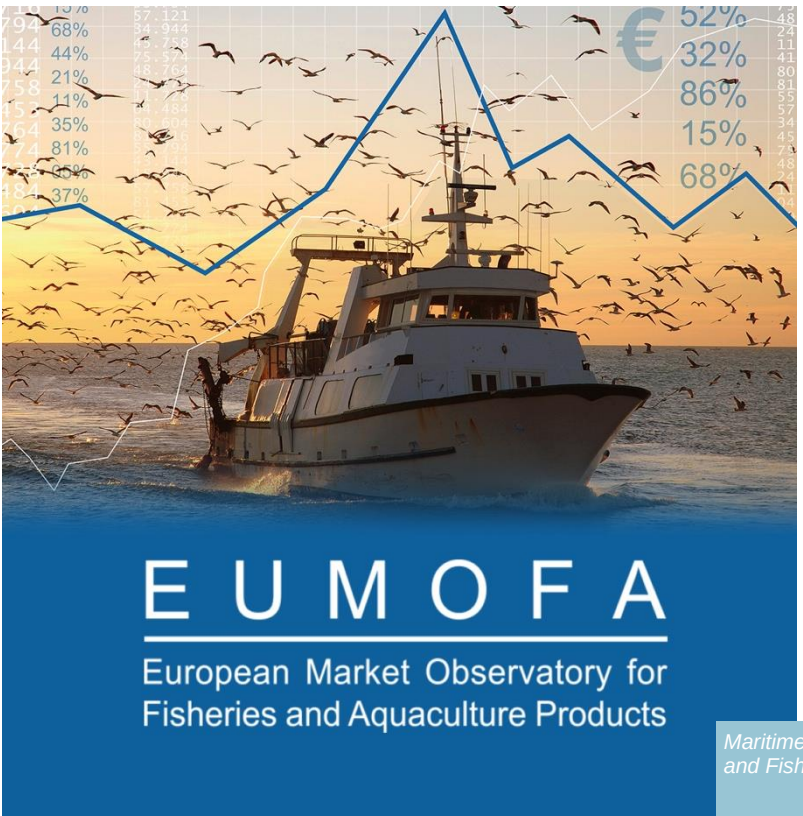
European Commission

# SALMON AND TROUT ROE




## PRODUCTION, TRADE, AND CONSUMPTION

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# SUMMARY

This study was carried out upon request of the Market Advisory Council (MAC). The MAC drew attention to the need for specific studies to assess the market for caviar analogues, in particular the market for salmon and trout roe for human consumption. Historically, roe from fish other than sturgeon has been consumed all over the world, but caviar substitutes may be viewed as alternatives to sturgeon caviar that are sold at lower prices.

Most of the salmon roe is produced from wild salmon. Given this, the majority of salmon roe production happens in countries with large stocks of wild pacific salmon such as the USA, Russia, and Japan.

Salmon roe from the USA is primarily produced in Alaska. In 2021, a total of 13.335 tonnes of salmon roe was produced in Alaska. Compared with 2020, which saw a lower catch of salmon, the production of roe increased by 83% in 2021. In Russia, the production of salmon roe during 2021 was estimated to be 29.500 tonnes, nearly a doubling from the year prior.

According to Eurostat, EU MS produced a total of 998 tonnes of trout roe in 2020 for a value of roughly EUR 16 million. This was an increase of 12% in terms of volume and 1% in terms of value when compared to 2019.

In 2021, the USA exported an estimated 12.699 tonnes of salmon and trout roe at a value of nearly EUR 191 million. Compared with 2020, the export volume was 54% higher and the value 87% higher. Given the production of 13.335 tonnes in Alaska in 2021, this leads to assume that nearly 95% of salmon roe produced in the USA is exported. The majority or roe exports in 2021 (69%) was destined to Japan.

Russia exported an estimated 11.975 tonnes of salmon and trout roe at a value of nearly EUR 280 million in 2021. This was an increase of 174% in terms of volume and 320% in terms of value when compared with 2020. The majority (81%) of the volume exported in 2021 was destined for Japan.

According to stakeholders, trout roe is sold at roughly half the price of salmon roe. According to industry players, demand for trout roe rises when the availability of salmon roe is limited, or the price has increased. Trout roe may be exported both under the code “caviar substitutes” which covers roe from a multitude of species or under codes used for salmon roe, making the actual trade difficult to identify in trade statistics.

As the largest importer of salmon and trout roe, the market dynamics in Japan reflect the global dynamics of the salmon and trout roe market. In 2021 Japan imported an estimated 19.780 tonnes salmon and trout roe at a value of EUR 438 million. This was an increase of 57% in terms of volume and 101% in terms of value when compared with 2020.

# DEFINITIONS

| | |
|---|---|
| Caviar | Refers to roe from sturgeons for human consumption |
| CITES | The Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| CN | Combined Nomenclature[1] |
| EU | The European Union as of 1st January 2021, i.e., excluding the United Kingdom |
| EUMOFA | European Market Observatory for Fisheries and Aquaculture |
| FAO | Food and Agriculture Organization of the United Nations |
| HS | Harmonised System[2] |
| MAC | Market Advisory Council |
| MCS | Main commercial species |
| MS | Member States |

[1] Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common Customs Tariff

[2] World Customs Organization http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx

# 1 SCOPE AND METHODOLOGY

## 1.1 Study scope

This study was carried out upon request of the Market Advisory Council (MAC). The MAC drew attention to the need for specific studies to assess the market for caviar analogous, in particular the market of salmon roe and trout roe for human consumption.

Production data for trout roe is available for EU MS. However, during the initial planning of this study, it became apparent that isolating the trade flows of trout roe was impossible as it does not have its own code in the nomenclature used for recording imports and exports. Given that EU MS do not produce any notable amounts of salmon roe for human consumption, and that the trade of trout roe is indistinguishable from the trade of other roe for human consumption, this study consequently focuses mainly on non-EU countries' trade of salmon roe.

## 1.2 Methodology

The study is based on publicly available literature, research, press articles, and public/private data sources. Through contact details received from FEAP, the major producers of trout roe stakeholders in the EU that have been contacted and asked to contribute to the study. Four interviews were conducted, covering one trader of salmon roe, one producer of salmon roe, one producer of trout roe, and one FEAP member. Each stakeholder contributed with both general and specific insight regarding production, trade, and market outlets.

### 1.2.1 Russian war of aggression against Ukraine

Russia is one of the primary producers of salmon roe. At the initial planning phase of this study, several Russian stakeholders were mapped for a further interview to give insight into the market. However, due to the outbreak of the Russian war of aggression against Ukraine during the time of composing this report, no interviews with Russian stakeholders have been conducted.

### 1.2.2 Brexit

This report analyses data for the years period 2014-2020. The UK formally left the EU on 31st January 2020 and hereafter entered a transition period that lasted until 31st December 2020. Thus, the sake of consistency, the UK is excluded from the EU aggregate data. All mentions of the EU in this study refers to EU-27.

## 1.3 Data

### 1.3.1 Salmon roe production and wholesale data

Based on stakeholder interviews and expert insight, three countries have been identified as major producers of salmon roe, namely the USA, Russia, and Japan.

For countries where data on roe production data is not directly available, FAO has been used to estimate the production of salmon and trout. Although FAO numbers do not represent the production of salmon and trout roe, they give insight into the size of the production of the roe producing species.

### USA

For the USA production, data, the Alaska Department of Revenue Tax Division[3] had been used. The Department of Revenue publishes quarterly and annual reports on price and production of Alaskan salmon for the purpose of determining and collecting taxes.

The wholesale data is gathered from the Alaska Department of Revenue Tax Division's yearly price report. These price reports contain data in two formats, either divided by region or as an aggregated category "all areas". The "all areas" category is often larger than the aggregation of that listed as production in individual areas. This is due to confidentiality concern as production in certain areas might easily be linked to specific stakeholders, as such this production included in the total, but not on a disaggregated level. s. As a rule, the production for "all areas" is used. In instances where the aggregated value and volume are missing, the total is calculated based on the disaggregated production to find the weighted average prices. Data is gathered starting from the year 2015.

Wholesale prices are reported in USD/pound and manually converted to EUR/kg. The yearly average of the USD/Euro exchange rate, as reported by the European Central Bank, had been used for each respective year. The values are nominal.

### Japan

Japanese wholesale data was collected from Tokyo Metropolitan Central Wholesale Market. Wholesale prices are reported in Yen/kg., but manually converted to EUR/kg. The yearly average of the Yen/Euro exchange rate, as reported by the European Central Bank, has been used for each respective year. The values are nominal.

## 1.3.2 Trout roe production

EU production data on trout roe is gathered from Eurostat. The dataset used is "Production of fish eggs for human consumption from aquaculture" [4]. The data covers production in all EU MS. According to Regulation (EC) No 762/2008, aquaculture production means the output from aquaculture at first sale intended for human consumption. Non-commercial aquaculture is thus not accounted for.

Prices in the dataset are reported as average price per unit in the national currency and converted to EUR by Eurostat. The economic value of the production is calculated by multiplying the mean price with the quantity produced.

## 1.3.3 EUMOFA – data from IHS Markit on trade flows between third countries

EUMOFA collects monthly trade data reported by non-EU countries from IHS Markit. These data have been used when assessing the imports and exports of seafood roe products. Although IHS data are comprehensive, it must be underlined that imports and exports of goods are reported in accordance with the Harmonised System[5] (HS) and the Combined Nomenclature[6] (CN), which do not include detailed information on roe products. As such, it is not possible to identify the actual trade of trout roe as it does not have a unique code. Input from stakeholders indicate that trout roe may be exported under a variety

[3] http://tax.alaska.gov/programs/programs/reports/index.aspx?60624

[4] https://ec.europa.eu/eurostat/databrowser/view/fish_aq2b/default/table?lang=en

[5] World Customs Organization http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx

[6] Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common Customs Tariff

of codes depending on the exporter. Data on trade flows between non-EU countries are publicly available at MCS level on the EUMOFA website[7]

Salmon roe is the focus of the trade analysis, because the trade and price of salmon roe is considerably higher than that of trout roe, thus the former may be identified in trade statistics. Trout roe may be exported both under the code "caviar substitutes" which covers roe from a multitude of species or under codes used for salmon roe. Although the price range of trout roe is known (roughly half the price of salmon roe according to stakeholders), the price of trout roe is like other fish roe (excluding the high-priced sturgeon caviar). A price floor/ceiling would therefore not be effective in isolating the trade of trout roe.

Based on interviews with stakeholders, the use of trade codes for salmon and trout roe products varies between exporters. As such, the trade codes must be identified per exporting country based on stakeholder input and expert insight into the market. However, it should be noted that the trade presented in this chapter are estimates, as smaller amounts of salmon and trout roe could be exported under codes not included in this analysis.

The trade is analysed based on the known large producers of salmon roe for human consumption, namely the USA and Russia. As such, it can be assumed that most of the exports under the identified trade codes is salmon roe.

## USA

For the USA, three trade codes have been identified pertaining to the trade of salmon roe products for human consumption.

| Trade code | Description |
|---|---|
| **0303.91.4040** | Salmon roe (frozen). |
| **0305.20.4020** | Salmon roe (dried, smoked, salted or in brine). |
| **1604.32.0000** | Caviar substitute. |

## Russia

For Russia, four codes have been identified relating to the trade of salmon and trout roe. Although certain descriptions cover more than salmon roe, insight into the trade of Russian products indicates that most of most products are indeed salmon roe for human consumption.

| Trade code | Description |
|---|---|
| **1604.32.0010** | Sturgeon caviar substitutes: salmon caviar (red caviar). |
| **1604.32.0090** | Other sturgeon caviar substitutes. |
| **0303.91.9000** | Liver, eggs and milt, other (frozen). |
| **0305.20.0000** | Liver and roe fish, dried, smoked, salted or in brine. |

[7] Main Commercial Species are EUMOFA aggregates of CN and HS codes as part of the harmonisation rules. Read more about EUMOFA data management methodologies (https://www.eumofa.eu/supply-balance-and-other-methodologies) and harmonisation correlation tables (https://www.eumofa.eu/harmonisation)

According to the trade codes identified through IHS Markit, Russia exported an estimated total of 49.915 tonnes of salmon and trout roe at a value of over EUR 460 million in 2021. However, given that the Russian production of roe was estimated at roughly 30.000 tonnes in 2021 and more than half of this is used for domestic consumption, the export number is inflated due to the inclusion of other products than salmon roe.

The IHS Markit trade statistics reports significantly higher exports of salmon and trout roe to South Korea than to Japan. However, it is reasonable to assume that products other than salmon and trout roe are included in the selected trade codes. Russia exports the largest volumes of the trade code *0303.91.9000: frozen livers, roes, and milt*. In 2021, this category made up 97% of total exported volume and 95% of the value. Of the exports in this category, 79% of the volume was destined to South Korea, and 20% to Japan. However, the price of the exports to Japan are considerably higher than prices to South Korea. The weighted average price of exports of this commodity to Japan is 26,01 EUR/kg, while exports to South Korea average 4,78 EUR/kg. Given the much lower price of exports to certain markets, such as South Korea, it can be assumed that this commodity contains both lower grade salmon roe, roe from other fish, and other products. Therefore, the export from Russia to South Korea has been removed from the analysis.

**Table 1: Excluded IHS repored export of salmon and trout roe from Russia to South Korea (volume in tonnes, values in 1.000 EUR)**

| 2017 | | 2018 | | 2019 | | 2020 | | 2021 | |
|---|---|---|---|---|---|---|---|---|---|
| Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| 47.116 | 228.311 | 47.314 | 240.426 | 42.596 | 187.859 | 41.183 | 155.561 | 37.940 | 181.370 |

*Source: IHS Markit.*

### Japan

For Japan, the following trade codes have been identified as covering imports of salmon/trout roe for human consumption

| Trade code | Description |
|---|---|
| **0303.91.090** In use from 2017[8] | Livers and roes of fish (excluding nishin and tara), frozen. |
| **0305.20.030** | Hard roes of Salmonidae, dried, smoked, salted or in brine. |
| **1604.32.010** | Caviar substitutes (ikura), prepared or preserved. |

## 1.3.4 Other sources

Export data for Finland is collected from the online database available at the Natural Resources Institute of Finland (Luke). Data on export of roe for human consumption is collected from the dataset of imports and exports of fish and fish products. The volumes are in tonnes and values in 1.000 EUR.

8 0303.80 (Livers and roes of fish (excluding nishin and tara), frozen) in use from 2000-2012, then changed to 0303.90. 0303.90 (Livers and roes of fish (excluding nishin and tara), frozen), in use from 2012-2016, then changed to 0309.1.

# 2 AN INTRODUCTION TO SALMON AND TROUT ROE

This study is focused on salmon and trout roe for human consumption. Aside from caviar (lightly salted roe from sturgeons) salmon and trout is one of the most widely consumed and commercially important fish roe products. Salmon and trout roe ranges in colours from deep red to light orange, in contrast with the sturgeon caviar known for its black colour. The roe grains are also larger that roe from sturgeons.

In Japan, the process of creating salted roe skeins had a long history. In the early twentieth century, Russia introduced the products of granulated salmon roe[9]. Salmon and trout roe is also known as ikura (イクラ), a Japanese term based on the Russian word for fish roe, ikra (икра). Although ikura primarily refers to salmon roe, it may also cover trout roe[10]. During the Soviet era (1922-1991), salmon and trout roe became popular to distinguish the product from the better-known sturgeon caviar. The product was very popular, but the supply available by the producers in Russia and Japan did not meet the demand. During the 1960's, Alaska emerged as a viable supplier of salmon roe. With large supplies of wild salmon, Alaskan roe had typically been discarded as a by-product or used as bait. However, with Japanese investment in roe production, Alaska has today become one of the largest suppliers of salmon roe. Today salmon and trout roe have become popular products all over the world.

To increase its shelf-life, salmon and trout roe can be pasteurized without causing significant changes in taste. Pasteurized products may be lighter in colour and duller compared to non-pasteurised roe[11].

## 2.1 Salmon roe

High grade salmon roe should contain shiny and slightly transparent whole pearls. The grade of the roe is determined by the pearl size (with larger pearls being better), salt content (the less salt, the better), and drip (of which none is best).[12]

The density of the salmon roe differs depending on the fish it is produced from. Roe from aquaculture species is denser than roe from wild salmon, with more crunch and slightly more effort needed to bite through compared to the softer roe from wild salmon[13].

**Atlantic salmon** (*Salmo salar*)

Roe from Atlantic salmon for human consumption is primarily from salmon raised in aquaculture. As such, the production from Atlantic salmon is relatively small as fish is typically harvested before they reach sexual maturity. Roe from this species is typically a by-product of broodstock production, as the broodstock producers often have a larger production than the need for contingency. In most cases, the excess broodstock is not used for breeding and may therefore be used in production of roe for human consumption.

**Chinook/ King salmon** (*Oncorhynchus tshawytscha*)

Roe from chinook salmon is the largest of the salmon species. High grade roe has a size of 5 mm and up. Chinook/ King salmon is both a wild and farmed species but roe production for human consumption is produced from catches of wild Chinook.

[9] https://www.seafood-harvest.com/index.php/2021/02/04/ikura-aka-red-caviar/

[10] https://www.sushi-pedia.com/en/sushi/ikura/#Ovissipour%20et%20al.,%202018

[11] https://eeu-cdn.alaskaseafood.org/wp-content/uploads/2019/12/Roe-Guide.pdf

[12] https://eeu-cdn.alaskaseafood.org/wp-content/uploads/2019/12/Roe-Guide.pdf

[13] https://www.fishnet.ru/news/novosti_otrasli/roskachestvo-opublikovalo-rezultaty-issledovaniya-krasnoy-ikry-infografika-/

**Chum salmon** (*Oncorhynchus keta*)

Also known as Keta salmon, roe from this species has the second largest grain size of the salmon roe, with high grade pearls measuring 5 mm or larger in diameter. Chum salmon is the preferred roe for the Japanese market. This might be because of their own high catch rates of this fish and the familiarity with the product. Chum salmon is only available from Pacific salmon fisheries. The species is harvested in the late summer/autumn.

**Coho salmon** (*Oncorhynchus kisutch*)

Coho salmon is available both as a wild- and farmed species. In the wild environment, Coho is generally the last to spawn in the season. High grade roe of the species has a pearl size up from 4.5 mm and anything above.

**Pink salmon** (*Oncorhynchus gorbuscha*)

Pink salmon is only available from fisheries and is the most abundant salmon species in Alaska[14], and in Russia. The highest grade of carver pearls is 3,5 mm or larger in size [15].

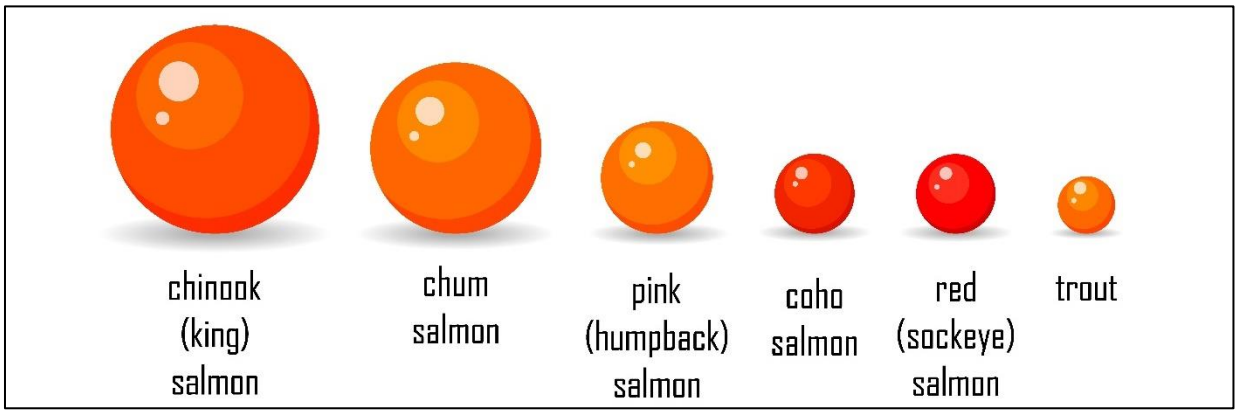
**Sockeye salmon** (*Oncorhynchus nerka)*

Roe from the Sockeye salmon roe is the smallest of from the salmon species. The roe is considered high grade if pearls measure 2.5 mm and up. The roe has a vibrant red colour. Most sockeye salmon are caught during the middle of summer. The sockeye roe can have a slightly bitter taste compared with other salmon roe[16]. Sockeye salmon is a wild salmon species.

## 2.2 Trout roe

Trout roe is primarily collected from farmed rainbow trout (*Oncorhynchus mykiss*). The roe from trout is smaller than the salmon roe, around 4 to 5 millimetres, but still larger than that of sturgeon. Trout roe has a "mild salmon flavour".

**Figure 1: Illustrative representation of size and coulor of salmon and trout roe types**




*Source: Shutterstock[17].*

[14] https://eeu-cdn.alaskaseafood.org/wp-content/uploads/2019/12/Roe-Guide.pdf

[15] Ibidm

[16] https://uifsa.ua/en/about-fish/advice-from-alaska-seafood/wild-salmon-caviar-of-alaska

[17] Photo by Ekaterina_Mikhaylova

# 3 PRODUCTION

Salmon and trout roe is processed in a similar fashion as caviar from sturgeons. In most cases the fish is slaughtered, and the egg sac is removed. However, for fish raised in aquaculture roe may be removed without killing the fish. Depending on the specific product demanded by customers, future processing may vary. The entire egg sac may be frozen whole and sold unprocessed. This is known as green roe. Alternatively, the eggs may be separated from the membrane and cleaned hereafter which salt/ or brine is added to the eggs.

Roe that has been salted can be sold in "buckets" or large plastic container for direct use, later repackaging, or repackaged directly into smaller containers as pasteurised items. The roe can also be smoked or used in other value-added products. The process of roe treatment is similar for salmon and trout.

## 3.1 Salmon roe

Most of the salmon roe is produced from wild salmon caught in nets. Given this, the majority of salmon roe production happens in countries with large stocks of wild pacific salmon such as the USA, Russia, and Japan and more marginally in Canada. A small minority of salmon roe comes from farmed Atlantic salmon in Norway and Iceland. Both are large producers of Atlantic salmon and produce some small quantities of salmon roe, mainly destined for the export market.

Salmon roe has a window of period where it is considered optimal for consumption. The roe gradually hardens to prevent breaking during the spawning. Hardened roe is not considered optimal for consumption. In Japan, fish with roe caught in this late stage is known as "ping-pong" salmon roe as it bounces away in the mouth[18].

The wild salmon captured will also be used for meat production. As such, fishers need to weight the quality of roe against the quality of meat because fish caught in an earlier roe development will have a higher quality of meat. However, capturing the fish too early likely means roe which is not yet mature. Consumers typically find more mature roe to be more desirable as these eggs have a higher fat content, a better mouthfeel, and generally are larger in size.

Salmon roe is graded by the industry on a scale from 1 to 3, where grade 1 (No. 1) is premium roe, grade 2 (No. 2) is standard grade, and grade 3 (No. 3) is industrial grade. The grade 1 roe can further be divided into hard- shell or soft-shell roe. The lower the grade of the roe, the longer the roe must soak in brine. This is because immature roe has a weaker shell and the salt acts as a stabiliser which prevents the shell from bursting and leaking[19].

### 3.1.1 USA

Salmon roe from the USA is primarily produced in Alaska. The main season for catches starts in July and ends in September. One interviewed fisher mentioned that salmon population size varies on a four-year cycle, with an increase in population size every four years. In 2021, a total of 13.335 tonnes of salmon roe was harvested in Alaska according to the Alaska Department of Revenue. Compared with 2020, which saw a lower catch of salmon, the production of roe increased by 83% in 2021.

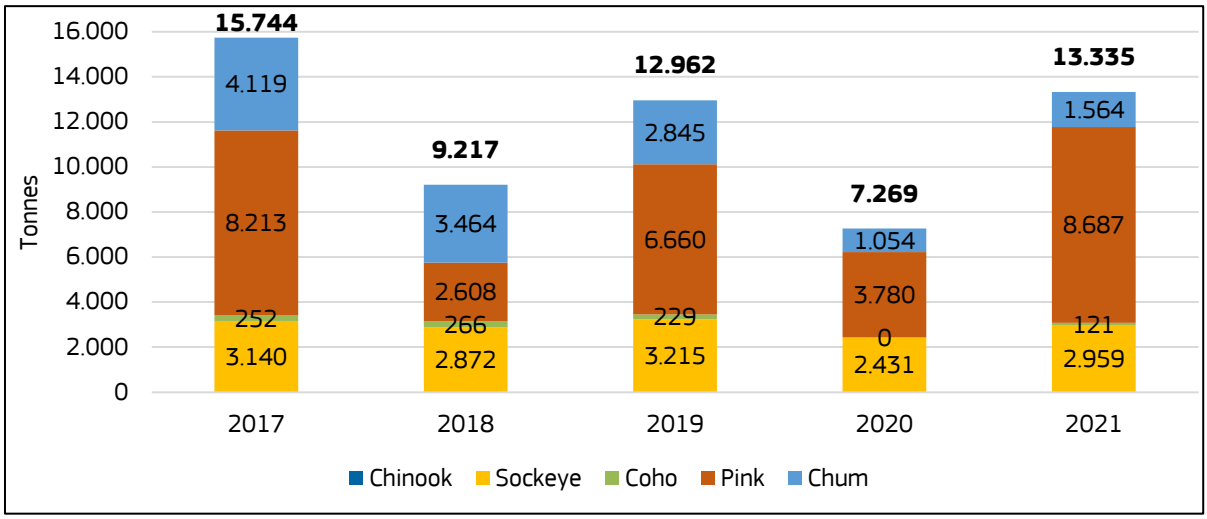
Except for 2019, pink salmon has made up most salmon catches over the last five years. The amount of Chinook salmon caught has decreased over the past five years, while shares of pink salmon have

[19] https://globalseafoods.com/blogs/news/red-caviar

increased. In 2021, the share of species used to produce roe was pink (65%), Sockeye (22%), Chum (12%), Coho (1%), and Chinook (<1%).

Over the past 10 years, stakeholders report a trend of smaller fish being caught, and that the number of productive places has been reduced. Now, the focus is on fishing in Bristol Bay and catches of pink salmon. The industry has also consolidated to consist of fewer but larger parties.

**Figure 2: Salmon roe production in Alaska by species**



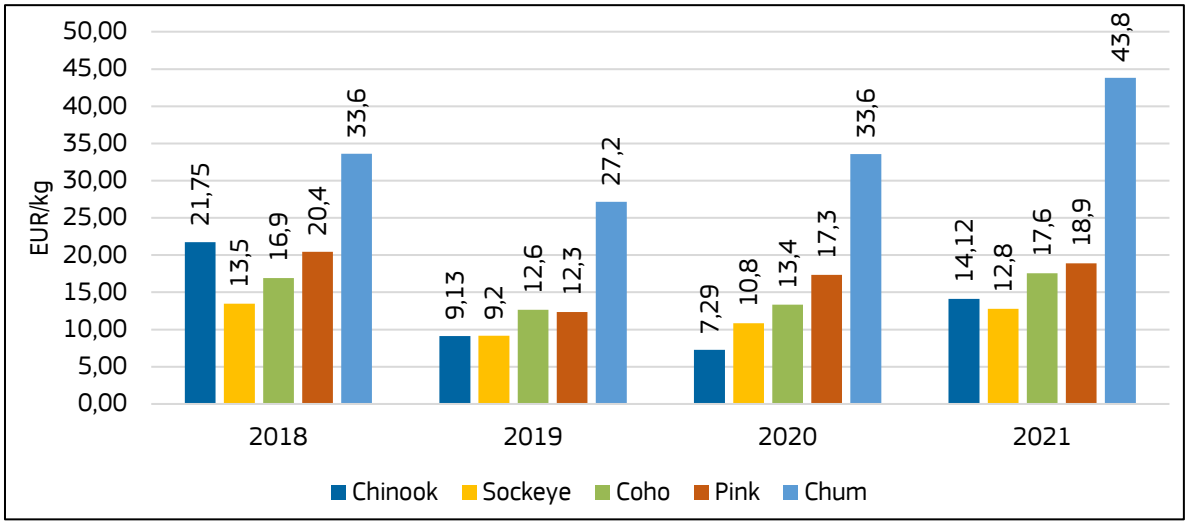

*Source: Alaska Department of Revenue*[20]

In the USA, roe from the Chum salmon is sold at the highest price and is the most popular ikura. Roe from chum salmon is also the most popular in Japan, perhaps because of their own familiarity with chum fishery.

Given that the Alaskan salmon roe is very popular in Japan, it has become common for Japanese technicians to travel to the USA and partake in the processing of roe according to the stakeholders interviewed. By having their own technicians handling the roe, Japanese buyers can ensure the roe is produced according to their standards which again can influence the branding of the product.

[20] http://tax.alaska.gov/programs/programs/reports/index.aspx?60624

**Figure 3: Wholesale prices of salmon roe from Alaksan salmon (weigthed average price)**




*Source: Alaska Department of Revenue*[21]

### 3.1.2 Russia

Russian statistics report 539.000 tonnes of Pacific salmon being caught in 2021. This was an increase of 80% compared to with 2020 and of 8,2% compared with 2019[22]. The production of salmon roe during 2021 was estimated to be 29.500 tonnes, nearly a doubling from the year prior[23].

For 2022 the quota for salmon catches was set at 332.000 tonnes, of which 190.000 tonnes for pink salmon and 90.000 tonnes for Chum salmon[24]. On the 1st of March, new veterinary and sanitary rules came into force, entailing that a veterinary must be present during the salmon roe salting[25]. Stakeholders, worry that this requirement may lead to decrease in production as much of the production of salmon roe happens in remote and hard to reach areas, and thus higher prices[26].

[21] http://tax.alaska.gov/programs/programs/reports/index.aspx?60624

[22] https://www.fishnet.ru/news/rynok/v-rosrybolovstve-ocenili-riski-deficita-i-rosta-cen-na-ikru/

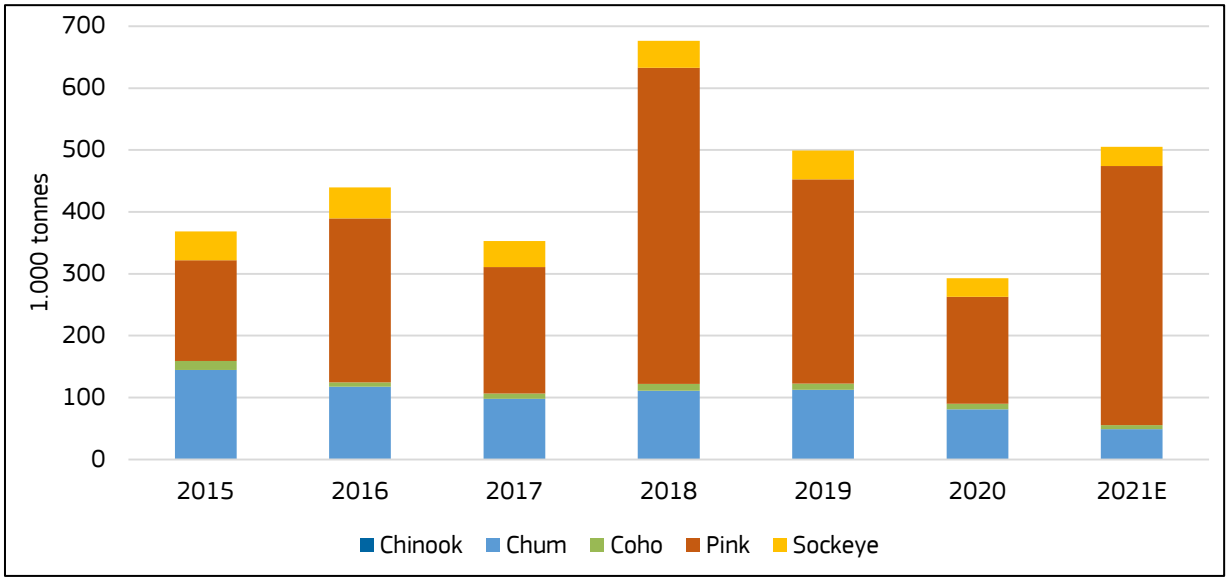
[23] https://www.fishnet.ru/news/rynok/glava-rosselhoznadzora-ceny-na-krasnuyu-ikru-mogut-povyshatsya-iskusstvenno/

[24] https://www.fishnet.ru/news/novosti_otrasli/vypusku-krasnoy-ikry-grozyat-novye-pravila-ekspertizy/

[25] *Ibidem*

[26] *Ibidem*

**Figure 4: Russian catches of salmonids**




*Source: Pacific Salmon Commission/Kontali Analyse*

In 2021, the fishing season in Russia was considered successful and catches were high compared with 2020. Thus, due to more salmon roe available in the market, the price achieved by producers dropped by 20%-25%. Through 2021, the price of salmon roe has increased, although it seems that most of the increase occurred at retail stage. The price achieved by the fisher/producer is usually around half of the final cost of the product. In 2021, salmon roe prices rose from around 40,00 EUR/kg – 42,00 EUR/kg at the start of the year and to more than 53,00 EUR/kg at the end of the year. At the start of 2022, it was reported that salmon roe producers requested retail buyers to increase their prices by 7%-30% (mark-up determined by product type)[27]. The inclination behind the price increase was high demand and an increased cost of logistics.[28]

### 3.1.3 Japan

In 2020, FAO reports a catch of 96.581 tonnes of salmonids in Japan, a slight increase (+1%) from 2019, but still lower than the catches of the past 10 years. Nearly all the salmonid volumes caught in 2020 was Chum salmon (93%). The remaining 7% included pink salmon (3%), Sockeye salmon (2%) and Masu/Cherry salmon (2%).

The autumn fishing season in 2021 was poor for the Japanese fisheries, causing a price increase for the second half of the year. The catch in Hokkaido primarily during September and October covers nearly 90% of all salmon catches in Japan[29]. Higher water temperatures are thought to be one of the reasons for the poor catch season, in addition to red waves (out of control algae growth) killing salmon and other marine life. [30]

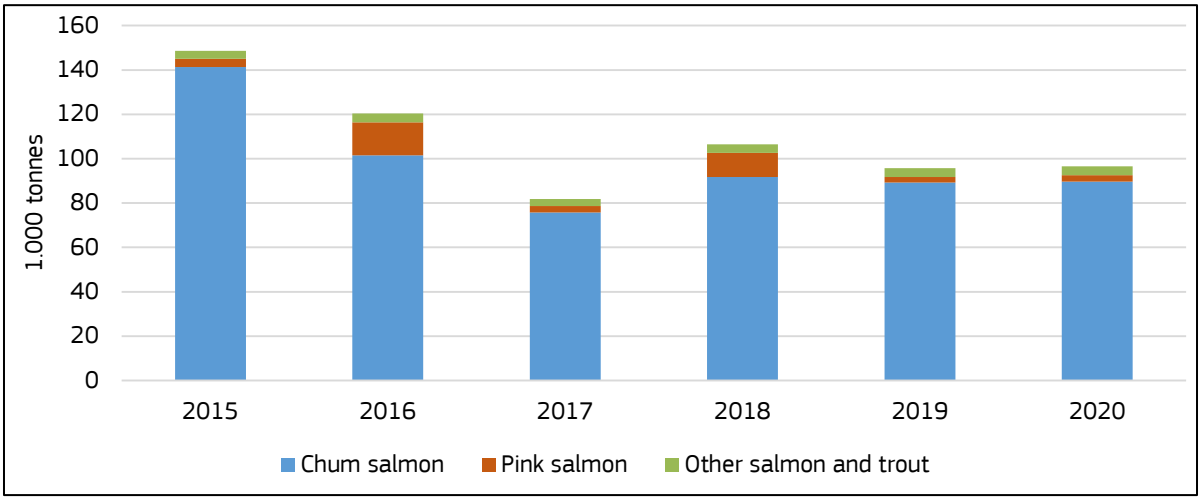
[27] https://www.fishnet.ru/news/rynok/v-rosrybolovstve-ocenili-riski-deficita-i-rosta-cen-na-ikru/

[28] *Ibidem*

[29] https://www.gyoren.net/ikura-shun

[30] https://salmonbusiness.com/prices-in-japan-surge-as-red-tides-devastate-marine-life-in-hokkaido/

**Figure 5: Catches of salmon and trout in Japan**




*Source: FAO*

## 3.2 Trout roe

The production of trout roe is like that of salmon roe. In contrast to salmon roe, trout roe is primarily supplied by aquaculture producers. According to a producer, the roe is collected from trout of around 1-2 kg, and at the time of harvest; the roe represents around 10% of the total fish weight. From the roe, green roe, hard-shell and softshell ikura, and sujiko can be produced depending on the demand. Roe may also be removed from the trout through "milking", a process where roe is massaged out of the fish. This process allows roe to be collected from a fish over several cycles. However, some claim this process changes the texture and taste of the roe.

Green row, a raw material, may be sold to processors who wish to produce soft shell ikura. The green roe is frozen in a plate freeze immediately after being removed and typically packed in blocks and sold bundled together in a carton[31].

Hard-shell ikura is produced as the trout is ready for spawning. Soft shell roe is processed from the raw material and can be produced throughout the year. Soft shell ikura is sold at a lower price than hard shell ikura and, due to its constant availability, it is primarily sold to the HoReCa segment on a global scale[32]. Soft shell ikura is commonly sold frozen and may be sold in sizes ranging from 50 g to 1 kg.

Trout roe may also be sold as sujiko, where the entire egg skein is removed. To produce sujiko, the skein should be removed early in the maturity, while the meat quality of the fish is still good[33]. This product is typically sold to Japan, and buyers often send their own technicians to ensure that the production is according to their specifications.

According to FAO, the largest producers of trout in 2020 was Iran, Turkey, and Norway. With a high aquaculture production of trout, there is likely to also exist extraction of roe for human consumption. However, no data has been found to indicate the volume or value of trout roe in third countries. A large production of trout is not necessarily synonymous with a large production of trout roe. For example, Finland has the highest production of trout roe in the EU, but produces less trout than France, Italy and Denmark.

[31] One producer reports selling green roe master cartons consisting of 3x7,5 kg blocks.

[32] https://www.aquapri.dk/our-products/trout-caviar

[33] https://www.svanoyhavbruk.no/fou

**Table 2: Global aquaculture production of trout (volume in 1.000 tonnes, value in EUR 1.000)**

| | 2016 | | 2017 | | 2018 | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| Iran | 163 | 490 | 168 | 503 | 180 | 719 | 188 | 752 | 197 | 789 |
| Turkey | 107 | 275 | 110 | 261 | 114 | 285 | 126 | 351 | 147 | 391 |
| Norway | 88 | 438 | 67 | 374 | 68 | 376 | 83 | 395 | 96 | 402 |
| Russia | 29 | 202 | 34 | 237 | 35 | 247 | 45 | 317 | 91 | 691 |
| Chile | 85 | 694 | 77 | 831 | 78 | 744 | 82 | 722 | 88 | 764 |
| Peru | 52 | 192 | 55 | 165 | 64 | 192 | 51 | 198 | 54 | 198 |
| China | 35 | 97 | 41 | 114 | 39 | 106 | 39 | 109 | 38 | 104 |
| France | 36 | 144 | 36 | 154 | 34 | 148 | 37 | 154 | 37 | 155 |
| Italy | 37 | 117 | 37 | 119 | 34 | 127 | 39 | 136 | 34 | 120 |
| Denmark | 31 | 113 | 33 | 125 | 30 | 120 | 31 | 118 | 33 | 125 |
| Other | 200 | 878 | 207 | 975 | 207 | 1.026 | 205 | 993 | 206 | 992 |
| **Total** | **863** | **3.639** | **864** | **3.860** | **885** | **4.089** | **927** | **4.244** | **1.022** | **4.732** |

*Source: FAO*

According to Eurostat, EU MS produced a total of 998 tonnes of trout roe in 2020 for a value of roughly EUR 16 million. This was an increase of 12% in terms of volume and 1% in terms of value when compared to 2019. However, when compared to 2016 the production volume has decreased by 11% while the value of production has increased by 9%.

**Table 3: Production of trout roe by EU MS (volume in tonnes, value in 1.000 EUR)**

| | 2016 | | 2017 | | 2018 | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| Finland | 469 | 5.211 | 465 | 6.840 | 424 | 6.851 | 390 | 6.693 | 417 | 4.779 |
| Denmark | 514 | 7.385 | 525 | 8.691 | 564 | 10.525 | 324 | 5.615 | 377 | 7.074 |
| France | 99 | 1.768 | 103 | 1.896 | 117 | 2.182 | 111 | 2.328 | 110 | 2.412 |
| Spain | 28 | 410 | 28 | 428 | 36 | 554 | 36 | 593 | 64 | 1.066 |
| Italy | 1 | 49 | 11 | 473 | 12 | 446 | 16 | 576 | 13 | 475 |
| Estonia | 5 | 128 | 4 | 115 | 3 | 101 | 6 | 160 | 11 | 292 |
| Poland | 2 | 55 | 3 | 123 | 3 | 190 | 7 | 284 | 5 | 270 |
| Germany | 3 | 137 | 2 | 92 | 2 | 94 | 2 | 99 | 2 | 89 |
| **Total** | **1.121** | **15.143** | **1.142** | **18.657** | **1.161** | **20.942** | **891** | **16.348** | **998** | **16.456** |

*Source: Eurostat*

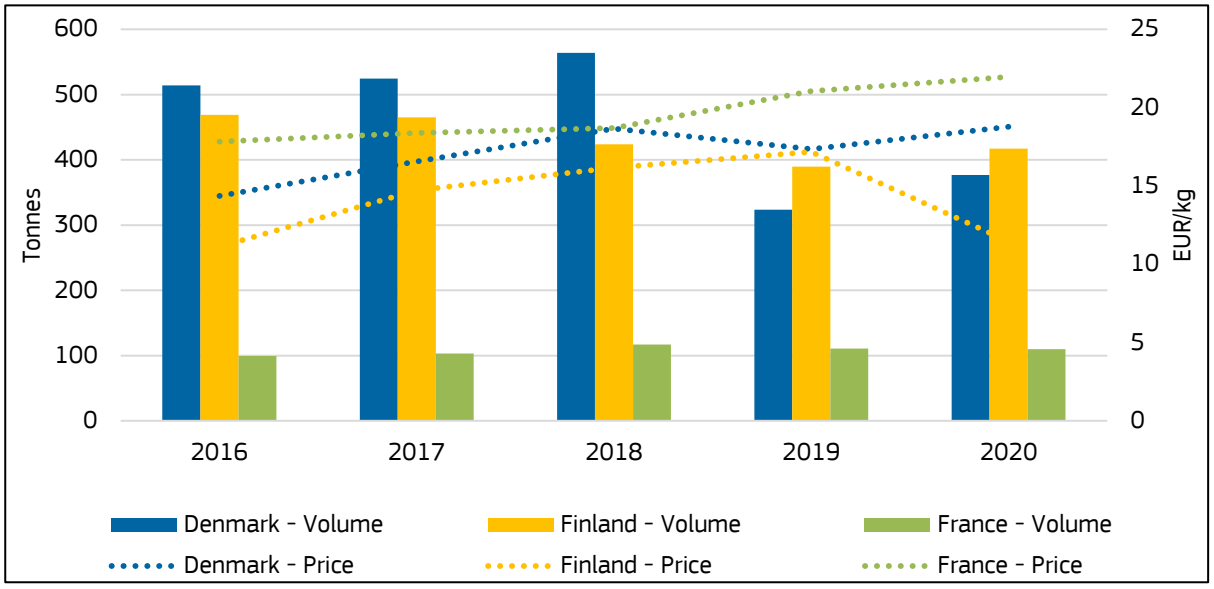
The largest producers of trout roe in the EU are Finland, Denmark, and France. Together these countries cover 91% of the total EU production. Traditionally Denmark has been the largest producer of trout roe, however Finland surpassed them in 2019.

In 2020, Finland produced a total of 417 tonnes trout roe for a value of nearly EUR 5 million. This was an increase in volume of 7% compared with 2019 but the value was 29% lower than the previous year. Despite being the largest producer, the farmgate price of Finnish trout roe was the lowest of all EU MS (11,46 EUR/kg). The highest prices in 2020 were observed for Germany (55,67 EUR/kg), Poland (50,36 EUR/kg), and Italy (36,00 EUR/kg).

In 2020, Denmark produced 377 tonnes of trout roe for a value of roughly EUR 7 million. The production of trout roe has fluctuated over the last four years, while the price reached a peak in 2020. France

produced 110 tonnes of salmon and trout roe at a total value of EUR 2,4 million in 2020. This was a reduction of 1% in volume, but an increase of 4% in value from 2019.

**Figure 6: Volume and price of trout roe production by top 3 EU MS**




*Source: Eurostat*

According to the data provided by Eurostat, 89% of the production of trout roe by EU MS in 2020 was from rainbow trout roe and 11% was roe from trout nei. All the production of trout roe from trout nei found place in France. Cross checking production of trout roe with the FAO production of trout, nearly all the French production of trout is rainbow trout (and minor amounts of sea trout). As such it can be concluded that nearly all trout roe produced in France is from rainbow trout. Overall, this suggests that nearly all (99,5%) of trout roe production in the EU is from rainbow trout, while production of trout roe from Brook trout, Chars nei and Sea trout is negligible.

# 4 TRADE

As stated in the methodology section, identifying the actual trade of salmon and trout roe is challenging as the trade codes used for salmon and trout roe may also cover products other fish roe. As such, only a general analysis can be made regarding trade.

## 4.1 USA Export

In 2021, the USA exported an estimated 12.699 tonnes of salmon and trout roe at a value of nearly EUR 191 million. Compared with 2020, the export volume was 54% higher and the value 87% higher. Given the production of 13.335 tonnes in Alaska in 2021, this leads to assume that nearly 95% of salmon roe produced in the USA is exported.

The majority or roe exports in 2021 (69%) was destined to Japan, with some amounts also going to Ukraine (10%) and Germany (8%). This follows the trend seen over the past five years.

Nearly all the salmon roe exported from the USA is frozen (92%) while the share of other identified commodity codes (dried/smoked/salted/in brine and caviar substitutes) were the same in 2021, with 4% each.

**Table 4: Estimated US exports of salmon and trout roe by destination (volume in tonnes, values in 1.000 EUR)**

| Destination | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| Japan | 9.487 | 130.774 | 6.141 | 96.537 | 7.359 | 71.779 | 5.263 | 67.218 | 8.754 | 132.246 |
| Ukraine | 649 | 9.532 | 480 | 6.013 | 1.210 | 12.883 | 1.030 | 13.020 | 1.324 | 18.498 |
| Germany | 793 | 13.786 | 469 | 9.783 | 1.271 | 16.664 | 354 | 5.207 | 1.036 | 18.068 |
| Lithuania | 1.139 | 13.310 | 101 | 940 | 946 | 7.635 | 343 | 3.211 | 622 | 7.709 |
| Other | 2.097 | 35.932 | 1.960 | 34.903 | 1.649 | 22.481 | 1.230 | 13.300 | 964 | 14.066 |
| **Total** | **14.165** | **203.333** | **9.150** | **148.177** | **12.435** | **131.442** | **8.221** | **101.957** | **12.699** | **190.587** |

*Source: IHS Markit*

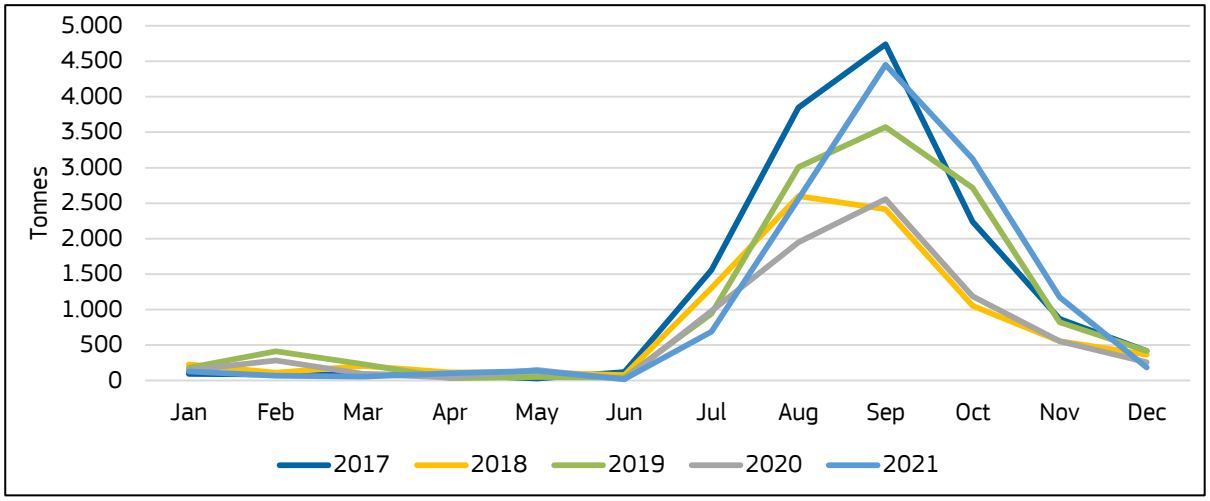
The prices achieved by salmon roe export vary depending on the type of roe being sold. In 2021, roe from Chum could sell for up to 72,00 EUR/kg, while roe from pink salmon was sold for slightly less at 64,00 EUR/kg (grade No. 1). The prices of salmon roe have greatly increased in 2021 compared with 2020. In 2020, Chum salmon was sold at around 54,00 EUR/kg for grade No. 1, while grade No. 2 roe was sold at prices between 45,00 EUR/kg and 47,00 EUR/kg, while pink salmon roe was sold for around 41,00 EUR/kg for grade No. 1 and 39,00 EUR/kg for grade No. 2.

The reason why Chum roe is sold at a higher price than pink roe, is likely since Japanese customers prefer the former as they themselves have their own stock of this fish and are familiar with it. Also, Chum salmon is larger than that of pink, and thus easier to separate into ikura. As the catches of King salmon are very low, Chum roe is the next option as it has the second largest grains.

One stakeholder reported that traditionally frozen green roe has been sent to Russia for further processing. However, given the current sanctions against Russia there will likely be a shift in the market with the green roe going elsewhere or being processed in the USA.

Exports of salmon and trout roe from the USA are highly seasonal, with most exports happening between August and October. This seasonality coincides with the Alaskan spawning season

**Figure 7: Exports of salmon and trout roe from the USA**




*Source: IHS Markit*

## 4.2 Russia Export[34]

Russia exported an estimated 11.975 tonnes of salmon and trout roe at a value of nearly EUR 280 million in 2021. This was an increase of 174% in terms of volume and 320% in terms of value when compared with 2020.

The majority (81%) of the volume exported in 2021 was destined for Japan. The remaining exports primarily went to old former Soviet countries such as Belarus (7%) and Ukraine (6%). This is a change from 2020 when only 60% of the exports were destined for Japan, while 26% of the volume went to Ukraine and 13% went to Belarus.

**Table 5: Estimated Russian exports of salmon and trout roe by destination (volume in tonnes, values in 1.000 EUR)**

| Destination | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| Japan | 1.665 | 27.360 | 5.000 | 65.405 | 3.297 | 45.562 | 2.600 | 53.328 | 9.720 | 252.824 |
| Belarus | 488 | 4.274 | 500 | 4.987 | 243 | 3.598 | 582 | 3.823 | 817 | 6.311 |
| Ukraine | 376 | 1.623 | 447 | 1.934 | 584 | 2.554 | 704 | 3.645 | 702 | 4.941 |
| Kazakhstan | 57 | 1.145 | 112 | 1.261 | 130 | 2.052 | 187 | 1.887 | 140 | 2.500 |
| Germany | 0 | 0 | 5 | 161 | 24 | 658 | 14 | 170 | 110 | 3.540 |
| China | 259 | 2.622 | 356 | 3.422 | 203 | 2.050 | 40 | 480 | 93 | 1.609 |
| Other | 426 | 5.795 | 527 | 6.382 | 421 | 5.573 | 283 | 3.718 | 486 | 9.437 |
| **Total*** | **3.012** | **40.197** | **6.591** | **80.129** | **4.698** | **59.997** | **4.369** | **66.571** | **11.975** | **279.554** |

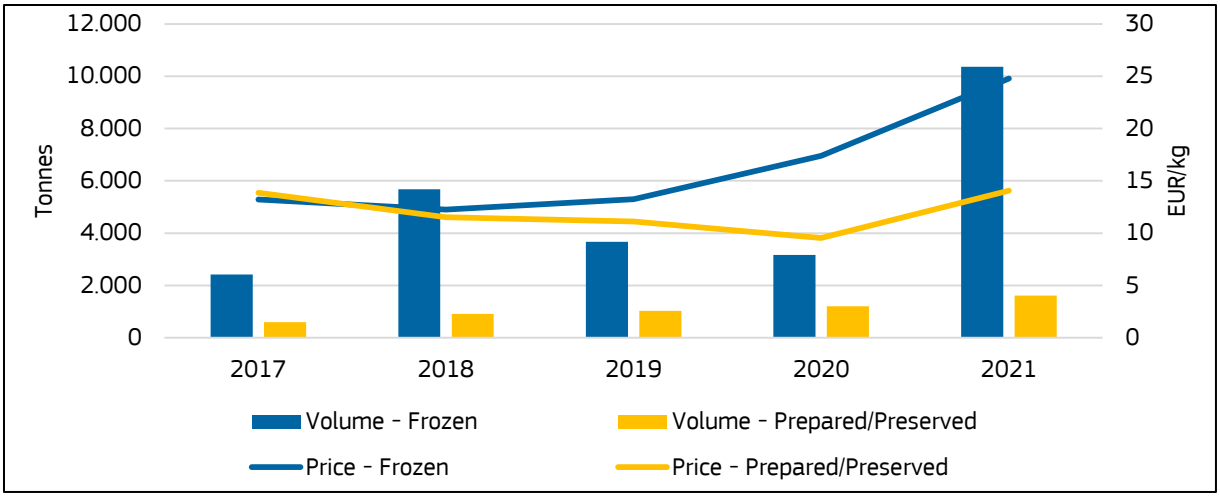
**Exports to South Korea have been removed, see methodology chapter 1.3.2*

*Source: IHS Markit*

[34] This chapter reflects the market situation prior to the Russian war of aggression against Ukraine and as such portrays a market situation which may not align with the current status.

Nearly all the salmon and trout roe from Russia to Japan was exported as frozen. Conversely, salmon and trout roe destined for areas geography closer to Russia (such as Belarus, Ukraine, Kazakhstan, and Germany) was primarily prepared or preserved in some form.

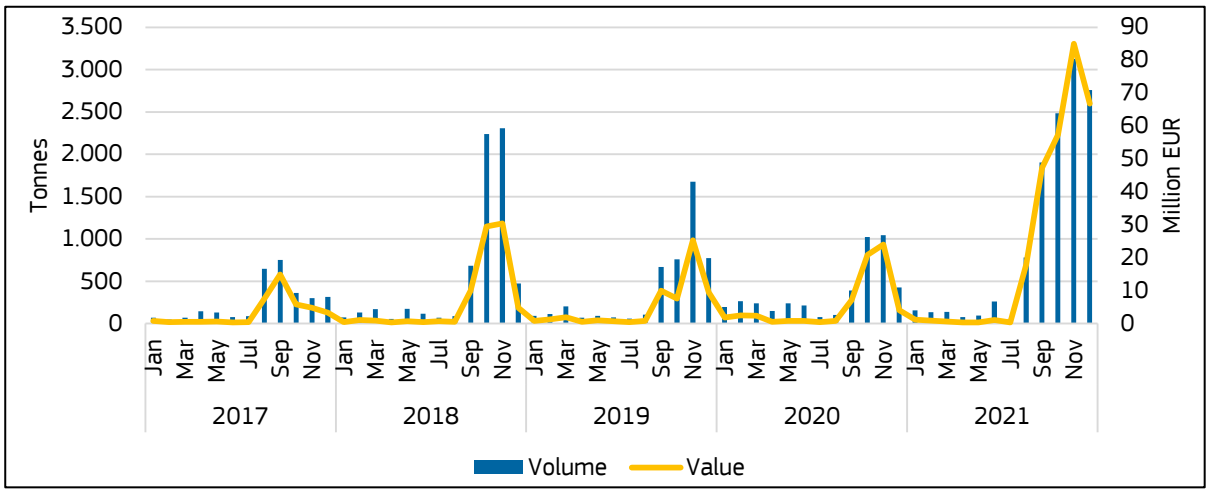
**Figure 8: Estimated Russian exports of salmon and trout roe by preservation state (weighted average prices)**




*Source: IHS Markit*

Russian salmon and trout roe exports are clearly seasonal, with peaks occurring from autumn to the end of year, coinciding with the salmon spawning season.

**Figure 9: Estimated Russian export of salmon and trout roe**




*Source: IHS Markit*

## 4.3 Trade of trout roe

According to stakeholders, trout roe is sold at roughly half the price of salmon roe. According to industry players, demand for trout roe rises when the availability of salmon roe is limited, or the price has increased.

The largest producer of trout roe in the EU, Finland, does not publish trade data directly covering this product but an aggregated category of roe for human consumption. However, according to Eurostat, rainbow trout roe is the only one produced commercially for human consumption in 2019 and 2020, while small amounts of roe from other marine fishes was produced in 2017 and 2018. For the years

2017 and 2018 the production of roe for human consumption was 6 tonnes and 4 tonnes respectively, with the producing species only listed as marine fishes. As the export data only shows an aggregate of roe exports, it is possible that part of the salmon and trout roe exported in 2017 and 2018 are from other marine species, not rainbow trout. Some of the production of roe from marine fishes could be consumed domestically and not exported, as such the actual export of this product could vary from nothing up to the production of 6 and 4 tonnes respectively. However, most of the Finnish export of roe and roe products is trout roe. In 2021, it is estimated that Finland exported a total of 263 tonnes of trout roe at a value of nearly EUR 6 million. Given that the production of trout roe was 417 tonnes in 2020, this means an estimated 63% of Finish trout roe was exported.

**Table 6: Finland exports of roe for human consumption (volume in tonnes, values in 1.000 EUR)**

| Partner country | 2017* | | 2018* | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| Estonia | 27 | 491 | 93 | 2.007 | 111 | 2.744 | 129 | 2.681 |
| Japan | 44 | 1.018 | 14 | 472 | 18 | 737 | 35 | 876 |
| Latvia | 4 | 59 | 8 | 190 | 27 | 626 | 38 | 826 |
| Sweden | 0 | 0 | 22 | 626 | 22 | 615 | 16 | 451 |
| Ukraine | 0 | 0 | 21 | 322 | 11 | 160 | 24 | 486 |
| Belarus | 0 | 0 | 41 | 639 | 10 | 128 | 0 | 0 |
| Other | 1 | 208 | 8 | 359 | 10 | 387 | 21 | 567 |
| **Total** | **76** | **1.776** | **207** | **4.615** | **209** | **5.397** | **263** | **5.887** |

** A small part of the volumes and values created this year could be due to the roe of other marine species, not just rainbow trout. Source: Natural Resources Institute of Finland (Luke)*

In Denmark, according to stakeholders, approximately 90% of the trout roe produced is exported, mostly to other European countries and Asia, primarily Japan. The remaining 10% is delivered to HoReCa and Danish fish processing industry. The product is mainly supplied to Western Europe and the USA and is considered a premium product. Most of the hard-shell ikura is sold in fresh in 10 kg buckets to other processors who repackage and brand the product[35].

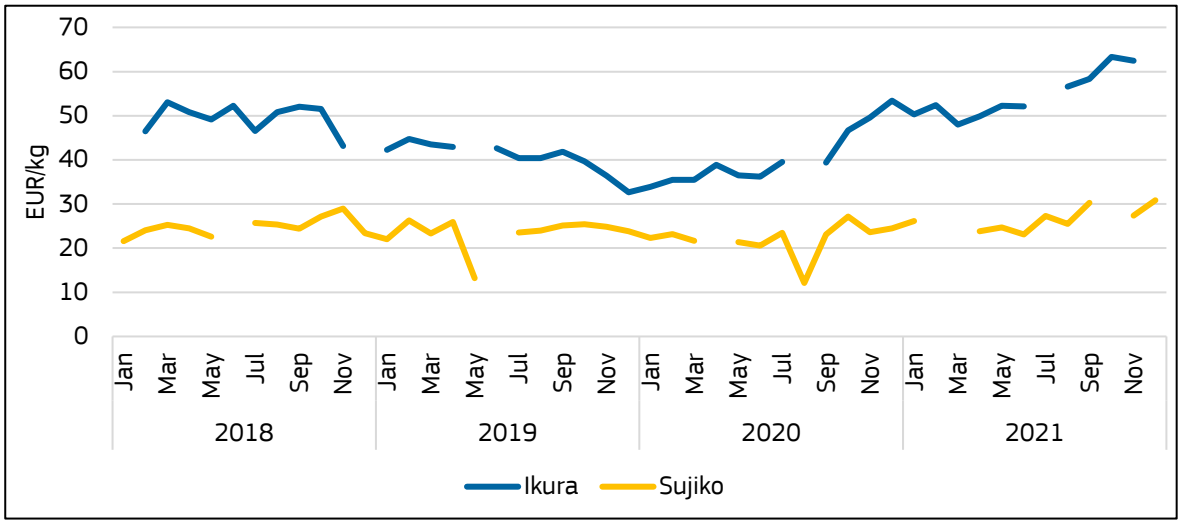
[35] https://www.aquapri.dk/our-products/trout-caviar

# 5 MARKET TRENDS IN JAPAN AND CONSUMPTION

## 5.1 Market trends in Japan

As the largest importer of salmon and trout roe, the market dynamics in Japan reflect the global dynamics of the salmon and trout roe market. The wholesale price of ikura in Japan has been rising over the last years, in October 2021, it reached a peak of 63,00 EUR/kg.

**Figure 10: Wholesale prices of ikura (weighted average price in EUR/kg)**




*Source: Tokyo Metropolitan Central Wholesale Market*[36]

Japan has specific trade codes dedicated to the import of salmon and trout roe, under the names ikura and sujiko. Due to changes in trade codes, analysis will not extend to prior 2017.

In 2021 Japan imported an estimated 19.780 tonnes salmon and trout roe at a value of EUR 438 million. This was an increase of 57% in terms of volume and 101% in terms of value when compared with 2020. Since 2017 the volume of imports has increased by 10% while the value is 33% higher.

The USA was the largest origin country for salmon and trout roe imports, as it covered 48% of the Japanese imports volume and 38% of the value in 2021. They were closely followed by imports from Russia which covered 45% of the volume and 57% of the value. It can be assumed that most of the imports from Denmark is trout roe, while for the other nations it is primarily salmon roe.

[36] https://www.shijou.metro.tokyo.lg.jp/

**Table 7: Estimated Japanese imports of salmon and trout roe by origin country (volume in tonnes, value in 1.000 EUR)**

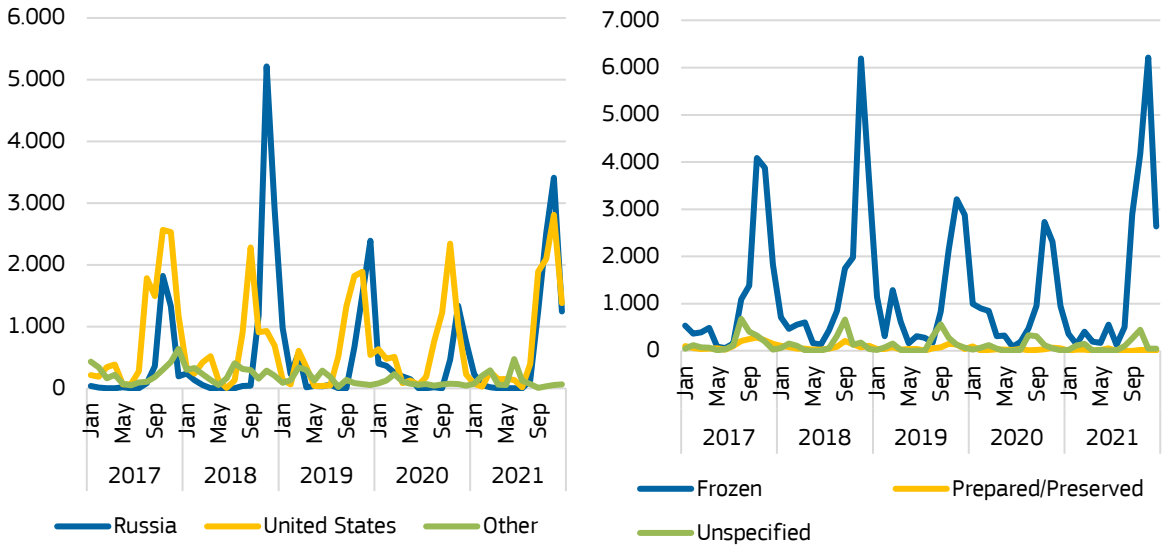
| Origin country | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Value | Volume | Value | Volume | Value | Volume | Value | Volume | Value |
| USA | 11.085 | 197.448 | 7.502 | 134.537 | 7.377 | 91.821 | 7.654 | 107.289 | 9.409 | 165.268 |
| Russia | 3.852 | 85.242 | 9.810 | 164.592 | 6.498 | 101.575 | 3.930 | 89.769 | 8.860 | 247.413 |
| Iceland | 1.446 | 9.041 | 1.389 | 7.351 | 519 | 3.911 | 109 | 666 | 596 | 7.755 |
| Denmark | 334 | 6.544 | 454 | 10.374 | 358 | 9.564 | 372 | 9.469 | 479 | 11.671 |
| Canada | 464 | 12.069 | 247 | 4.646 | 111 | 1.837 | 42 | 845 | 159 | 2.057 |
| Other | 788 | 18.725 | 799 | 16.737 | 832 | 14.470 | 515 | 9.662 | 277 | 3.395 |
| **Total** | **17.969** | **329.069** | **20.201** | **338.237** | **15.696** | **223.178** | **12.623** | **217.700** | **19.780** | **437.559** |

*Source: Japan Customs*

The import of salmon and trout roe shows clear seasonality, with peaks in August, September, and October. There are also some smaller peaks in March.

Due to seasonality of the fisheries, imports from the USA usually peaks a bit before Russia, arriving in the period September to November, while Russian imports usually peak slightly later, in November and December. The exception to this was in 2021, when imports peaked from both countries in November. Nearly all (93%) of salmon roe imports in Japan are frozen.

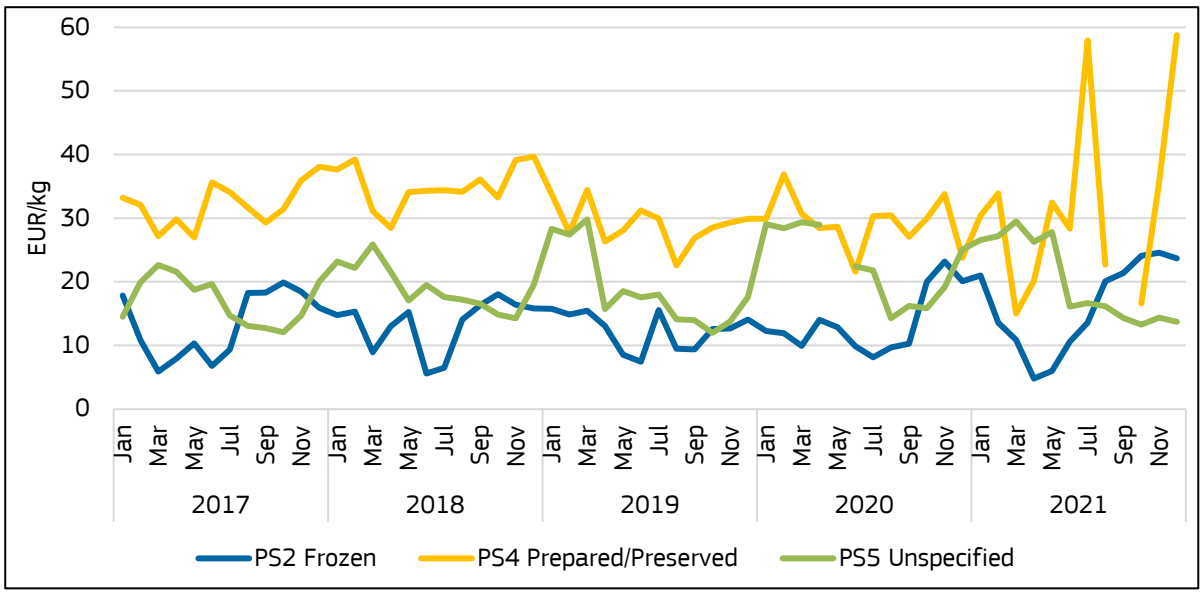
**Figure 11: Japan imports of salmon and trout roe for consumption by origin country (left) and preservation state (right), (volume in tonnes)**




*Source: Japan Customs*

As seen in Figure 12, prices rose significantly in end-2021. The high prices in December were achieved by imports from France (65,92 EUR/kg), Denmark (63,85 EUR/kg), and Canada (58,72 EUR/kg), and specifically concerned imports of prepared and preserved salmon and trout roe. It should be noted however, that the total import volume of from France, Denmark, and Canada were relatively low, totalling 27 tonnes. As such the prices are not representative for most products imported. Imports from the Russia and the USA made up most of the volumes, 1.248 tonnes and 1.380 tonnes respectively. Frozen product from Russia and USA achieved prices of 25,06 EUR/kg and 23,05 EUR/kg respectively.

**Figure 12: Price development (weighted average price) for imported salmon and trout roe products in Japan**




*Source: Japan Customs*

The stock levels of frozen salmon roe in Japan at the start of 2022 was estimated to be around 6.000 tonnes, which was around 25% higher than in 2021. The reason for the increased supply was a strong increase in the supply of frozen salmon and trout roe from Russia. In March 2022, the consumption of salmon and trout roe in Japan was high, and the salmon and trout roe inventory decreased by around 7% falling to below 5.670 tonnes. This is still 55% higher than the inventory volume in March the previous year.

## 5.2 Consumption

Salmon and trout roe is typically used as garnish on meals, sandwiches, and sushi among others. Salmon and trout roe varies in appearance and flavour depending on the fish species. In general, trout roe is considered milder in flavour than roe from salmon.

There are some differences in preferences for salmon and trout roe according to stakeholders. In Europe, the size and appearance of the roe is considered important, and consumers typically prefer hard shell, while in Japan smaller grain soft shell roe is more attractive[37]. In Japan, many buyers also prefer to buy sujiko (roe in skeins), to make their own soy pickled salmon row.

Given Japan's estimated 20.000 tonnes import of salmon and trout roe in addition to their own production of salmon roe, this country has the largest consumption of salmon and trout roe in the world. Typically, salmon and trout roe are served with sushi, rice, and sashimi.

In Russia, the domestic demand for salmon roe is estimated between 16.000 and 18.000 tonnes[38]. Given an estimated salmon roe production of 29.500 tonnes in 2021, this means that between 54% and 61% of Russian production of salmon roe is destined for domestic consumption. As such, the domestic demand is met through local production and the remaining roe can then be exported. In Russia and many of the former Soviet countries, salmon and trout roe has an especially prominent place during New Year Eve or other celebrations. The salmon and trout roe is typically served on blini, bread, or tartlets and by tradition it is often served with cold vodka.

Traditional Alaskan cuisine include compacting and drying whole salmon roe skeins into a cheese-like product and fermented salmon roe (also called stink eggs)[39].

According to stakeholders, in the EU, salmon and trout roe is typically served as a holiday meal but also on occasions as way to add a luxury touch to food. The salmon and trout roe is typically served alone or as part of appetizer (for example on tartlets, canapes, and eggs) or as garnish, for example on sushi.

[37] https://royalcaviar.com/en/fish-roes/-salmon-roe-17.html

[38] https://www.fishnet.ru/news/rynok/v-rosrybolovstve-ocenili-riski-deficita-i-rosta-cen-na-ikru/

[39] Bledsoe GE, Bledsoe CD, Rasco B. Caviars and fish roe products. Crit Rev Food Sci Nutr. 2003;43(3):317-56. doi: 10.1080/10408690390826545.

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