

## **Fish Leather a Traditional Crafts and Industrial Goods**

Dr. Alois Georg Püntener\* and Anatol Donkan\*\*

\*VESLIC Association of Swiss Leather Chemists and Technologists

c/o Alois Puentener  
Pulverweg 13  
CH-4310 Rheinfelden  
veslic@hotmail.com

\*\*Fish Leather Museum Association Germany

c/o Anatol Donkan  
Spitalgasse 1  
D-94234 Viechtach

### **Abstract:**

Fish skin leather is known to have been produced since immemorial times but only in small quantities in moderate temperate regions with a healthy state of the fish resources. It was basically a woman's handicraft employment mostly kept as family or clan secret, forgotten and reinvented by artist to stimulate art and fashion.

Although worldwide production of fish leather is insignificant it has been recognized as trendsetter in terms of providing unique fashion accessories. This should not be underestimated in light of giving decisive stimuli to progressive trends in commercial leather production.

In some countries, specialized tanneries have been emerged, but the driving force to get involved in these rediscovered trade remains the field of handcraft activity. Fish leather has a lot of potential. It is strong as cow leather, exotic as snake skin, lightweight and tear-resistant. It is the most exciting leather to have appeared in the fashion world in the last 20 years. Commercial upscale production is extremely difficult; every fish is different with extremely sensitive skin. Fish farming is becoming more and more popular enabling better uniformity and consistency in skin production for commercial applications compared to traditional fishing.

These enablers have opened up new opportunities for tanners, designers and investors in trend-setting fashion.

This paper gives an overview of today's state of technology and specific details of sturgeon tanning as well as a view to the untapped commercial potential.

**Keywords:** Fish leather, accessories, art and fashion, commercial potential, sturgeon tanning

## 1. Introduction

In principle, fish skin tanning technically it is not difficult. Nevertheless, only a few tanners have the technical knowledge and the required craftsmanship skill to produce the expected leather type. What is feasible is not always what is desired and what is desired is not always feasible.

In the thirties of the last century over 10 factories were located in Germany who handcrafted supplementary fish leather besides other types of leather. Today, experienced craftsmen are rare or unavailable. Currently there are only a handful of small tanneries of fish leather<sup>1</sup>. Even among native people, there are only a few who can master this process. For example, the Nanai, living at the Amur River in Siberia were called by the Chinese "barbarians in fish skin". The Nanai refined the art of tanning fish skins over generations. However, the refreshing of the old knowledge is very difficult, even for locals.

*"In my childhood, I have seen the Nanais in the collective farms wearing fish leather gloves for fishing. Later, as a cadet in the Naval Academy, the old gloves were patched with shark skin. Back at home, there were no longer kolkhozes existing but still solid fish leather gloves to find, even though they were already badly frayed.*

*The secret of making fish leather was forgotten, only an old grandmother still preserving fish leather in order to sewing a beautiful costume dress of Amur catfish. Grandmother told me that after drying, you have to knead the fish skin forceful with hands to make them soft. Behind the house were an old boiler, a wooden anvil and a hammer and the elderly neighbors told different rumors and strange stories about the tanning equipment and the process. So I had to start almost from the beginning."*<sup>2</sup>



**Fig 1. Nanai shaman dress**<sup>3</sup>

In the past, the skin of sharks was of some commercial interest. According to the World Conservation Union<sup>4</sup> about a third of sharks and rays in Open Ocean are affected by

<sup>1</sup> <http://de.wikipedia.org>

<sup>2</sup> Anatol Donkan (Co-author and local Nanai)

<sup>3</sup> Fischledermuseum e.V. D-94234 Viechtach Germany

<sup>4</sup> <http://www.iucn.org>

extinction. The main cause is overfishing. Sharks are by-catch in tuna and swordfish fishing and are not useable for eating. More dramatic is the practice of finning. Finning is the inhumane practice of hacking off the shark's fins for shark fin soup and finally throwing its still living body back into the sea. In the opinion of specialists around 200,000 tons of sharks are annually thrown back into the sea<sup>5</sup>. The practice is banned in some international waters but rarely controlled. According the International Union for Conservation of Nature (IUCN) since the 1970s the population of several species has been decimated by over 95%<sup>6</sup>. To protect sharks better before finning some new laws were enacted. The latest news comes from the European Union, 22. Nov.2012 the deputies voted to ban the shark finning in the EU and fishermen will be to monitor sharper<sup>7</sup>. The tanning shark skin has therefore completely lost its attraction due to environmental concerns.

Unlike wild caught fish, fish farming is an excellent alternative to produce exotic leather. Usually, the fish skin is waste and must be disposed. But for leather production breeding guaranteed a regular access of skin with consistent quality. Nobody must have a bad conscience when buying farmed fish leather products - on the contrary. This is in view of the huge available amount of raw material totally nonsensical. No fish is caught, bred or slaughtered specifically because of his skin.

Today, the biggest farmed fish is salmon. The skin from the salmon retains its characteristic after tanning. The scales bags remain as a different colored skin patterns. The textured salmon leather is comparable to the leather of snakes. The leather pieces are relatively small and to receive larger area one must ensures accurate matching before sewing.

	2005	2006	2007	2008	2009*	2010*
<b>ATLANTIC SALMON</b>						
Norway	573	600	725	790	880	900
Chile	379	370	355	360	180	95
UK	119	125	140	145	150	160
Canada	103	115	110	110	120	140
Faeroe Is.	16	13	20	25	30	35
Australia	16	16	20	20	20	22
Ireland	12	15	15	15	15	18
USA	10	10	12	12	15	20
Others	3	3	3	3	5	5
Total	1231	1267	1400	1480	1415	1395
<b>PACIFIC SALMON</b>						
Japan	12	10	10	10	10	10
Chile	115	115	120	113	120	135
Canada	21	10	8	7	7	7
New Zealand	9	10	10	10	10	10
Total	157	145	148	140	147	162
<b>Grand Total</b>	<b>1388</b>	<b>1412</b>	<b>1548</b>	<b>1620</b>	<b>1562</b>	<b>1557</b>

Fig 2. Salmon aquaculture production<sup>8</sup>

<sup>5</sup> <http://de.seashepherd.org>

<sup>6</sup> <http://www.iucn.org>

<sup>7</sup> <http://www.europarl.europa.eu>

<sup>8</sup> <http://globefish.org>

## 2. Sturgeon

By now, for bigger leather slices one can find a good alternative, sturgeon is more suitable but somehow different. One has to consider that sturgeon breeding is still at the beginning. Nevertheless, it is worthwhile to look into the future to see the potential of sturgeon leather.

The first references to sturgeon and derivative food products can be found in the works of Homer, Herodotus and Aristotle. One legend states that the peoples of Europe first learned about sturgeon caviar from the voyages of Alexander the Great<sup>9</sup>.

The Greek writer Herodotus, mentioned the giant sturgeon already 450thBC in one of his memoranda. In the fourth volume of his History<sup>10</sup> he describes the Dnieper River, judging it to be the most useful river in the world after the Nile. He spoke about the riches of the Dnieper, and in Strabo, we learn that Acipenser sturgeon was fished in large quantities in Pantikapaion (modern-day Kerch)<sup>11</sup>. Meanwhile in China, a legend has been passed down since ancient times that sturgeon can grow into dragons.

Until the 19<sup>th</sup> century sturgeon trading centers overspread all cities which were at one of the great European rivers. In Vienna and Hamburg sturgeon were considered mass food for the common people who had to eat no more than three sturgeons by lay in a week<sup>12</sup>. Tons of the fish were caught and partially fed to dogs and cats. With ignorance, accompanied by political incompetence and not realizing to all signs of overfishing have decimated the sturgeon almost completely.

Sturgeons live exclusively in the northern hemisphere. One knows over 20 species with well-known names like sterlet, kaluga and beluga. They are diadromous fish which spend most of their lives in the sea and migrate to fresh water to breed. Sturgeons are harvested for their roe, which is made into caviar. This makes the sturgeons the most valuable of all harvested fish. Most sturgeon caught in the Caspian Sea far behind the Sea of Azov and the Black Sea.

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<sup>9</sup> Ekaterina Shadrina, The great Caspian caviar game security, INDEX No. 1 (81), Volume 13. ANALYSES

<sup>10</sup> Historien 4. Buch Griechisch/Deutsch von Herodot, Reclam (Deutsch)

<sup>11</sup> <http://www.kaviari.fr>

<sup>12</sup> <http://www.aquaristik.de>

YEAR	RUSSIA	KAZAKHSTAN	AZERBAIJAN	Turkmenistan	The former Soviet Union	Iran	Total
1900	22800	0	5100	1100	29000	0	29000
1930	9700	6	3600	400	13700	1100	14800
1950	11000	100	2400	0	13500	760	14260
1970	10700	5200	170	0	16070	0	16070
1990	11665	1936	70	0	13671	2645	16316
1995	2302	562	43	180	2907	1500	4407
1997*	2044	460	23	0	2527	1200	3727

**Fig 3. Sturgeon capture in the Caspian Sea (tons)<sup>13</sup>**

Sturgeons belong to one of the oldest families of bony fish. They are native to subtropical, temperate and sub-Arctic rivers, lakes and coastlines of Eurasia; China and North America. They are known for their elongated body which is protected with five longitudinal rows of humped bone plates (scuta), lack of scales, and great size with up to 5m in length. In 2012 in a northeast China Heilongjiang River whose name translates as Black Dragon River, at Tongjiang, a city that borders Russia in northeast China a fishermen caught sturgeon weighting more than half a ton<sup>14</sup>.

Economically, the sturgeon only plays a role in Russia, Ukraine and Iran. They have factories which produce caviar and sturgeon meat of caught wild fish. However, time has changed and the sturgeons getting more and more seldom and farming is becoming increasingly important for the most valuable fish. According Food and Agriculture Organization of the United Nations (FAO) aquaculture provides nearly 50 percent, of the annual world fisheries production of 110 million tons of food fish in 2006.

	2001	2005	2008	2009	2010
Tons	3091	17955	28211	33359	40273

**Fig 4. Aquaculture sturgeons production<sup>15</sup>**

Unfortunately, not all sturgeon species can be raised without problems. In many cases, they are competing with each other, however, the sturgeon breeders managed to overcome their initial difficulties. In 2003, some unofficial and most accurate estimates for the various Siberian sturgeon products are listed in the table shown below. The animals reach in a normal case, a length of 80 to 140 centimeters and a weight of about 65 kilograms. In many western countries, caviar has become the main purpose of rearing sturgeon. Today, farmed caviar has comprised about two percent of the world's market. Maybe the market will change so that in the near future it will be 98 percent. That will be good for wild sturgeons' comeback, consumers' environment concern and for farmers' efforts.

<sup>13</sup> <ftp://ftp.fao.org/> Hossein Abdolhay

<sup>14</sup> <http://www.telegraph.co.uk> (News)

<sup>15</sup> <http://www.fao.org> (Yearbook of Fishery Statistics)

Country	Production of meat (tones)	Production of caviar (tones)	Production of eggs (0) and alevins (a)
China	2200	–	–
Russia	1250	–	5.10 <sup>6</sup> (a) and 20.10 <sup>6</sup> (0)
France	350	7	Large potential
Poland	180	–	Large potential
Germany	120	2	4.106
Italy	100	–	350 000 (0)
Belgium-Netherlands	20	2	–
Spain	6	0.4	30 000 (a)
Ukraine	5	–	–
Uruguay	1	–	0
Hungary	0	–	5.10 <sup>6</sup> (0)
USA	0.5	–	–
<b>Total</b>	<b>4232.5</b>	<b>11.4</b>	<b>–</b>

**Fig 5. Caviar production of farmed sturgeon<sup>16</sup>**

Everything from sturgeon has been processed and consumed even the bones are used as aromatic substance for cooking. The skin is left for fish meal or leather. The past decade has seen the rapid development of farmed fish; however, far too little attention has been paid to use this potential of new raw material sources for tanneries.

### 3. Leather making process

#### 3.1 Fish skin

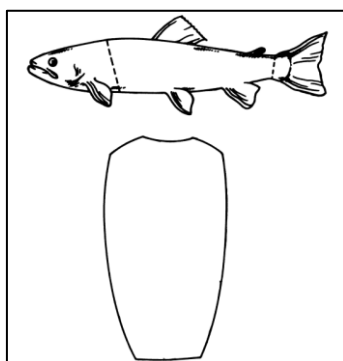
Fish skin is different to those of terrestrial animals. Water is denser than air and higher pressure is on the skin and body. Fish has no hair; the skin consisted of epidermis and corium. The corium cannot be divided into reticular and papillary layers because the papillary layer is missing<sup>17</sup>. The fibers are not woven in three dimensions as in mammals; they are parallel in three directions like a three-dimensional coordinate system. The body of most fish is covered with scales.

Sturgeon is an ancient fish, highly successful and little changed for something like 200 million years. Within the bony fish, their skeleton consists mainly of cartilage. The sturgeon skin is thick and rough.

#### 3.2 Fish skinning and cleaning

<sup>16</sup> <http://www.fao.org> (Cultured aquatic species Information Programme)

<sup>17</sup> J.A. Sagoschen, Handbuch der Gerbereichemie und Lederfabrikation 3. Band/1Teil 1961 Springer Verlag



**Fig 5. Fish skinning**<sup>18</sup>

To skin a fish, you prepare the first cut down the center back on either side of the fin. Circle the tail and just behind the head with a knife and then use your fingers or pliers to work the skin off. The cleaning of the skin is very important. The secret is in the combination of chemicals that are used to remove all the fish oils so that there is no odor. However, working in the beamhouse requires extreme caution. The fish skin is much more sensitive than those of mammals: It shrinks at a lower temperature, is severely limited to acids, alkalis, enzymes and hydrotropism substances and the putrefactive processes start faster. Timing and temperature is critical in the chemical soaking stage. If soaked too long, it will lose its strength and eventually fall apart.

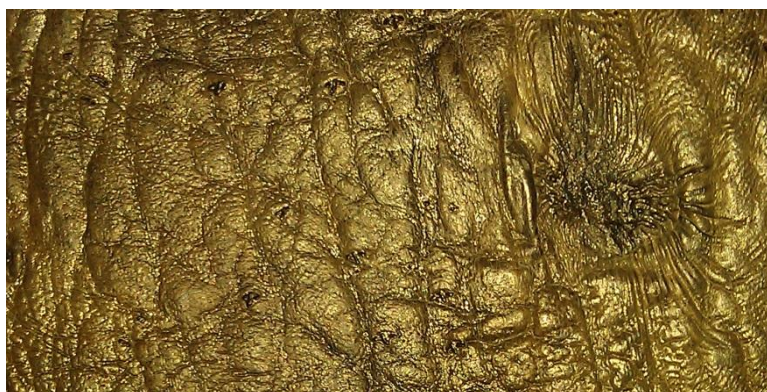
### 3.3. Tanning, retanning and finishing

Other than working more carefully, the tanning of fish skin is not much different from the tanning of most other leather. One company uses vegetable agents or chromium or fish oil or a combination of all through the process, but the true recipe is kept as a secret. We have to consider that to optimize the tanning process for fish leather takes about a month, because every fish is different - saltwater, freshwater, northern, southern, and everyone has a different expectance. Sturgeon skin is thick and therefore trough tanning is decisive for good leather. The challenge is not the tanning process as such but the recipes and the technical realization, basically the concept behind. This tendency can also be seen in the scarce patent literature<sup>19</sup>. Invention in the manufacture of fish leather are essentially from very well-known chemicals, the process steps differ in the order of their application, and at least partially by the process conditions.

<sup>18</sup> James E. Churchill, The Complete Book of Tanning Skins and Furs 1983, Stackpole Books

<sup>19</sup> e.g.DE3534353A1





**Fig 6. Sturgeon Leather**<sup>20</sup>

Keep in mind that retanning, fatliquoring and especially drumming needs special attention, because it is important to keep the leather soft. Dyeing and finishing is subject to fashion but should not limited the special character of fish leather.

Please note, there are numbers of different finishes which also affect the appearance of the leather. Practically, the same recipes as for ordinary leather are applied, a range from a natural finish which has a suede or felt-like appearance through to highly glossed or lacquered finishes. Between these are a wide variety of finishes each giving the fish leather a subtly different look and feeling.

Best praxis to initiate your one fish tanning business is to use a basic recipe which is maybe publicly available<sup>21</sup> and to start optimizing. Note, paying attention to details, it could be a long way. Perform research with the old method “by trial and error” or use modern technique like design of experiments (DOE ) originate from the work of R. A. Fisher found in the early part of the 20th century in his innovative books: "The Arrangement of Field Experiments" (1926) and the Design of Experiments (1935).<sup>22</sup> In contrast to the traditional approach, which only one factor in a test series change, several factors will change simultaneously within the statistical experiment design. Many of the major commercial statistical software packages have a module for statistical experimental design. In addition, there are special statistical software for the less experienced user that facilitate planning and evaluation.<sup>23</sup>

#### 4. Conclusion

Fish leather has been used since ancient times; however the refinement of the techniques for tanning fish is relatively new. Theoretically the skin of any fish can be tanned to make leather. Farmed fish provide new opportunities. The aquaculture production of salmons and long-term uptrend in demand for the bigger more valuable sturgeon shows new opportunities. The new type of fish leather offers designers and producers an exceptional opportunity to work with exotic leather without compromising their green credentials with new innovative ideas that are springing up. The similarity with reptile leather is obvious. Fish leather is exotic, durable,

<sup>20</sup> <http://www.donkan.de>

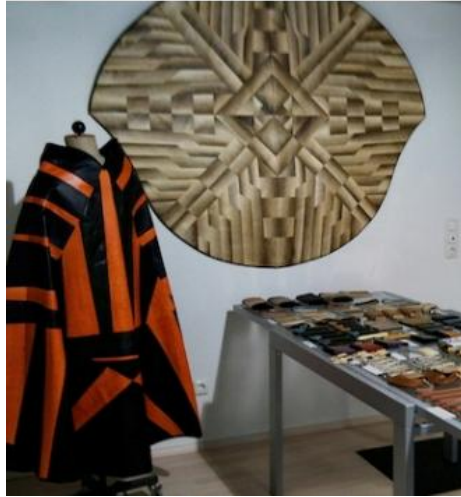
<sup>21</sup> e.g Karlheinz and Manuel Fuchs, World Leather 1998, p 61 or 1999/2000 p 73

<sup>22</sup> Fisher, R.A. (1971) The Design of Experiments, 9th Edition, Macmillan

<sup>23</sup> e.g. STAVEX, <http://www.aicos.ch>



and magnificent. It is used for clothing, shoes, wallets, belts, purses, watch straps, briefcases, handbags, home decoration and all kind of other accessories. The natural size of the fish skin usually determines the use. The production of larger fashion articles it is more complicated. The bigger the size of fish, like sturgeon, the bigger the advantages. For bags and even clothing the fish skins are selected to suit the size and properties. Every single fish skin is cut and then sewn.



**Fig 6.** Home decoration, clothing and all kind of accessories made of fish leather<sup>24</sup>

Fish leather is a brilliant example of how a by-product of food production can be utilized. This natural cross-fiber pattern makes fish leather stronger than standard leather. The strength of fish leather depends on the type of fish and a multitude of other variables. Nevertheless, generally speaking for all types of strength test fish leather scores at least as highly as normal leathers and for some it scores significantly higher. Good fish leather does not become unusually smelly or sticky. Unlike other leather types that are very heavy, fish leather is much lighter.

In conclusion, although the demand for fish leather is not so high this time, it will change if we are able to produce good quality leather in combination with an appropriate promotion. Fish leather provides good business opportunity for small and medium tanneries, designers, accessories manufacturer including startup companies to create elegant leather with a uniquely individual character.

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<sup>24</sup> Fischlederhaus, D-94234 Viechtach Germany