pdf>.

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stocks<sup>15</sup>. Selecting brood fish for spawning is complicated as females do not ovulate every year (with some exceptions). In a cohort between 35-63% of the stock ovulate annually<sup>14</sup>. To select appropriate brood fish for spawning the breeder must determine the stage of gonadal maturity by use of stock history, tissue samples and study of the oocytes<sup>14,15,16</sup>. Broodstock ready for spawning are placed in spawning tanks where spermination and ovulation are stimulated by use of hormones. When the procedure is successful, females will ovulate within 18-30 hours and males will sperminate within 18-24 hours<sup>15</sup>. Eggs and milt are then collected and mixed for fertilization.

**Figure 3: Production cycle of Siberian sturgeon.**



Source: FAO.

Larvae normally hatch after six to nine days and first feeding occurs between 9-14 days post hatching<sup>14,15</sup>. Larvae can be fed composite food straight away, but some breeders prefer to use live feed (brine shrimp nauplii) before weaning them onto commercial starter feeds. Small troughs (200 x 50 x 40 cm; length, width, and depth) are often used for rearing larvae the first four weeks before they are moved into larger circular tanks (2 m diameter)<sup>14</sup>.

Several different technologies are used for ongrowing of sturgeons. Estimates from 2016 show that roughly 36% of sturgeons are reared in flow-through systems, 21% in recirculating aquaculture systems<sup>17</sup> and 18% in open net pens<sup>18</sup>. Ponds are also used, but only make up a small percentage (7%)<sup>19</sup>. The remaining sturgeon ongrowing is carried out using a combination of techniques.

<sup>16</sup> Oocytes are the immature eggs of female sturgeons involved in reproduction.

<sup>17</sup> Read more about RAS in the EUMOFA report **Recirculating Aquaculture Systems**, published in December 2020

<sup>18</sup> Bronzi, P, Chebanov, M, Michaels, JT, Wei, Q, Rosenthal, H, Gessner, J. Sturgeon meat and caviar production: Global update 2017. *J Appl Ichthyol.* 2019; 35: 257– 266. <https://doi.org/10.1111/jai.13870>

<sup>19</sup> Ibidem

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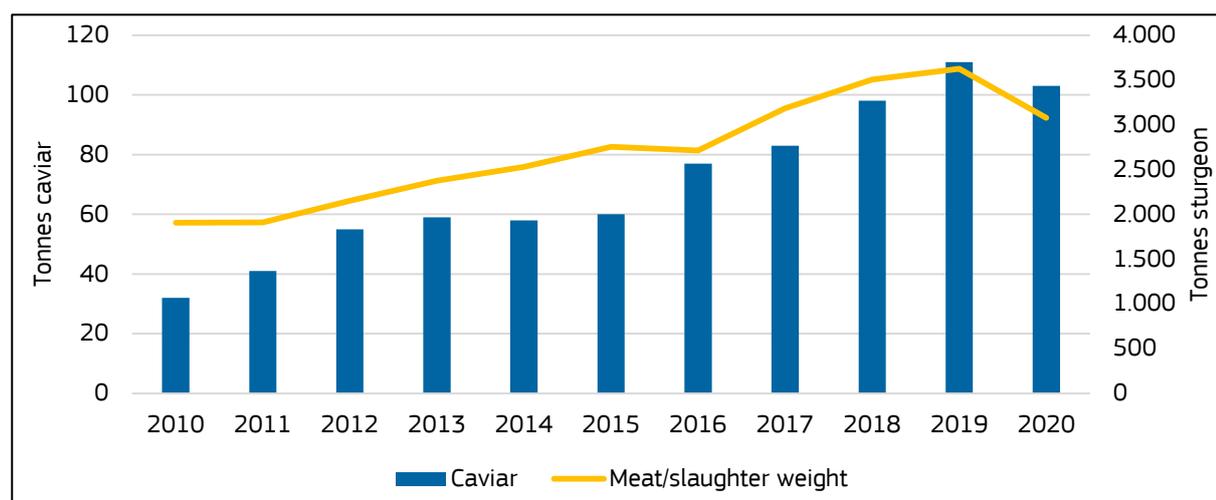
Table 3: Common sturgeon species in aquaculture production<sup>20</sup>.

Sturgeon species	Maturity in the wild (years)	Maturity in captivity (years)	Spawning frequency (years)	Comments
<b>Siberian</b> <i>Acipenser baerii</i>	19-20	6-8	3-5	Reaches maturity in the wild after 11-12 years in the Lena River.
<b>Kaluga</b> <i>Huso dauricus</i>	14-23	7-12	4-5	China has developed a hybrid species which is more cost effective than the original Kaluga species.
<b>Beluga</b> <i>Huso huso</i>	19-22	16-18		Spawning occurs after a minimum of five years after reaching maturity in the wild. It is the most expensive sturgeon species to rear.
<b>Danube</b> <i>Acipenser gueldenstaedtii</i>	12-16	9-11	4-5	Both anadromous and freshwater populations of Danube sturgeons exist in the wild.
<b>White</b> <i>Acipenser transmontanus</i>	11-34	9-11	9-11	Young females spawn every four years on average, but the caviar is of lower quality.
<b>Starry</b> <i>Acipenser stellatus</i>	9-11	8-10		Females rarely spawn more than three times during their lives.
<b>Sterlet</b> <i>Acipenser ruthenus</i>	4-8	4-5	1-3	The Sterlet has the shortest life span (22-24 years) in the genus <i>Acipenser</i> . Females live longer than males.

## 2.1.1 EU

The economic viability of a sturgeon farm relies on the existence of a meat market. Meat is still an important product for sturgeon farms once the stock of caviar producing females is established, and around 20 tonnes of sturgeon meat is produced for each tonne of caviar. The relationship between caviar production and sturgeon slaughter weight (LWE) is shown in Figure 4.

Figure 4: EU production of caviar and sturgeon meat (volume in tonnes).



Source: EUROSTAT and FAO.

<sup>20</sup> FAO Fish Finder. <https://www.fao.org/fishery/en/aqspecies/search?page=1&q=acipenser%20huso#search>.

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Italy was the largest sturgeon producer of EU MS over the past decade. In 2020, Italy produced 1.051 tonnes of sturgeon, which was 19% lower than in 2019, but still 5% higher than in 2016. According to FAO, the value of sturgeon production in Italy in 2020 was nearly EUR 7 million. This was exceptionally low, and a reduction of 43% compared to the previous year. Lower production value could possibly be explained by the COVID-19 pandemic limiting demand.

Over the past decade Poland and Bulgaria followed Italy as the second and third largest EU producers of sturgeon, respectively. Production of sturgeon in Poland has increased steadily since 2015. However, in 2020, Poland produced 450 tonnes of sturgeon at a value of EUR 2,5 million, which was a 44% reduction in production volume compared to 2019 and 29% below average production volumes since 2015. The value of production has followed a similar trend, with a 43% decrease since 2019 and down by 12% compared to 2016. The reduction in volume and value could be an effect of the COVID-19 pandemic.

Bulgaria produced 376 tonnes of sturgeon at a value of EUR 2,7 million in 2020; this was an increase of 13% compared to production volume the previous year and 18% higher than production volume in 2016. Production value has increased slightly over the past decade in Bulgaria, with an 11% increase in 2020 compared to the previous year and 2% higher value than in 2016.

France has also been a big producer of sturgeon in the EU over the past decade, with production levels on a par with Bulgaria. France produced 400 tonnes of sturgeon in 2020, at a value of nearly EUR 3 million. This was a 39% increase in production volume compared to 2019 and 55% higher than in 2016. Production value has generally increased and was up by 144% in 2020 compared to 2016. However, in 2019 recorded the lowest production value of the decade (EUR 1 million for 289 tonnes), and value increased by 184% from 2019-2020.

**Table 4: Production of sturgeon in EU-27 (volume in tonnes, value in 1.000 EUR).**

	2016		2017		2018		2019		2020	
	Volume	Value								
Italy	1.000	9.796	1.000	9.998	1.179	11.638	1.300	12.165	1.051	6.874
Poland	530	2.933	640	3.615	784	4.629	805	4.506	450	2.570
Bulgaria	320	2.598	322	2.408	454	3.355	333	2.388	376	2.654
France	258	1.217	321	1.304	409	2.091	289	1.044	400	2.970
Germany	185	1.433	183	1.422	160	1.209	161	1.354	149	1.261
Lithuania	127	872	120	953	155	1.195	166	1.201	85	576
Netherlands	50	996	100	2.033	150	3.189	150	3.023	150	3.084
Romania	33	334	252	1.802	51	580	94	700	85	803
Spain	54	1.347	72	510	4	26	147	1.265	150	1.293
Hungary	76	989	97	1.669	69	901	87	857	67	701
Others	79	703	76	743	92	973	96	796	118	1.068
<b>Total</b>	<b>2.711</b>	<b>23.219</b>	<b>3.184</b>	<b>26.458</b>	<b>3.506</b>	<b>29.786</b>	<b>3.628</b>	<b>29.297</b>	<b>3.081</b>	<b>23.855</b>

Source: FAO.

The average unit value (value per kg) from sturgeon production has shown a downward trend in the period 2016-2020. In 2016, the average unit value amounted to 8,56 EUR/kg, in 2018 8,50 EUR/kg, while in 2019 and 2020 the unit values were 8,08 EUR/kg and 7,74 EUR/kg.

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FAO production data contain limited information regarding which sturgeon species are produced in EU MS and species information is often classified as “sturgeons nei<sup>21</sup>”. CITES export data have been used to complement FAO production data to indicate which sturgeon species are produced in each MS.

In Table 5, EU MS aquaculture sturgeon producers<sup>22</sup> in the period 2016-2020 are listed at the top of the table. Production of sturgeon species in each MS is then marked as follows:

- Species that were reported in production data from FAO, but were not reported in export data from CITES are marked with an **F**
- Species that were reported in production data from FAO and were reported in export data from CITES are marked with an **X**
- Species that were not reported in production data from FAO, but were reported in export data from CITES are marked with a **C**.

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<sup>21</sup> Not included elsewhere.

<sup>22</sup> Data retrieved from FAO.

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Table 5: Aquaculture production of sturgeon species in each MS, 2016–2020.

	Austria	Belgium	Bulgaria	Croatia	Cyprus	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Italy	Latvia	Lithuania	Netherlands	Poland	Romania	Slovakia	Spain
<b>Siberian sturgeon</b> <i>Acipenser baerii</i>	C	C	F		F		C	C	C	C		C	C	C		C	C			X
<b>Danube sturgeon</b> <i>Acipenser gueldenstaedtii</i>		C	X				C		C	C			C			C	C	C		F
<b>White sturgeon</b> <i>Acipenser transmontanus</i>						C			C	C			C			C				C
<b>Acipenser hybrid</b>									C	C										
<b>Siberian/Adriatic sturgeon hybrid</b> <i>Acipenser baerii x naccarii</i>									C											C
<b>Adriatic sturgeon</b> <i>Acipenser naccarii</i>													C							X
<b>Danube/Siberian sturgeon hybrid</b> <i>Acipenser gueldenstaedtii x baerii</i>									C											
<b>Adriatic/Danube sturgeon hybrid</b> <i>Acipenser naccarii x gueldenstaedtii</i>																				
<b>Acipenseridae hybrid</b>			C						C											
<b>Siberian/Danube sturgeon hybrid</b> <i>Acipenser baerii x gueldenstaedtii</i>													C			C				
<b>Starry sturgeon</b> <i>Acipenser stellatus</i>			F						C				C			C				
<b>Beluga</b> <i>Huso huso</i>			X					C	C	C			C							F
<b>Beluga/Siberian sturgeon hybrid</b> <i>Huso huso x Acipenser baerii</i>													C							
<b>Sterlet sturgeon</b> <i>Acipenser ruthenus</i>			F	F						C								C	F	
<b>Persian sturgeon</b> <i>Acipenser persicus</i>																				
<b>Kaluga/Amur sturgeon hybrid</b> <i>Huso dauricus x Acipenser schrenckii</i>														C						
<b>Acipenser spp./Sturgeons nei.</b>	F		F			F	F		X	F	F	F	F	F	F	F	F	F		F

Source: Elaboration of FAO aquaculture production data and CITES export data.

**F** FAO reports production of this species but CITES has not registered exports from this species.

**X** FAO reports production of this species and CITES reports exports of products from this species.

**C** Cites reports exports of sturgeon meat and other by-products from this species. However, FAO does not report production of this species.

Based on export data from CITES and production data from FAO for the period 2016–2020, Italy appeared to produce primarily white sturgeon (47%) followed by Danube sturgeon (28%) and Siberian

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sturgeon (23%). Poland and Bulgaria mainly produced Siberian (56% and 22 %, respectively) and Danube sturgeon (44% and 73% respectively), while France produced Siberian (96%) and white sturgeon (3%).

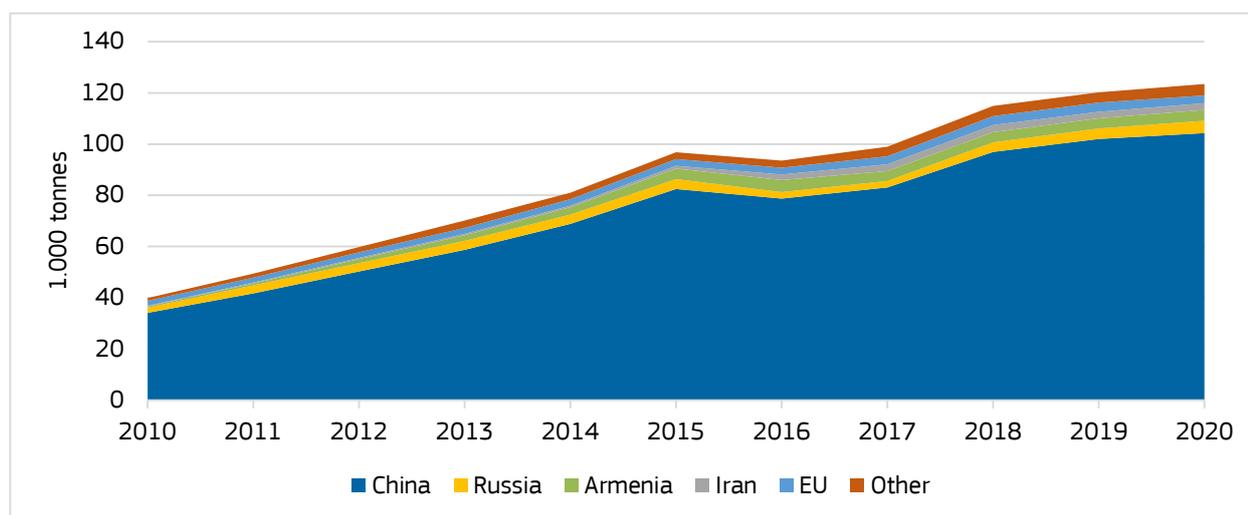
In other sturgeon producing MS, Danube, Siberian and white sturgeons were mainly produced (55%, 27%, and 9%, respectively of reported exports). Export data from the period 2016–2020 show that Germany (82%) and the Netherlands (14%) were the main exporters of Danube sturgeon, while Germany (73%) and Latvia (16%) were the main exporters of Siberian sturgeon. White sturgeon was mainly exported by Germany (97%). Production data from FAO (2016–2020) imply that Germany, Lithuania, the Netherlands, and Romania were the main producers of these species, accounting for 24%, 19%, 17%, and 15% of produced “sturgeons nei”, respectively.

In the period 2016–2020 other species, such as Adriatic, Beluga, Starry, Sterlet, and hybrid sturgeons were also exported (and likely produced) by EU MS. Italy was the main exporter of Beluga, Starry, Adriatic, and hybrid sturgeons such as Siberian/Danube and Beluga/Siberian sturgeons. While Romania was the main exporter of Sterlet sturgeon, Germany was the main exporter of sturgeons found in the CITES categories “*Acipenser hybrid*” and “*Acipenseridae hybrid*”.

## 2.2 Other regions

Over the past 20 years there has been a steep growth in aquaculture production of sturgeons, driven mainly by China. According to FAO, world production in 2002 was 4.100 tonnes, half of which took place in Russia and the remainder in the EU. In 2003, world production more than tripled when China reported a production of over 9.000 tonnes. In 2015–2017, a decline in Chinese production was linked to a new governmental regulation for environmental protection which prohibited cage culture in inland waters<sup>23</sup>. A major part of the sturgeon production had to be moved to land-based farms and sturgeon not fit for caviar production was sold as meat. As such, the meat production was higher in 2015 and slightly lower the following years. Since 2003, Chinese production has increased tenfold to an estimated 104.280 tonnes in 2020<sup>24</sup>.

**Figure 5: Aquaculture production of sturgeon by top producing countries (volume in 1.000 tonnes).**



Source: FAO.

<sup>23</sup> Paolo Bronzi, Mikhail Chebanov, James T. Michaels, Qiwei Wei, Harald Rosenthal, and Joern Gessner (2019), Sturgeon meat and caviar production: Global update 2017

<sup>24</sup> FAO statistics.

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In 2020, China accounted for 84% of global sturgeon production, followed by Russia at 4% (4.836 tonnes), and Armenia at 3% (4.200 tonnes). Trade data from CITES show that China started importing large quantities of live sturgeon eggs in 2001, and thus support production data from FAO. Since then, China has built production and established its own stocks of Siberian sturgeon. Chinese stock building matches CITES data which shows a significant decline in Chinese imports of live eggs from 2013 onwards.

The majority of countries with high sturgeon meat production also have significant exports of caviar (see EUMOFA's report on [The Caviar Market](#)). The exception is Armenia which has very low levels of caviar exports, much lower than their sturgeon production would imply. An explanation for this could be that Armenia has a culture for raising sturgeon primarily for meat consumption, not for caviar production.

**Table 6: Global aquaculture production of sturgeon (volume in tonnes).**

	2015	2016	2017	2018	2019	2020
China	82.436	78.764	83.058	96.914	102.042	104.280
Russia	3.845	2.517	2.584	3.791	4.021	4.836
Armenia	4.115	4.649	3.798	3.910	4.000	4.200
EU-27	2.756	2.711	3.184	3.506	3.628	3.081
Iran	1.071	2.146	2.618	2.839	2.516	2.640
Vietnam	785	939	1.331	1.400	1.716	2.410
USA	947	947	947	1.166	1.166	1.166
Other	898	847	1.437	1.374	1.061	863
<b>Total</b>	<b>96.853</b>	<b>93.520</b>	<b>98.957</b>	<b>114.900</b>	<b>120.150</b>	<b>123.476</b>

Source: FAO.

For all sturgeon producers listed in Table 6, no species can be identified in FAO statistics.

## 2.3 Sturgeon meat and other by-products and processed products of sturgeons

### 2.3.1 Meat

Sturgeon meat is dense and much appreciated for its firm, meaty, and boneless texture, which compares to that of chicken breast, pork, or veal meat and is considered a good substitute for each<sup>25,26</sup>. The colour of sturgeon meat varies depending on the species, with colours ranging from slightly yellow, grey, and white when cooked<sup>27</sup>. Siberian sturgeon meat is reputed for its yellow colour. The colour of the meat is not related to the quality of sturgeon meat.

The amount of caviar that a female sturgeon produces depends on the species, size, and age. Most sturgeon females produce between 10-30% of their total body weight in caviar<sup>28</sup>. For example, Beluga females produce between 15-20 kg caviar, while Danube females produce between 5-20 kg caviar<sup>29</sup>. Siberian, Starry, and Sterlet sturgeon females produce between 5-8 kg caviar. As females are older and

<sup>25</sup> Seafood Source. <https://www.seafoodsource.com/seafood-handbook/finfish/sturgeon>.

<sup>26</sup> Marshallberg Farm. <https://thecaviarfarm.com/product-category/sturgeon-meat/>.

<sup>27</sup> Saaee Aquaculture. <https://saaee-aquaculture.com/en/sturgeon-meat>.

<sup>28</sup> Chapman, F. A., Eenennaam, J. P. (2022). Technically speaking, what is sturgeon caviar? UF/IFAS.

<https://edis.ifas.ufl.edu/publication/FA194>.

<sup>29</sup> House of caviar and fine foods. <https://www.houseofcaviarandfinefoods.com/blog/5-facts-about-sturgeon-caviar-you-should-know>.

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larger than males when slaughtered, they provide a greater meat yield than male sturgeons. Male sturgeons are slaughtered once they reach maturity and gender is determined. The slaughter weight and meat yield from males depend on the species and their growth rates until sex determination, depending on the species, at approximately 3,5 years of age. The marketable size of white sturgeon is between 1-3 kg<sup>15</sup>, while Danube sturgeon are somewhat larger at harvest, between 5-7 kg, according to one stakeholder<sup>26</sup>. Another stakeholder in Iran reported that sturgeons have a good economic ratio of useful fillet content compared to other fish, and that one can harvest about 53% from breeding Beluga sturgeons and about 47% from Persian sturgeons<sup>30</sup>. On average, the butchering yield from sturgeons is between 45-95%, depending on the cut (round, whole/gutted, bullet) and whether the skin and/or bloodline<sup>31</sup> is removed<sup>32</sup>.

Farmed sturgeons are raised in a controlled environment, which consistently produces meat of good quality. However, some observers claim that sturgeon reared in aquaculture have larger fat deposits than wild sturgeon which are said to negatively affect the taste of sturgeon meat<sup>33</sup>. This is especially prominent in sturgeons that have been fed to reduce the time needed for the fish to reach maturity. Other observers claim wild sturgeons are leaner, firmer, and have a milder and less “fishy” taste than sturgeons reared in aquaculture<sup>31</sup>. The flavour of wild (and cultured) sturgeons varies depending on their diet and whether they are caught in brackish or fresh water<sup>30</sup>.

### 2.3.2 Other by-products and processed products of sturgeons

In CITES export data, by-products and processed products of sturgeons are listed under various categories such as “extract”, “cosmetics”, “fins”, “derivatives”, “powder”, “medicine”, and “leather products (small)”. Upon reviewing uses of different sturgeon parts, such as the cartilage, bone marrow, skin, swim bladder, head, and gonads, it was in some cases unclear which of these categories encompass export of which by-products and processed products from sturgeons. For instance, sturgeon extracts and cosmetics appeared to be utilized for the same purpose, which is predominately in cosmetics. Powders may also be used for the same purpose. Cartilage seems to be used for the extraction of gelatine, medicinal purposes<sup>34,35</sup>, and in cooking<sup>36</sup>.

Swim bladders may be used to produce glue and isinglass<sup>37</sup>, while sturgeon skins can be tanned into leather for production of leather goods. Spinal cords of sturgeons are considered a delicacy<sup>38</sup> and are used in soups, stews, and other dishes. Fins and viscera are mainly used to make fish meal. With proper management, nearly the entire sturgeon can be utilized for different purposes.

<sup>30</sup> Fard Fisheries Department. <https://fardfishery.ir/trade-status-of-sturgeon-meat-caviar-and-other-byproducts/?lang=en>.

<sup>31</sup> A darker strip of meat that is more fishy tasting and often oily.

<sup>32</sup> Chef's resources. <https://www.chefs-resources.com/seafood/finfish/sturgeon/>.

<sup>33</sup> Caspian Monarque. <https://caspiamonarque.com/why-is-farmed-caviar-inferior-to-caviar-harvested-from-wild-sturgeon/>.

<sup>34</sup> Universidad de Granada. <https://www.innoget.com/technology-offers/8202/sturgeon-cartilage-biomaterial-for-tissue-regeneration>.

<sup>35</sup> Zhang, Z., et al. (2022). <https://www.frontiersin.org/articles/10.3389/fmars.2022.925407/full>.

<sup>36</sup> Acadian sturgeon. [https://www.acadian-sturgeon.com/en/products/recipes/acadian\\_sturgeon\\_bone\\_marrow\\_cartilage\\_belly\\_bouillabaisse/](https://www.acadian-sturgeon.com/en/products/recipes/acadian_sturgeon_bone_marrow_cartilage_belly_bouillabaisse/).

<sup>37</sup> Mainly used in the brewing process of some beers and wines for clarification or fining.

<sup>38</sup> Cook's info. <https://www.cooksinfo.com/vesiga>.

**Sturgeon meat and other by-products of caviar: production, trade and consumption in and outside the EU****2.3.2.1 Cosmetics and extracts**

Sturgeon extracts are used in beauty products such as facemasks, moisturizers, anti-wrinkle creams, shampoo, and conditioners<sup>39,40</sup>. These products are marketed based on the unique properties of sturgeon extracts, which are said to contain omega 3, 6 and 9, polypeptides for anti-aging, essential amino acids, collagen, chondroitin, taurine, and minerals.

Some companies also use caviar extracts, namely sturgeon DNA, in their products and market them as high-end luxury products<sup>41</sup>. Sturgeon caviar is a nutritious product that is rich in amino acids and essential fatty acids<sup>42</sup>. Essential fatty acids are an integral part of cell membranes and affect the function of cell receptors in these membranes but can only be acquired by the body through food. Consumption of fatty acids is linked to several health benefits, such as reduced risk of heart disease and stroke, as well as reduced inflammation and fatigue, and increased energy and vitality. Caviar in skincare is marketed as having anti-aging and rejuvenating effects, designed to enhance the skin's outer glow and illuminate it<sup>43</sup>.

**2.3.2.2 Leather**

Sturgeon leather, made from raw sturgeon skin, is highly durable and a desirable commodity for textile and product designers and is used in products such as handbags, wallets, belts, bracelets, shoes, and key rings<sup>44,45</sup>. Unlike many other animal leathers, sturgeon leather is waterproof and does not get damaged from repeated contact with water. It is also robust and develops its own patina over time<sup>44</sup>.

Sturgeon skin must be tanned into leather before it can be used to produce products. One stakeholder cleans the skins by hand and places them in barrels for tanning – a process which lasts three weeks<sup>44</sup>. The skins are then pressed, lubricated with oil and steam, pressed again, and then finally dried. To make the leather smooth and even it is shaved once it has dried. The grain of the finished product has an unusual surface that looks like wood or cork<sup>46</sup>.

Sturgeon leather is easier to process compared to traditional leather and is also biodegradable and recyclable<sup>44</sup>. Leather developed from fish skins is generally stronger than other leather types when comparing the same thickness<sup>45,46</sup>.

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<sup>39</sup> The Zoeun Skin, Korea. <https://gynong.gobizkorea.com/mini/site/productList.do>.

<sup>40</sup> MIRRA, Lithuania. <https://mirra.eu/en/search?controller=search&s=sturgeon>.

<sup>41</sup> La Maison Valmont, Switzerland. <https://www.lamaisonvalmont.com/eu/en/brands/l-elixir-des-glaciers/marvelous-collection.html>.

<sup>42</sup> Caviarlieri Switzerland. (2022). The world's most effective caviar DNA extract with marine bioactive peptides. <https://swisscaviarlieri.com/benefits/the-worlds-most-effective-caviar-dna-extract-with-marine-bioactive-peptides>.

<sup>43</sup> Cosmetics & Toiletries. <https://www.cosmeticsandtoiletries.com/formulas-products/skin-care/news/21844171/valmont-illuminates-skin-with-essence-of-gold-sturgeon-collection>.

<sup>44</sup> Oona Caviar. <https://www.oona-caviar.ch/en/caviar-knowledge/sturgeon-leather-products>.

<sup>45</sup> Mascolori. <https://mascolori.eu/sturgeon-leather>.

<sup>46</sup> Leather dictionary. [https://www.leather-dictionary.com/index.php/Fish\\_leather#Sturgeon\\_leather](https://www.leather-dictionary.com/index.php/Fish_leather#Sturgeon_leather).

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### 3 INTERNATIONAL TRADE

Trade of sturgeon meat is analysed based on CITES data. This data contains only volumes but are more detailed *inter alia* in terms of species. A more thorough description of sources, methodologies and assumptions is available in the chapter on methodology. This chapter only covers exports of sturgeon meat, as import data in CITES are incomplete.

Data concerning 2019 and 2020 are not complete in terms of data submission. As such, only data up to 2018 is analysed. Reported export volumes by Armenia in 2018 is low compared to the previous years, but export data from 2018 have been included in the trade analyses.

#### 3.1 Export of sturgeon meat

The major exporters of sturgeon meat are China, Armenia, and the EU. In 2018, they accounted for 92% of total sturgeon meat exports. The sturgeon meat category covers both whole sturgeon and other presentations.

**Table 7: Global exports of sturgeon meat (whole and other presentation, volume in tonnes).**

Exporter country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
China	75	164	296	690	476	705	879	859	265	315
Armenia	1.129	1.260	1.580	1.765	1.325	1.294	1.216	597		
EU-27	243	349	335	192	77	215	127	222	152	201
Uruguay	0,07		0,15	69	43	32	31	73	56	35
Kyrgyzstan							23	22	21	
Moldova	21	14			3	28	41	20	10	65
Israel	15	17	0,02	20	16	31	12	17	45	22
Canada		0,01	0,10			0,13	0,08	5		
Belarus						4	2	5		1
Georgia	0,31	19		14	17			2	18	
Other	102	58	53	36	0,04	7	4	0,27	0,01	8
<b>Total</b>	<b>1.586</b>	<b>1.880</b>	<b>2.263</b>	<b>2.785</b>	<b>1.957</b>	<b>2.317</b>	<b>2.336</b>	<b>1.822</b>	<b>567</b>	<b>646</b>

Source: CITES.

##### 3.1.1 China

In the period 2014-2018, the majority of Chinese sturgeon exports were destined for Russia (73%). In 2018, exports to Russia accounted for 77% of China's sturgeon exports, followed by Azerbaijan and the USA which both accounted for 6% of sturgeon exports. Of Chinese exports to Russia and Azerbaijan in 2018, nearly all sturgeon was exported as whole fish (bodies) (99%). However, in 2014 and 2015 all sturgeon exports from China to Russia were reported as meat. Exports to the USA were split between whole fish and meat in 2018, with the majority (76%) reported as meat. This could indicate that there is no clear division between the terms "meat" and "bodies" in CITES export data, and that sturgeon meat is exported under both terms.

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**Table 8: Chinese exports of sturgeon meat (whole and other) by destination country (volume in tonnes).**

Destination country	2011	2012	2013	2014	2015	2016	2017	2018
Russia			85	423	359	465	717	660
Azerbaijan	38	70	98	154	42	132	62	49
USA			21	23	44	20	16	49
Germany						14	21	30
Kyrgyzstan						23	22	23
Georgia	12	39	53	42	10	11	22	19
Ukraine	13	42	28	14	14	28	7	18
Israel		12	2	6	6	13	11	12
Others	12	1	9	29	0,11	0,01	2	0,03
<b>Total</b>	<b>75</b>	<b>164</b>	<b>296</b>	<b>690</b>	<b>476</b>	<b>705</b>	<b>879</b>	<b>859</b>

Source: CITES.

**3.1.2 Armenia**

In the period 2014-2018, the majority of Armenian sturgeon exports were destined for Russia (97%). In 2018, exports to Russia accounted for 92% of Armenia's sturgeon exports, followed by the USA and Israel which accounted for 5% and 2%, respectively. Of Armenian exports to Russia in 2018, 68% of sturgeon exports were exported as whole fish, while 35% were exported as meat. Exports to the USA were mainly exported as meat (93%) and all exports to Israel in 2018 were exported as meat.

**Table 9: Armenian exports of sturgeon meat (whole and other) by destination country (volume in tonnes).**

Destination country	2011	2012	2013	2014	2015	2016	2017	2018
Russia	1.114	1.257	1.568	1.764	1.284	1.252	1.184	551
USA			0,06	0,02	0,02	2	12	33
Israel						10	20	10
Georgia	10		1	1	27	0,22		3
Iran			9	0,30		15		
Ukraine	5	0,30	1		2			
Turkmenistan					2	15		
Kazakhstan					10			
Others		2	1		0,32		0,05	
<b>Total</b>	<b>1.129</b>	<b>1.260</b>	<b>1.580</b>	<b>1.765</b>	<b>1.325</b>	<b>1.294</b>	<b>1.216</b>	<b>597</b>

Source: CITES.

**3.1.3 The EU**

Exports of sturgeon meat from the EU in the period 2014-2018 mainly exited the EU from Italy (53%), followed by Poland (22%) and Germany (12%). Most of these exports went to Azerbaijan (25%), Russia (14%), and Georgia (11%), followed by Switzerland (9%), Iran (7%), and Belarus (7%). All exports from Italy in 2018 were exported as meat, while all exports from Poland were exported as whole fish. Exports from Germany were predominately exported as whole fish (96%). Since 2014, the EU has not registered

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any exports of sturgeon meat to Russia. This may be related to the Russian invasion of Crimea, which led many countries (including the EU) to impose sanctions against Russian individuals, businesses, and officials. Russia's response to these sanctions was a total ban of food imports from several countries, including the EU.

**Table 10: EU exports of sturgeon meat (whole and other) by destination country (volume in tonnes).**

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Azerbaijan	0,03	17				40	65	102	43	3
USA	0,03	0,07	0,03	0,05	5	0,12	0,29	42	0,14	44
Georgia	10	18		20	6	39	7	23	78	44
UAE	0,06	1	0,1	0,1	10	1	1	20	0,01	18
Armenia					0,03			13		
Ukraine	21	34	33	11	6	10	14	9	24	58
Belarus			5		1	37	16	6	0,10	
Switzerland	10	9	11	26	11	21	12	5	3	0,36
Monaco							1	1		
Singapore	1	0,45	0,29	1	0,22	0,44	0,32	0,25	0,50	0,25
Other	201	270	286	134	38	66	11	0,46	5	35
<b>Total</b>	<b>243</b>	<b>349</b>	<b>335</b>	<b>192</b>	<b>77</b>	<b>215</b>	<b>127</b>	<b>222</b>	<b>152</b>	<b>201</b>

Source: CITES.

### 3.2 Export of by-products and processed products

By-products and processed products from sturgeons (excluding meat, caviar, and live fish/eggs) are also traded globally and registered in CITES export data. However, CITES export data pertaining to by-products and processed products appear to be incomplete, especially considering that the major producers of sturgeon have not reported any trade in these products. This could either be because they do not trade in these products or due to inaccurate reporting of trade in these products. Of countries that do report trade in by-products and processed products, most are EU Member States. This may be due to a higher focus on accurate reporting of trade in EU Member States and/or on getting the most out of sturgeon production.

The reader should also keep in mind that many by-products and processed products have been reported without any unit of measure in CITES export data. Products without units of measure were removed from the dataset used in the analyses for this report as it was not possible to quantify the exact export of these products. The export data presented below should therefore be considered as the minimum exported quantities of by-products and processed products from sturgeons.

In 2018 a total of 2.403 kg sturgeon by-products and processed products were exported. Most of these exports were extracts (38%), followed by cosmetics (20%), fins (16%), and derivatives (11%). The largest exporter of sturgeon by-products and processed products in terms of volume was France which in 2018 exported 832 kg of extracts (92%), 52 kg of derivatives (19%) and 7 kg of cosmetics (1%). Of French exports of sturgeon extracts in 2018, 29% were destined for Switzerland, 27% for China, 14% for Japan, and 13% for Russia. Since 2012, Switzerland has been the largest destination for French exports of sturgeon extracts.

Germany and Austria were the main exporters of sturgeon cosmetics in 2018, each accounting for 38% of total exports. Germany mainly exported cosmetics to Russia (63%), followed by Singapore (19%), and China (5%). Cosmetics exports from Austria mainly went to Hong Kong (82%), followed by Switzerland (9%), and Norway (4%).

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**Table 10: Global exports of sturgeon by-products and processed products by product type (volume in kg).**

	2011	2012	2013	2014	2015	2016	2017	2018
Extract	1.676	1.806	1.794	1.359	915	723	1.016	908
Cosmetics					41	53	99	486
Fins				4			2	380
Derivatives	621	2.621	1.284	792	6	26	95	273
Powder								201
Genitalia	280	2				100	84	150
Swim bladders		135	5	5		6		5
Specimens		5						
Bones		5						
<b>Total</b>	<b>2.577</b>	<b>4.574</b>	<b>3.083</b>	<b>2.160</b>	<b>962</b>	<b>908</b>	<b>1.295</b>	<b>2.403</b>

Source: CITES.

In 2018 Spain exported 80% of sturgeon derivatives, followed by France. Nearly all derivative exports from Spain went to Japan (99%) in 2018, which is a change from previous years when derivative exports went to a multitude of other countries, such as Switzerland, USA, Mongolia, Costa Rica, India, Taiwan, and the United Arab Emirates. In 2018, exports of sturgeon derivatives from France went mainly to Japan (94%). Previously, the primary destination for French derivative exports was Switzerland and Japan received very few exports of derivatives from France.

In 2018, Belarus was the only exporter of sturgeon fins, all of which were reported to be exported to Russia. Sturgeon powder exported in 2018 originated from Denmark, produced from the species white sturgeon. All exports were destined for Japan. Similarly, all exports of sturgeon genitalia in 2018 originated in Canada and were exported to Italy. In 2012, Canada exported 135 kg swim bladders to China.

## 4 CONSUMPTION

Sturgeon meat is sold fresh, frozen, and smoked as whole fish, steaks, and fillets<sup>25</sup>. Smoking of the meat generally adds value to the product, which is then sold as high-end products by many caviar retailers<sup>26,47,48,49</sup>. The price of sturgeon meat varies depending on the sturgeon species as well as the cut and preparation of the meat. Some stakeholders interviewed claim that meat from Beluga sturgeons is especially pricey (both fresh and smoked) due to the longer time that is required before this species can be harvested. Other stakeholders claim that the highest quality sturgeon meat comes from White sturgeon<sup>50</sup>.

Most stakeholders interviewed (mainly caviar producers) reported that they sell fresh and frozen sturgeon meat on the EU market at a price between 6,00-8,00 EUR/kg. However, some stakeholders said that sturgeon meat can sell for as much as 50,00 EUR/kg, and that meat from males usually sells at a higher price than meat from females. Prices of smoked sturgeon fillets range from 75,00-120,00 EUR/kg online and in high-end caviar retail stores where it is marketed as a luxury product, while smoked meat which is further processed into pastes and slices has an average price of 167,00 EUR/kg<sup>26,47,48,49</sup>.

Sturgeon meat has a mild, clean, and savoury flavour, which makes it versatile to use when cooking and complementary to most seasonings<sup>26</sup>. In addition, sturgeon meat is protein rich and low in fat, which makes it an increasingly popular choice on the dinner table for consumers<sup>30</sup>. Due to its density, sturgeon meat is best prepared slow cooked until tender before additional preparations such as grilling, sautéing, roasting, or searing. It is also common to prepare it smoked, stewed, deep fried, or to consume it raw as sashimi or in sushi<sup>51</sup>. Sturgeon meat is well adapted for paste products such as sausages and cutlets, as well as dough products due to the boneless structure and low-fat content of the meat.

Sturgeon farming started as a meat-oriented production in Europe, but since caviar is a more profitable commodity, farming is nowadays oriented towards producing caviar<sup>50</sup>. Italy is the biggest producer of caviar and sturgeon meat in the EU. However, consumers in Italy tend to avoid sturgeon meat, as they are not familiar with the product. As such, sturgeon meat is still considered a secondary and/or by-product of caviar, and most of the meat is sold frozen abroad, mostly to the eastern European and Russian markets. In eastern European countries such as Bulgaria, Romania, Serbia, and Ukraine, both caviar and sturgeon meat are common products in shops, supermarkets, restaurants, bars, and local markets<sup>52</sup>. According to the World Wildlife Fund<sup>52</sup>, consumer demand for caviar and sturgeon meat in these markets is rising and there is evidence of poaching and illegal trade of sturgeon products on a widespread and systematic scale in these countries.

Bearing in mind that CITES export data pertaining to sturgeon by-products and processed products are limited and incomplete, and that major sturgeon producing countries have not reported any trade in these products, it can be observed that these products are consumed worldwide. Most of them are exported from EU Member States (76% of total export volume in 2018). Sturgeon by-products and processed products include products such as cosmetics, extracts (mainly used in cosmetics), and fins. The main consumers of these products in 2018 were Russia (25%), Japan (24%), Switzerland (11%), and China (11%).

Sturgeon meat has been consumed in Chinese cuisine for a very long time and it has been recorded that fried sturgeon was a popular food during the Song Dynasty<sup>53</sup>, around 1000 A.C. Sturgeon farming in

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<sup>47</sup> ANNA Dutch. <https://www.annadutch.nl/en/product-category/anna-dutch-fish/>.

<sup>48</sup> Caviar de Neuvic. <https://caviar-de-neuvic.com/en/epicerie-neuvic/322-smoked-sturgeon.html#/4-weight-100g>.

<sup>49</sup> Gourmet House Caviar. <https://gourmethouse.com/shop/delicatessen/smoked-sturgeon/>.

<sup>50</sup> Lopez, A. et al. (2020). Sturgeon meat and caviar quality from different cultured species. DOI: **10.3390/fishes5010009**.

<sup>51</sup> Fishmasters. <https://fishmasters.com/can-you-eat-sturgeon/>.

<sup>52</sup> WWF. (2021). Evidence for trafficking of critically endangered sturgeon in the lower Danube region. <https://danube-sturgeons.org/wp-content/uploads/2021/04/Market-survey-final.pdf>.

<sup>53</sup> UIFSA. <https://uifsa.ua/en/about-fish/aquaculture/caviar-industry-in-china>.

### Sturgeon meat and other by-products of caviar: production, trade and consumption in and outside the EU

China is mainly oriented toward meat production, but China is also the world's leading producer of caviar<sup>54,50</sup>. Retailers in China mainly sell fresh, small sturgeons of 1-2 kg for meat consumption at an average price of 3,5-4,5 EUR/kg<sup>55</sup>.

In Russia, sturgeon meat is sometimes used in a traditional dish of the indigenous people of northern Arctic Siberia called stroganina<sup>56</sup>. The dish consists of long, thin slices of raw frozen fish served in large ice bowls with dipping sauces on the side. In northern Russia festivals have been created to celebrate this dish. The masters of the artform have their own techniques for whittling fish, and are judged on how thin the slices are, how high the stacks are, and how long the fish stays frozen.

Sturgeons are old and venerable fish that have been appreciated for their roe and meat since the Persians invented caviar<sup>57</sup>. It was established as an exclusive product already in the Middle Ages, as caviar easily spoiled without refrigeration, and was decreed a "royal fish" by the English king, Edward II. To this day, all wild sturgeons found in UK waters are considered the property of the English monarch<sup>58</sup>.

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<sup>54</sup> EUMOFA. (2021). The caviar market. <https://www.eumofa.eu/documents/20178/449260/2021+-+The+Caviar+Market.pdf/04e7de02-bdc8-d0e2-96cb-59c730436b78?t=1620208745691>.

<sup>55</sup> Thanh Luu, L., and Dinh An, N. (2021). Learning about sturgeon imported from China.

<https://vietnamagriculture.nongnghiep.vn/learning-about-sturgeon-imported-from-china-d312396.html>.

<sup>56</sup> Gala in the kitchen. <https://galainthekitchen.com/russian-dish-stroganina/>.

<sup>57</sup> Petrossian. [https://www.petrossian.fr/fr\\_en/history-caviar](https://www.petrossian.fr/fr_en/history-caviar).

<sup>58</sup> Ask an Academic. <https://askanacademic.com/law/what-happens-if-you-catch-a-sturgeon-in-the-uk-1560/>.

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