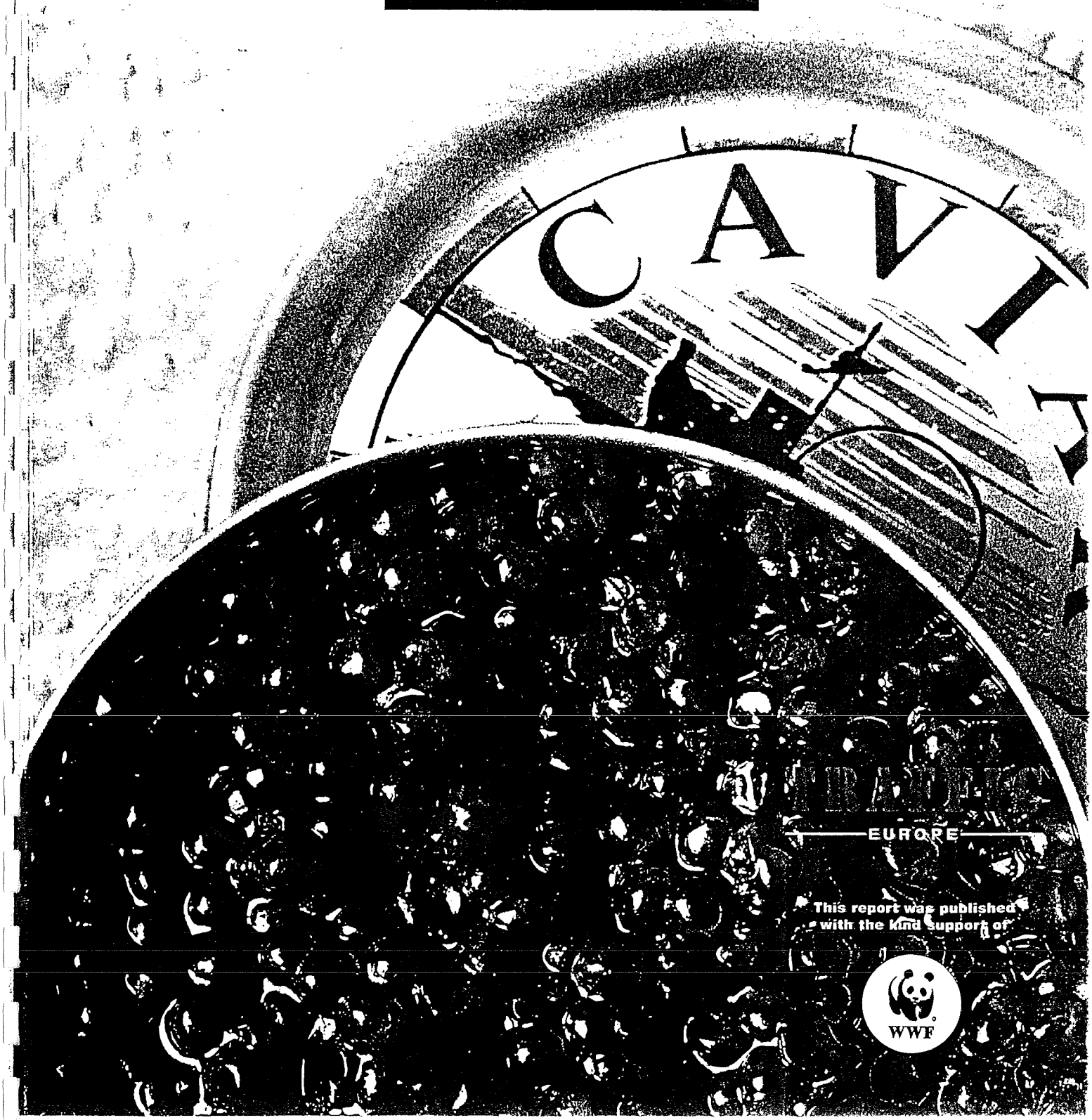
SPECIES IN DANGER

STURGEONS OF THE CASPIAN SEA

AND THE INTERNATIONAL TRADE IN CAVIAR

T. DE MEULENAER and C. RAYMAKERS

A TRAFFIC NETWORK REPORT



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STURGEONS OF THE CASPIAN SEA AND THE INTERNATIONAL TRADE IN CAVIAR

compiled by T. De Meulenaer and
C. Raymakers

The research for this report was generously funded by the Rufford Foundation.

Dieckmann and Hansen

Fishing plant in Astrakhan in the early twentieth century. Large sturgeons such as these are no longer easy to find in the Caspian Sea.

"On the white-sand of the bottom
Lay the monster Mishe-Nahma,
Lay the sturgeon, King of Fishes;
Through his gills he breathed the water
With his fins he fanned and winnowed,
With his tail he swept the sandfloor.

There he lay in all his armour;
On each side a shield to guard him,
Plates of bone upon his forehead,
Down his sides and back and shoulders
Plates of bone with spines projecting!
Painted was he with his warpaints,
Stripes of yellow, red, and azure,
Spots of brown and spots of sable...." (*Song of Hiawatha*, Longfellow, 1855).

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ACKNOWLEDGEMENTS

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BACKGROUND

Sturgeons are one of the oldest types of living vertebrate on earth. Considered "living fossils", they evolved 250 million years ago, surviving the sudden disappearance of most dinosaurs. They are primitive fish with cartilaginous skeletons and have some exceptional morphological features, including cartilaginous skeletal rods in adulthood and asymmetrical caudal fins. Their cylindrical bodies are armed with five rows of bony scuta, or shield-like plates (see Figure 2).

Within the order Acipenseriformes, the family Acipenseridae, it is usually accepted, consists of 25 sturgeon species - 17 in the genus *Acipenser*, two in the genus *Huso*, three in the genus *Scaphirhynchus*, and three in the genus *Pseudoscaphirhynchus* (Birstein and Bemis, in press; Anon. 1996). Current taxonomy is debated, however, particularly as regards the number of species *versus* sub-species in the genus *Acipenser*, mainly owing to the ease with which species hybridize and, moreover, produce fertile offspring.

Sturgeons are very large fish, adult lengths of different species ranging from 80cm to over five metres. The Kaluga *Huso dauricus* is considered to be the largest freshwater fish, capable of reaching more than 5.6m in length, and more than one tonne in weight at over 80 years of age (Nikol'skii, 1956). Sturgeons inhabit rivers and coastal marine waters, as well as some lakes, in the temperate zones of the entire Northern Hemisphere (Figure 1). Sturgeons are either anadromous, which means that mature fish migrate from the sea to rivers for spawning, and that juveniles return to the sea, or live their whole life in freshwater. Most species are highly tolerant of sharp salinity changes, but all sturgeon species spawn in freshwater, pebble deposits on river beds and side channels often serving as spawning grounds (Svirskii, 1976). The efficiency of sturgeon reproduction is facilitated by high water levels in rivers, which help up-stream travel (Khodorevskaya *et al.*, in prep.).

Sturgeons feed on benthic organisms (those which live at the bottom of lakes and seas), including, occasionally, plants. The morphology of the head is well adapted to their feeding habits: the mouth being on the underside of a long snout and preceded by four conspicuous barbels, used to search for benthic animals such as worms, molluscs, small shrimps and insect larvae (Figure 2). This feeding behaviour makes sturgeons less likely to escape nets used in bottom-trawling and dredging as well as vulnerable to the adverse affects of pollutants, which can build up in benthic communities, sometimes to the point of depleting food sufficiently to cause mass starvation among sturgeon populations (Khodorevskaya *et al.*, in prep.).

Although they are well protected from attack by non-human predators by their bony exterior, sturgeon populations are extremely vulnerable to overfishing because of their late sexual maturity (between six and 25 years, depending on the sex and the species), and a limited number of spawning grounds. Indeed, several species and populations of sturgeon are believed to be endangered critically and close to extinction, and almost all are threatened to some degree (Table 1). Data from the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) showed the linear trend of sturgeon fisheries in the Atlantic Ocean as "declining", according to 1990 catch figures and several countries are actively fishing sturgeons without stock enhancement programmes, despite the fact that all available information suggests that their sturgeon fisheries are in serious jeopardy. For example, this is the case for the Black Sea and Danube sturgeon fisheries in Bulgaria, for those of the Amur River in China, and those of Romania.

In part, the overall decline in sturgeon populations is as a result of habitat degradation. In the Caspian Sea basin, for example, the USSR began to build dams on the Volga River, the most important spawning sites for Caspian sturgeons, in the 1950s. Pollution from chemical plants and oil-producing installations built along rivers and the Caspian coastline in the 1960s and 1970s has exacerbated sturgeon habitat degradation (Khodorevskaya *et al.*, in prep.). The shrinking of the Aral Sea, owing to uncontrolled irrigation has

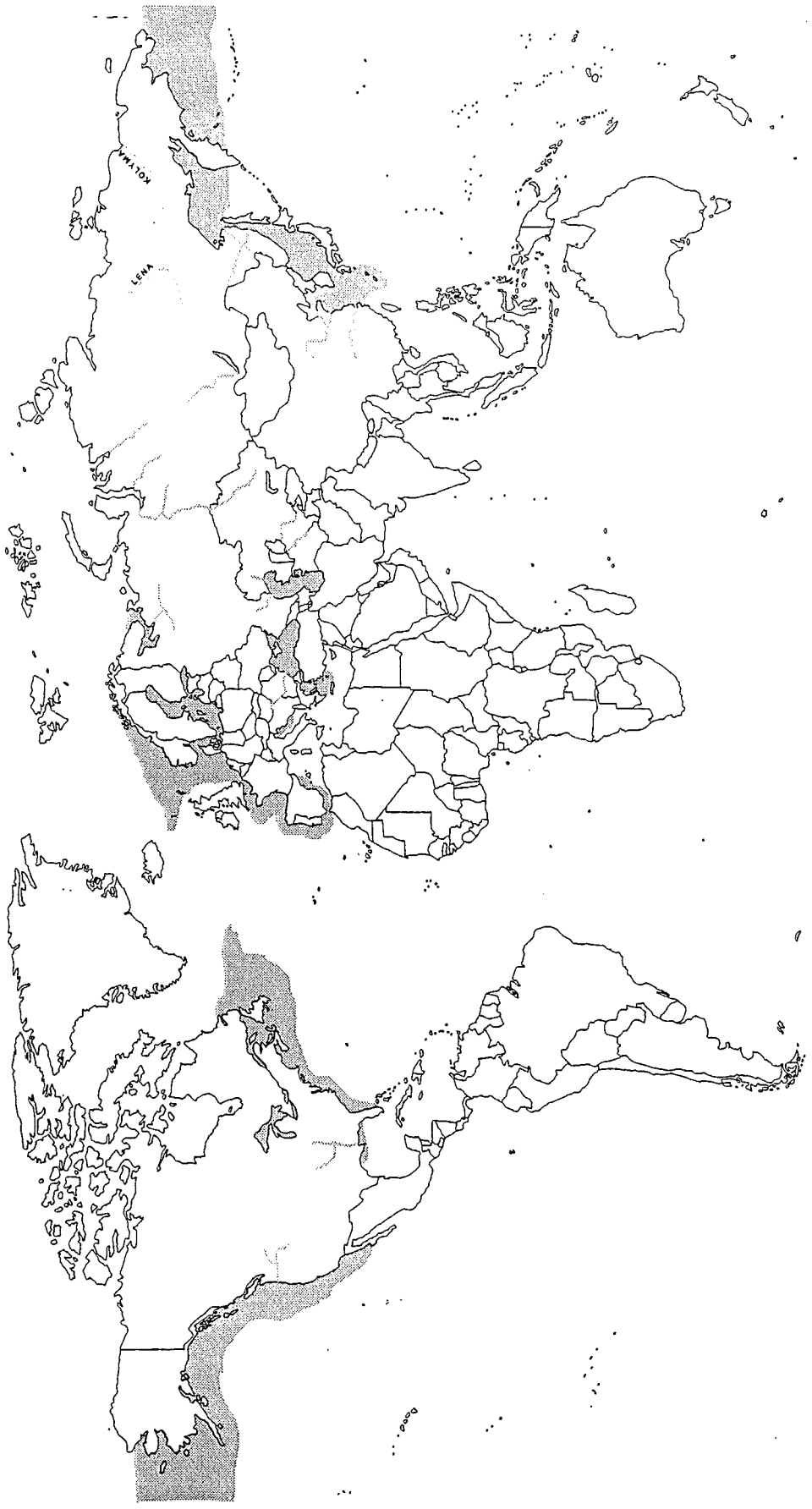


Figure 1
Map to show world distribution of sturgeons

Sources: Birstein, 1994, Williot, 1991.

Table 1

Acipenseriform species, distribution and conservation status

Geographical area	Scientific name	Common name	Distribution	Status(1)	Present (or proposed) CITES listing	Stock enhancement	Commerical aquaculture
western Europe	*Acipenser sturio*	Baltic or Common Sturgeon	eastern north Atlantic, Baltic Sea, Lakes Onega and Ladoga, Black and Mediterranean Seas	CR	I	Gironde River, France	
CIS and eastern Mediterranean	*Huso huso*	Beluga	Caspian, Black, Azov Seas (extinct in Adriatic Sea)	EN/CR(Azov)	(II)	Caspian and Azov Seas	+
	A. stellatus	Stellate Sturgeon	Caspian, Black and Azov Seas, maybe extinct in Aegean	VU(Caspian)/EN	(II)	Caspian Sea	+
	A. gueldenstaedti	Russian Sturgeon	Caspian, Black and Azov Seas	EN	(II)	Caspian Sea	+
	A. persicus	Persian Sturgeon	Caspian and Black Seas	VU/EN	(II)		
	A. nudiventris	Ship Sturgeon	Caspian and Black Seas, (extinct in Aral Sea), Danube River	EN CR			
	A. naccarii	Adriatic Sturgeon	Adriatic Sea (Po River basin)	VU	(I)		+
	A. ruthenus	Sterlet	Volga and Danube Rivers, northern and western Dvina and their tributaries	VU	(II)		+
Siberia	*A. ruthenus*	Sterlet	Ob, Irtysh and Yenisei Rivers	VU			
	A. baerii baerii	Siberian Sturgeon	Ob River basin	EN	(II)		
	A. baerii baicalensis	Baikal Sturgeon	Lake Baikal	EN	(II)		
	A. b. stenorrhynchus	Lena River Sturgeon	Yeissei, Lena, Irtysh and Kolyma Rivers	VU			+
	A. schrencki	Amur Sturgeon	Amur River system	EN			
	H. dauricus	Kaluga Sturgeon	Okhotsk Sea and Amur River	EN	(I)		
	A. mikadoï	Sakhalin Sturgeon	Pacific Ocean and Datta River	EN	(I)		
China	*A. dabryanus*	Yangtze or Dabry's Sturgeon	Yangtze River	CR	(I)		
	A. sinensis	Chinese Sturgeon	Yangtze River system, Pearl River and Chinese Sea	EN	(I)		
	Psephurus gladius	Chinese Paddlefish	Yangtze River	CR	(I)		

Table 1 continued

Geographical area	Scientific name	Common name	Distribution	Status(1)	Present (or proposed) CITES listing	Stock enhancement	Commerical aquaculture
Central Asia	***Psuedoscaphirhynchus fedtschenkoi***	Syr-Dar Shovelnose Sturgeon	Syr-Darya River (Kazakhstan)	CR			
	P. hermanni	Small Amu-Dar Shovelnose Sturgeon	Amu-Darya River (Uzbekistan)	CR			
	P. kaufmanni	Large Amu-Dar Shovelnose Sturgeon	Amu-Darya River (Uzbekistan and Turkmenistan)	EN			
eastern North America (Atlantic Coast)	***A. oxyrhynchus oxyrhynchus***	Atlantic Sturgeon	Atlantic coast (Labrador and south)	LR (nt)	(I)/II	USA	
	A. o. desotoi	Gulf Sturgeon	Gulf of Mexico, Florida	LR (nt)			
	A. brevirostrum	Shortnose Sturgeon	Atlantic coast	VU	I		
	A. fulvescens	Lake Sturgeon	Great Lakes, St. Laurent River	VU	(II)		
	Scaphirhynchus albus	Pallid Sturgeon	Missouri and Mississippi basins	EN	(I)		
	S. platorynchus	Shovelnose Sturgeon	Missouri and Mississippi basins	VU	(II)		
	S. suttkusi	Alabama Sturgeon	Mobil basin in Alabama and Mississippi	CR	(I)		
	Polyodon spathula	American Paddlefish	Missouri and Mississippi basins	VU	II	USA	+
western North America (Pacific Ocean)	***A. transmontanus***	White Sturgeon	Pacific coast, from the Gulf of Alaska to Baja Calafornia	LR (nt)			+
			population in the Kootenai River	EN			
	A. medirostris	Green Sturgeon	Pacific Ocean, from Aleutian Islands to Ensenada, Mexico	VU			

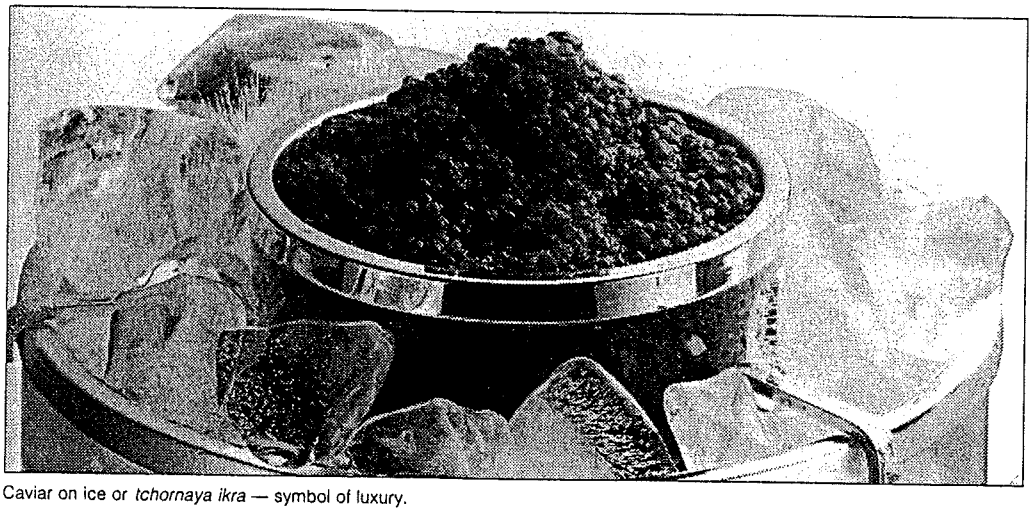
Sources: Birstein, 1994; V. Birstein, *in litt*, June and August 1996; Anon., 1994b; IUCN (in press).

(1) Threat category is classified using current IUCN Red List Categories:
(CR - Critically Endangered, facing an extremely high risk of extinction in the wild in the immediate future
EN - Endangered, the taxon is not critically endangered, but is facing a very high risk of extinction in the wild in the near future
VU - Vulnerable, facing a high risk of extinction in the wild in the medium-term future
LR - Low Risk, not qualifying for categories above, but may possibly do so in the near future
LR (nt) - Low Risk, Near Threatened — taxa which are close to qualifying for Vulnerable.)
For full category definitions, see Anon., 1994b.

\+ Aquaculture exists

already led two endemic sturgeon species to near-extinction, namely the Syr-Dar Shovelnose *Pseudoscaphirhynchus fedtschenkoi* and the small Amu-Dar Shovelnose *P. hermanni* (Birstein, 1993).

Apart from the adverse impact on sturgeon populations caused by alteration and impairment of their habitat, they are also beset by high levels of demand, particularly for caviar, on the international market. Caviar is by far the most valuable product of a sturgeon fishery and, from a biological point of view, consists of the oocytes (unfertilized eggs) of female sturgeons. It is not unlikely that the first humans to discover and enjoy caviar lived as long ago as the development of the ability to catch fish and maybe to organize a supply of salt (Grigson, 1973). Certainly it is known that early Persians enjoyed caviar and thought it had medicinal qualities, while Ancient Greek and Roman literature describes the "beautiful black pearls" served at banquets (Komesaroff, 1995) and Aristotle remarked that sturgeons were prized for their caviar (Grigson, 1973). Feudal lords and Popes were treated to the pleasures of the "Royal Fish" and its roe and in England sturgeons and their caviar were reserved exclusively for the king. The Chinese developed methods of treating and trading caviar as early as the tenth century AD: a gazetteer from that era includes the following description - "the natives catch sturgeon, simmer the roe in an infusion of *Gleditschia sinensis* seeds (an acacia-like plant, normally used as a black dye), then pickle it in brine" (Grigson, 1973). In Europe, caviar became more widely available as a fashionable luxury food item from the seventeenth and eighteenth centuries, although it had already been popular as such in Russia for several centuries. To the present day, "caviar on ice" (*tchornaya ikra* in Russian) is one of the world's symbols of exclusivity and wealth, and the price of caviar makes the sturgeon fishery one of the most profitable in the world.



Plodimex

Caviar on ice or *tchornaya ikra* — symbol of luxury.

Formerly, America played an important role in world caviar production and during the second half of the nineteenth century, the USA and Canada were major suppliers of caviar to Europe, but by 1910, several American sturgeon species were nearly extinct and production had all but ceased (Bourguignon, 1989; Anon., 1994a). During the first half of the twentieth century, the production of caviar was essentially based in the USSR, until 1953, when, following agreements with the USSR, Iran emerged as a significant exporter (Bourguignon, 1989). From that time until 1991, the two countries shared fishing rights in the Caspian Sea. After 1991, with the collapse of the USSR, however, four newly independent states (Azerbaijan, Kazakhstan, Russia[1] and Turkmenistan) shared the shores of the Caspian Sea with Iran (see Figure 3). The tightly regulated caviar-producing cartel formed by Moscow and Teheran had burst wide open.

Today, practically all caviar in the world is produced from the Caspian Sea by Russia, Kazakhstan,

Azerbaijan and Iran, which together account for perhaps 90% of the world's sturgeon catch and caviar output. Small quantities of caviar are produced by other countries, including China, Romania, USA, Turkey, and Canada, but according to specialist gastronomes in the main caviar-importing countries, only Caspian caviar meets the high-quality standards demanded by epicures. Nevertheless, even the quality of caviar of Caspian origin, however, has been called into question over the past five years, as the trade has become increasingly chaotic and marred by smuggling and illegal production. At the same time, the anarchic catch of Caspian sturgeons is perhaps the most pressing contemporary threat to these species' survival.

Six species of sturgeon inhabit the Caspian Sea and its tributaries. These are the Beluga (also commonly known as Giant Sturgeon) *Huso huso*, Russian Sturgeon *Acipenser gueldenstaedti*, Stellate Sturgeon *A. stellatus*, Ship Sturgeon *A. nudiventris*, Persian Sturgeon *A. persicus* and Sterlet *A. ruthenus*. Persian Sturgeons are apparently exploited to some degree in Iran and Ship Sturgeons are considered endangered (Birstein, 1993). It is the three first-mentioned species, however, which are the most heavily fished to provide caviar (Anon., 1995a; Khodorevskaya *et al.*, in prep.; Vlasenko *et al.*, 1989), hereafter referred to as the Beluga, Russian Sturgeon and Stellate Sturgeon in this report.

INTRODUCTION

Concern among reputable traders and scientists over the conservation status of Belugas, Russian Sturgeons and Stellate Sturgeons motivated the initiation of this study. The report describes the three species and their conservation status and examines potential threats to the species' survival. Current and past exploitation of Caspian sturgeons and the regulation of that exploitation is assessed as far as possible, as is Caspian caviar production, its regulation, and its impact on sturgeon numbers. Reported international trade in caviar of Caspian[2] origin is mirrored through Customs statistics of importing countries, and these are analysed in the report for the insight they allow to the effect of the caviar trade on the species of origin. Illegal trade in caviar, which exists, is harder to assess, although some indications of its volume and nature have been gathered for this report. Prices of caviar presented sometimes suggest illegal trade and reflect the sharp swings to which the caviar trade has been subject in the past few years. One activity which may aid the conservation of Caspian sturgeons, and the caviar trade, is that of breeding sturgeons in captivity for stock enhancement, practised worldwide, but for longest in the USSR/CIS (Commonwealth of Independent States)[3]. At the same time, there is much scope for conservation action on a global scale to protect the three species of fish, the Beluga, Russian Sturgeon and Stellate Sturgeon, on which almost all world trade in caviar is now based. With reference to this, the new socio-political conditions in the Caspian region are relevant, but this report does not attempt to recommend solutions to socio-economic, political and ecological problems affecting the countries surrounding the Caspian Sea.

METHODS

Effective research in producer countries proved to be difficult. In the USSR, nearly all data on commercial sturgeon catches and caviar production were monopolized by the USSR Ministry of Fisheries and regarded as state secrets. Nowadays, it is often the case that such information is a secret from the state in CIS countries and thus it could be gleaned only from unofficial, though as far as possible, informed sources in supply countries. In 1995, various investigative missions to Russia were conducted, to research the Caspian sturgeon fishery, principally in the vicinity of Astrakhan. Findings were documented confidentially to

TRAFFIC Europe and are incorporated into this report anonymously.

Customs import data from major caviar-consuming countries were consulted, namely, Eurostat (for states of the EU (European Union)), US National Marine Fisheries Service (for the USA), and Swiss and Japanese Customs statistics, in each case from 1992 to 1995. These import data afford the most reliable indication of exports of Caspian caviar for these years and have been widely consulted during research for this report. EU Member States, for example, require a certificate of country of origin to accompany Caspian caviar imports. The information such documentation may be expected to yield, however, may not necessarily be relied upon, yet it is not advisable to pursue investigations into the authenticity of these documents. Press articles have reported that Russian journalists have been jailed following their investigation of the caviar trade (Politovskaia, 1995). Information relating to Customs' seizures and confiscations of caviar were collected for France.

Legal texts relating to fisheries products, market prices, and information on product quality from importing countries were also researched. Intelligence from reputable importers on the situation in supply countries, based on decades of trade with the Caspian region, was of key importance to gaining or corroborating up-to-date findings about the state of the fisheries and caviar trade there, as well as on product quality and prices. Retail prices were gathered by TRAFFIC offices within the UK and France and by TRAFFIC USA and the IUCN/SSC Sturgeon Specialist Group in the USA.

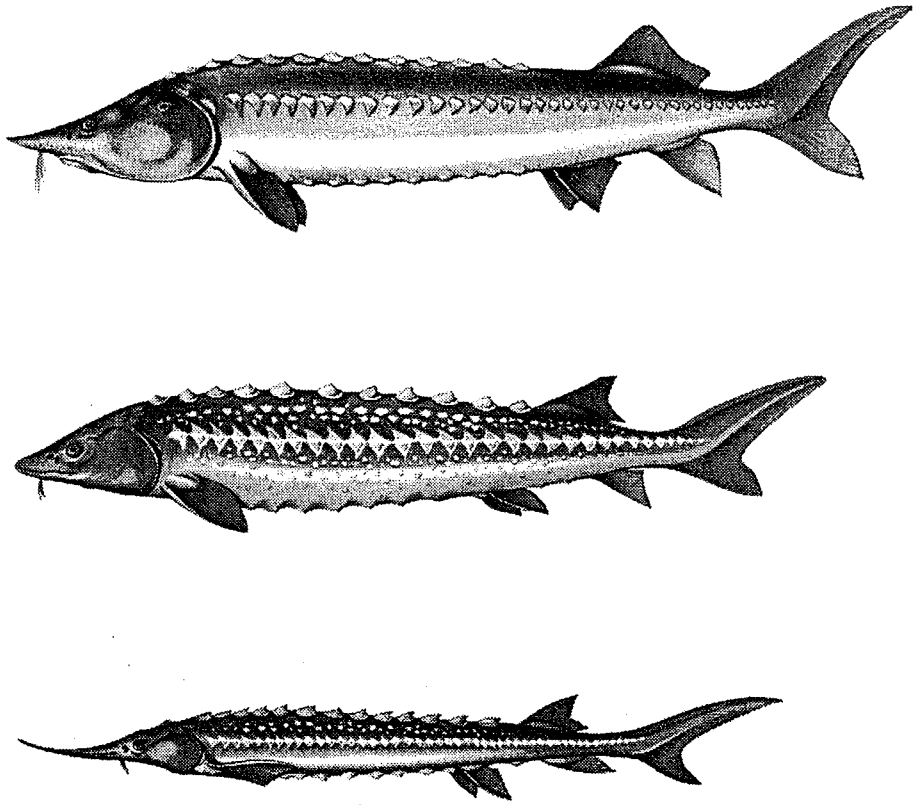
Finally, statistics and supplementary information were also gathered from sturgeon specialists, including those of the IUCN/SSC Sturgeon Specialist Group and the United Nations Food and Agriculture Organization (FAO), among other bodies. The only available data for caviar exports from the USSR/CIS and Iran, up until 1992, are published by FAO and these were especially useful as a source.

Despite imperfect results from information-gathering, this preliminary investigation has yielded information on Caspian caviar production and trade, which gives rise to serious concern about the sturgeon stocks in the region.

DESCRIPTION OF CASPIAN STURGEONS FISHED FOR CAVIAR

Figure 2

Morphology of the three sturgeon species commercially exploited on the Caspian Sea, from top to bottom, Beluga *Huso huso* (Linnaeus, 1758), Russian Sturgeon *Acipenser gueldenstaedti* (Brandt, 1833) and Stellate Sturgeon *Acipenser stellatus* (Pallas, 1771)



Plodimex

Small quantities of caviar of other Caspian sturgeon species have been found on sale in the USA, but the three species of sturgeon primarily fished for caviar in the Caspian basin, as stated earlier, are the Beluga, Russian Sturgeon and Stellate Sturgeon. In the wild, in all three species, spawning, fertilization and hatching take place outside the body of the adult fish, which return to the sea directly after mating.

Belugas

The species has been recorded in the Black, Caspian, Azov and Adriatic Seas, and in most of their river tributaries, but in practice may be extinct in the Adriatic, where they have not been recorded for 15 years (see Table 1 and Figure 3). Belugas are carnivorous, living on benthic fauna, such as molluscs, worms and crustaceans. Reputed to be one of the largest species of freshwater fish, Belugas can reach a length of 6m and weight of 1200kg. Maturation occurs between 15 and 20 years of age, and some Belugas live for 150 years. Their spawning season starts in May and ends in July, but the fish start to migrate up-river during mid-March.

The Caspian population of Belugas is small relative to those of the Russian and Stellate Sturgeons (see **Conservation status of Caspian sturgeons**). It is largely made up of fish from restocking programmes, most younger than 20 years old, and the mean size of Belugas in the Caspian Sea has decreased from 110kg, in the early 1970s, to 57kg in 1991 (Khodorevskaya *et al.*, in prep.).

Adult females produce up to 12% of their body weight in caviar, known in the case of this species as beluga.

Russian Sturgeon

This species occurs in the Black, Caspian and Azov Seas, and most of their river tributaries (see Table 1 and Figure 3). With an average length of two metres, Russian Sturgeons weigh about 200kg and usually reach maturity after 12 years, while the average age of fish of this species in the Caspian Sea is 30 to 40 years. In the late 1980s, hatchery-produced fish represented some 25 to 30% of the commercial catch of this species in the Caspian Sea basin (Khodorevskaya *et al.*, in prep.). Russian Sturgeons are the most numerous of the three commercially fished sturgeon species in the Caspian basin (Ivanov, *et al.*, 1995a).

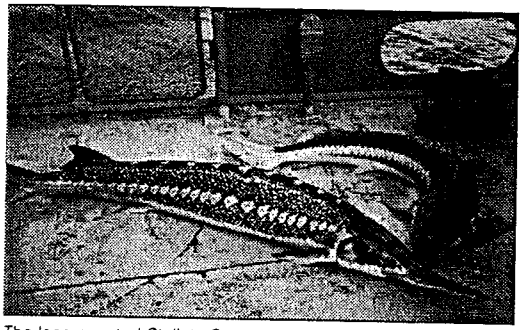
Up to six kilogrammes of caviar, known in the case of this species as osietra, can be extracted from one Russian Sturgeon.

Dr Yurii Altuf'ev

A freshly caught Russian Sturgeon.

Stellate Sturgeon

Recorded in the Black, Caspian, Azov and Aegean Seas and their river tributaries (see Table 1), the Stellate Sturgeon is in fact probably extinct in the last-mentioned sea (see Figure 3). Stellate Sturgeons are smaller than Belugas and Russian Sturgeons, reaching a maximum length of 1.5m and 25kg in weight. The species matures at approximately eight years old. Most Stellate Sturgeons in the Caspian Sea are under 30 years old (Khodorevskaya, *et al.*, in prep.). The spawning season of this species starts later than that of the Beluga and Russian Sturgeon and continues the whole summer (Khodorevskaya *et al.*, in prep.). Some 30% of all fish of this species caught in the late 1980s in the Caspian basin were hatchery releases (Birstein, *in litt.*, 1996).



Dieckmann and Hansen

The long-snouted Stellate Sturgeon is the smallest of the three species fished for caviar in the Caspian Basin.

This sturgeon is less productive than the two other species in terms of caviar, yielding at the most two kilogrammes per mature female. Caviar from this species is known as sevruga.

In general, the amount of caviar produced from each fish is between 5-20% of the weight of a mature female, on average, (S. Taylor, *in litt.*, May 1996). Caspian caviar production usually involves

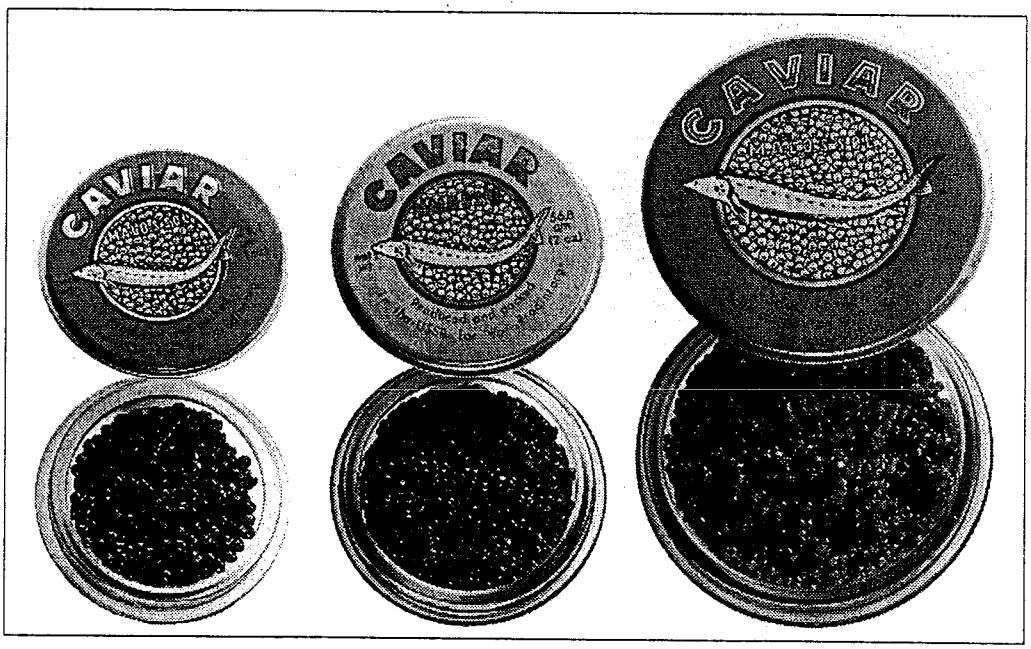
killing female sturgeons at a time when the oocytes are still in the gonads and not naturally ready for release (Anon., 1995b).

Caviar, the delicacy

Caviar is held to be one of the most delicious (and one of the most nutritious) things to eat in the world, and one of the most expensive. About one ounce (28.35g) of caviar per person is considered a usual amount to serve. Kept refrigerated until required, the caviar is traditionally placed on a dish surrounded by ice when brought to the table. Some believe that the taste of caviar is so delicate that it should not be eaten with vodka or wine, nor mixed with anything, such as cream. Grade of caviar may depend on the size of the eggs, their colour, and the fat content of the oocytes, which determines their firmness and in turn depends on their stage of maturity.

According to renowned caviar traders, each of the three species of sturgeon chiefly exploited in the Caspian Sea produces a distinctive caviar. In particular, the colour of caviar from Belugas (beluga[4]) should range from light to dark grey, while most traders describe the caviar of Russian Sturgeons (osietra) as blackish, to brown, to almost "gold". Caviar from Stellate Sturgeons (sevruga) is often described as black. The colour of the caviar is said sometimes to depend on the age of the sturgeon, but this may be something of a marketing myth, and colour is thought by longstanding caviar traders and producers to be a function of the pigmentation and diet of the fish (S. Taylor, *in litt.*, 17 May 1996). "White caviar" appears very rarely and indicates that the parent fish was an albino, and each oocyte has a red spot on it. Light grey beluga and light yellow osietra are two types of caviar which are now almost unavailable, probably owing to the low percentage of sturgeons producing these colours of roe, from species which themselves are much rarer than previously (S. Taylor, *in litt.*, 17 May 1996).

While it is not usually possible to distinguish between caviar from different species of sturgeon on grounds of its colour, nor is it possible to do so according to size. Although Beluga oocytes are on average larger than those of other species, and those of Russian Sturgeons are typically larger than those of Stellate Sturgeons, analysis has shown that there is considerable overlap (De Salle and Birstein, in press). Egg size is determined at least in part by the age and the size of the donor fish (Sternin and Dore, 1993) (See *Identification of caviar to species level.*)



Ploditnex

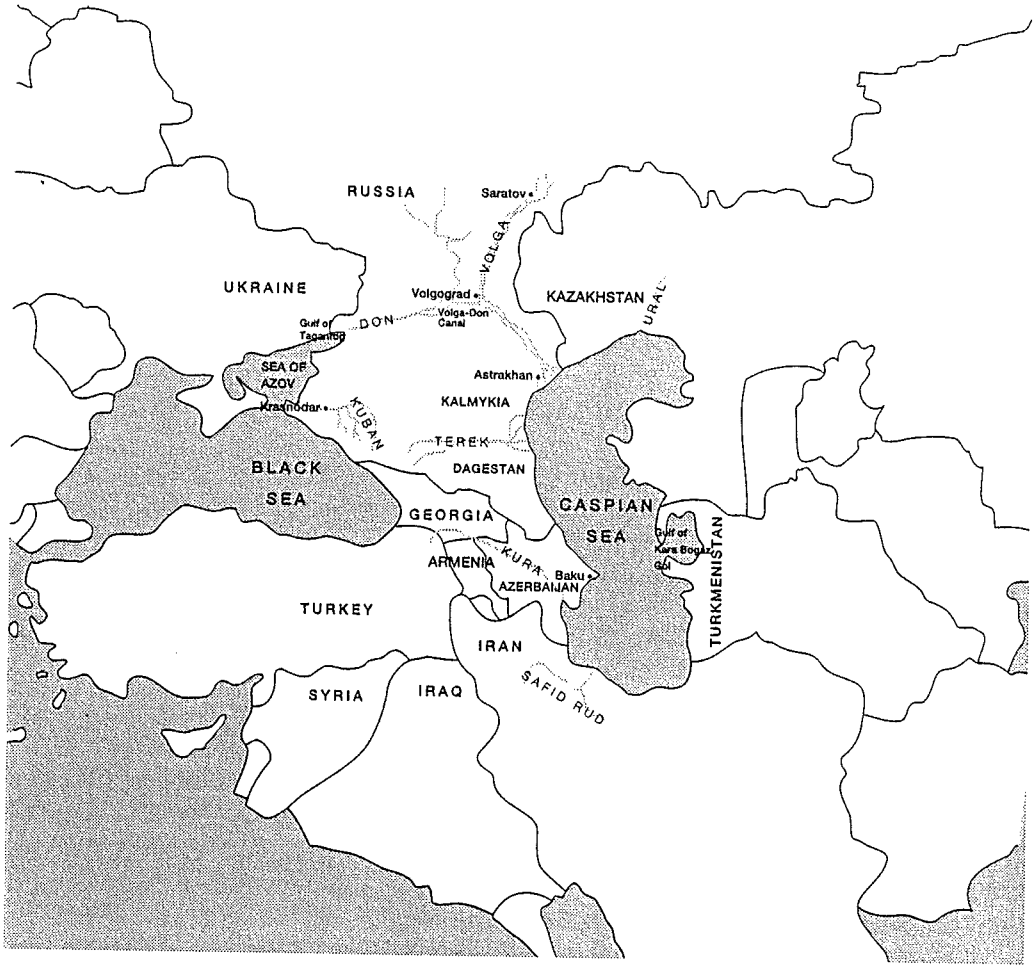
(left to right) Beluga, osietra and sevruga caviars from the USSR.

Habitat

The Caspian Sea is the largest (384 000km^2) and most voluminous (78 700km^3) inland water body on earth, with a maximum depth of 980m and stretching more than 1000km from north to south, in a depression between the European and Asian continental plates. The sea is surrounded by deserts to the north and east, and grasslands and forests to the west and south. It is an important source of petrochemicals, as well as caviar.

Figure 3

Map of Caspian Sea and bordering states



Some 130 rivers provide fresh water to the Caspian Sea, which consequently has a low salinity level. The most important is the 3530km-long Volga River in Russia (see Figure 3), contributing some 82% of the inflow to the upper northern part of the Caspian Sea. Other large rivers include the Ural River, in Kazakhstan, to the north-east; the Terek River, in Russia, to the north-west; and the Kura River, in Azerbaijan, and the Safid-Rud River, in Iran, to the south-west of the sea (Williot, 1991; Dumont, 1995).

Belugas, Russian Sturgeons and Stellate Sturgeons spend most of their time in the northern part of the Caspian Sea, although from October they migrate south to the deeper parts of the Sea, before mature fish migrate up-river to spawning sites in the spring (March-May). In recent times, the sturgeons' access to

natural spawning grounds in rivers flowing into the Caspian Sea has been blocked in several places by dams, reservoirs and other physical modifications.

Dr Vadim Birstein

Banks of the Volga River, lower Astrakhan.

CONSERVATION STATUS OF CASPIAN STURGEONS

Belugas, Stellate Sturgeons and Russian Sturgeons are not currently included in any published, globally recognized lists of threatened species, (e.g. the current IUCN Red List of Threatened Animals (Groombridge, 1993) or the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)). However, the Caspian populations of Belugas and Russian Sturgeons are considered Endangered (EN) and Stellate Sturgeons Vulnerable (VU), according to IUCN threatened species classifications, and all three species are considered eligible for listing in Appendix II of the CITES Appendices by the IUCN/SSC Sturgeon Specialist Group (see Table 1).

Catch numbers for Caspian sturgeons started to decline in the 1930s and 1940s owing to unfavourable climatic conditions and the associated drop in seawater levels, increased fishing activity and the first artificial water diversion schemes. Stocks started to recover following the establishment of quotas after the Second World War, and catches stabilized around 20 000t of sturgeon per year in the 1960s and early 1970s. Several other measures contributed to the relative improvement, such as sturgeon production in hatcheries, construction of artificial spawning grounds, a ban on dredging during the downstream migration of young fish, and a general ban on fishing in open Soviet seawater from 1962 onwards (though not in Iranian waters) (Williot, 1991; Khodorevskaya *et al.*, in prep.; Dumont, 1995). Sturgeon catches in the Caspian area began to rise in the late 1970s and reached a post-Second World War peak of 27 400t in 1977, by which time Caspian sturgeons had already been described as "in danger" (Grigson, 1973). The Caspian sturgeon catch has continued to decline overall since 1977 and there is now widespread concern over the fishes' conservation status in the wild. All experts and fisheries agents in Russia contacted during research for this report concurred that sturgeon stocks are rapidly declining in the Caspian Sea basin. There are several indications of this, for example:

- An estimated 25 000 Belugas migrated up the Volga River in the early 1970s, while by the early 1990s, spawners travelling up this river of this species did not exceed 11 700 in number (Khodorevskaya *et al.*, in prep.). The fact that this species's numbers are much lower than those of the

Russian and Stellate Sturgeons is illustrated by information gathered by summer trawling surveys. These showed a decline between 1983 and 1991 in numbers of adult sturgeons caught, from 0.29 to 0.27 in the case of Belugas; 1.1 to 0.54 in the case of Russian Sturgeons, and 1.3 to 0.61 in the case of Stellate Sturgeons (Malutin, 1995).

- The fall in number of Stellate sturgeons may be similarly illustrated by the number annually migrating up the Ural River. From the late 1960s to 1985, around 1 000 000 travelled up the river to spawn, but the Ural stock had declined to 200 000 by 1991 and has continued to decrease sharply ever since, to the point where the Caspian Stellate Sturgeon population requires urgent attention (Khodorevskaya *et al.*, in prep.).

- The number of adult sturgeons living in the Caspian Sea is estimated to have declined from 142 million adults in 1978 to 43.5 million in 1994 (Malutin, 1995).

- Recorded catches in Russia, Azerbaijan and Kazakhstan reflect the fall in Caspian sturgeon numbers, from 11 410t in 1991, to 10 620t in 1992, 6450t in 1993, and 5190t in 1994 (see Table 2; Figure 4). Catch records for sturgeon fisheries specifically in the northern Caspian Sea region show that the catch of Belugas in 1994 was one seventh of that in 1990, that of Russian Sturgeons one fifth, and that of Stellate Sturgeons about a quarter of that of 1990 (see Table 4).

- The Caspian Research Institute of Fisheries (KaspNIRKH) indicates that the official Russian catch of sturgeons in the Caspian Sea overall during 1994 was almost one fifth of that which it was in 1990, while the official catch for 1995 was expected to total only 1500t (Artyukhin, 1996).

While some estimates of sturgeon numbers are at variance with each other, all sources support the theory of a very marked decline in wild sturgeon stocks in the Caspian Sea.

THREATS TO STURGEON POPULATIONS OF THE CASPIAN SEA

Since the Second World War, and especially since the disintegration of the USSR (Altuf'ev, 1995), overfishing to supply the caviar trade and habitat degradation, including changing water levels, damming and pollution, (Williot, 1991) have emerged as the main factors seriously affecting sturgeon stocks in the Caspian Sea.

Exploitation for caviar and other sturgeon products

In recent decades, the Caspian Sea has provided some 90% of the world's caviar, an estimate borne out by examination of statistics from various sources (S. Taylor, *in litt.*, 1 August 1996; see Figures 5 and 6; compare Tables 7, 8 and 9; see Tables 12 and 13). The single-most important cause for the decline in sturgeon stocks in the Caspian Sea, according to experts and fisheries agents contacted by contributors to this report, is heavy unregulated fishing.

The fragmentation of the former USSR led to a situation of uncertainty with regard to legislation governing Caspian sturgeon fisheries and its enforcement (see **Regulation of Caspian sturgeon fisheries**). The subsequent lifting of restrictions, or non-enforcement of those which do exist, in an area with such a valuable fishery has led to unfettered harvest of sturgeons for the caviar they produce.

In Azerbaijan, Kazakhstan and Turkmenistan its is difficult to establish whether sturgeon catches and fishing techniques are legal or not. In any case, methods are often those outlawed by the previous Soviet

Government and catches are said to be the product of strenuous fishing effort: for example, there were six times as many nets in Azerbaijan in 1993 than in the 1980s (Ivanov *et al.*, 1995a). In Russia, widespread illegal fishing is known to be practised, motivated by international demand for caviar – 450t in 1995 – which was not met by production (legal and illegal) from Russia and Iran in that same year – 228t (Taylor, 1995). This motive is especially keen at times of harsh economic difficulty, such as has beset many within the CIS since the dissolution of the USSR. This much is testified to by the 1452 sturgeon poachers detained and the more than five tonnes of caviar and 113t of sturgeon confiscated, in Russia in 1994, according to the Russian Ministry of Internal Affairs. In Astrakhan, also in 1994, seven illegally operating caviar processing plants were shut down, while in other parts of Russia, 21t of sturgeon meat and 10.5t of caviar were confiscated, products of unauthorized fishing (Anon., 1995b) (see also ***Illegal trade***). Reflecting the scale of illegal sturgeon fishing is the estimate that as much as 80% of the caviar trade is under unofficial control in parts of the CIS, and the illegal production of 1200t of caviar in Russia in 1990, and of 200t in 1992 was reported (Lindberg, 1994). The former quantity would equate to a sturgeon catch of about 16 000t, based on the calculation that approximately 7.5% of a given weight of sturgeon catch results in caviar (S. Taylor, *in litt.*, 1 August 1996). This amount is as high as the reported commercial sturgeon harvest at the time from the USSR (Figure 4), representing a heavy toll on a declining stock.

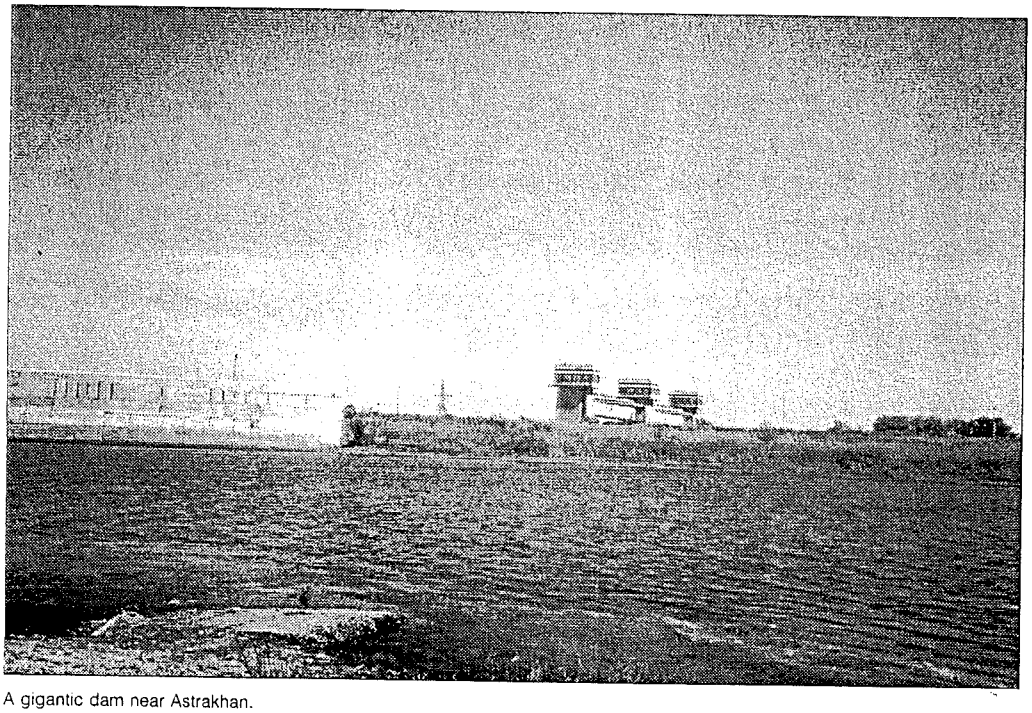
The threat posed by poaching to sturgeon populations in the Caspian region is exacerbated by the indiscriminate methods used by poachers. In the Caspian Sea waters fished by members of the CIS, poachers interested only in sturgeon females with ripe eggs (about seven per cent of the catch) nonetheless kill all fish they catch, including males and young sturgeons (Anon., 1995b). Killing sturgeons in their youth greatly accelerates the potential erosion of sturgeon stocks. This exploitation is exacerbated by the fact that trawling, although banned by USSR authorities in 1959, is thought to be in operation once again in the Caspian region. As a method of fishing it is unselective and thus destructive: large volumes of by-catch (including male and immature female sturgeons) are needlessly killed, while the trawl net dragged along the bottom of the sea or estuary, destroys the benthic ecosystem on which sturgeons feed (see **Regulation of sturgeon fisheries in the Caspian Sea**).

Although the caviar trade is the principal object of this investigation, there are various other products of the Caspian sturgeon fishery which contribute to the decline of Caspian sturgeons. Fresh, and especially smoked or dried meat (usually called *balyk* in Russian), is considered a delicacy by Russians and sold at R75 000 (15US$ per kg) in Moscow shops in September 1995 (Anon., 1995b), or for 15 to 20US$ for a dish of five slices in restaurants (Anon, 1996c). The meat of sturgeons is commonly dried and pickled in Iran, mostly to be consumed locally (Vadrot, 1990). Swim bladders are dried and used in the preparation of gelatin. Called isinglass, it is used in beer clarification, waterproofing materials, jellies, paint toners and glues. Recently, a tannery in Mazandaran Province of Iran reported that leather produced from 200 pieces of Caspian sturgeon skins, was used for handicrafts and bookbinding (Anon., 1994c).

Habitat degradation

From the early 1950s, the Government of the USSR dammed the Volga River and other tributaries of the Caspian Sea for the creation of reservoirs and hydroelectric plants. Through the construction of these, accessibility of natural spawning grounds in rivers conjunct with the Caspian Sea was reduced considerably. Lower Volga spawning areas were reduced by 85%, from 3500ha to fewer than 500ha: Belugas lost almost all their spawning sites in the river as a result (Birstein, 1996). In the Kura River, only 160ha remain, in the Safid-Rud River only 200ha, and in the Terek River 132ha: spawning apparently no longer takes place in

these rivers (Khodorevskaya *et al.*, in prep.). Not only do the dams themselves obstruct sturgeons physically, but the uptake of water for agricultural and industrial purposes from rivers leading to the Caspian Sea, (e.g. the Volga River and Atrek River, in Turkmenistan), is so great that some deltas are dry except during floods. Thus, adult sturgeons are prevented from reaching their natural spawning grounds (Raspopov *et al.*, 1995), and juveniles migrating downstream from reaching the sea. Engineers have tried to design "sturgeon passages" for the fish to by-pass the dams, but they appear not to be effective, (whereas special passages have been designed successfully for salmon) (Anon., 1995b).



Dr Vadim Birstein

A gigantic dam near Astrakhan.

It is estimated that before the Volga River flow was regulated in 1958, the spawning stock of sturgeons in the river system consisted annually of some 20 000 Belugas, 400 000 Stellate Sturgeons and 700 000 Russian Sturgeons. During the 1960s, with the aid of stock enhancement and bans on sea fishing, the stock was maintained at approximately 5700 to 11 000 Belugas, 600 000 to 907 000 Stellate Sturgeons and 334 000 to 450 000 Russian Sturgeons (Khodorevskaya, 1992). However, information collected at artificial fish passages documented a steady decline in spawning sturgeon populations since the 1960s. Figures from two such passages, for example, were 60 000 spawning sturgeon in 1967; 29 700 in 1980; 3400 in 1984; and only 2250 in 1987 (Dumont, 1995). While the fall in numbers is not solely attributable to regulation of the Volga River waters, this action which will have had a direct effect on sturgeon spawning by the 85% reduction in availability of spawning grounds caused (see above).

The Ural River remains the last large unregulated river flowing into the Caspian Sea. By contrast, it still has 1400ha of natural spawning grounds (Khodorevskaya *et al.*, in prep.), and the Ural is the only river feeding the Caspian Sea where sturgeons continue to reproduce completely naturally, there being no hatchery along its course.

A rise in the water level of the Caspian Sea between 1978 and 1989 (after a previous continuous fall from 1970-77), resulting in lower salinities, may positively have affected the reproductive metabolism of the fish, as well as accessibilty of feeding sites and abundance of food to be found. Increasing waterlevels are

associated with better growth rates of sturgeons, and indeed this was the case for Russian and Stellate Sturgeons in the Caspian Sea from 1978 to 1989. The average weight of Belugas, however, continued to fall after water levels rose, and thus an average Beluga weighed 110kg in 1970, but only 57kg in 1991 (Khodorevskaya *et al.*, in prep.).

Pollution from oil and industrial sewage output have caused serious degradation of the water quality and of the benthos (the flora and fauna living at the bottom of a lake or sea), essential sturgeon food. Petrochemical production is active on the Mangyshlak Peninsula, in Kazakhstan, and is a cause of pollution in the northern part of the Caspian Sea. Petrochemical pollution is also evident in the waters off Azerbaijan, while the discovery of new production fields in the sea gives potential for further impairment of water quality (Khodorevskaya *et al.*, in prep.). From 1985, scientific surveys in the USSR revealed that pollution, including from oil products and heavy metals, had started to affect the sturgeon reproduction in the Caspian Sea (Boyle, 1994). Between 1980 and 1992, the copper content in the Volga increased 11.5 times, zinc 9.8 times, lead and cadmium 4.9 times (Boyle, 1994). By 1989, concentrations of petroleum products in the northern Caspian Sea exceeded the maximum amount permissible by the the Government by nine times, and there were also considerable concentrations of phenols, surface-active agents, and pesticides (Boyle, 1994).

When, in 1987, muscle degeneration and mass starvation were first observed on a large-scale among Belugas, Russian Sturgeons and Stellate Sturgeons, it was found to be caused by the accumulation of certain toxic pollutants (Khodorevskaya *et al.*, in prep.). Although the incidence of muscle atrophy is declining at present, owing to the fact that a number of factories and industries in or near the Caspian Sea have closed down in recent years, environmental conditions have not improved sufficiently, such that Caspian sturgeons are free from the threat of habitat degradation. V.G. Shagaeva and her colleagues at the Russian Academy of Sciences reported that 100% of the mature sturgeon oocytes collected in 1990 from fish in the Volga River had "various anomalies", and that "all the eggs were deformed". Moreover, "foreign inclusions were noted in almost all eggs under the membranes and between them and the yolk granules". The scientists concluded that if water quality did not greatly improve in the near future, sturgeon reproduction rates would continue to decline, eventually to the point of the extinction of sturgeons in the Caspian Sea.

Genetic alteration

The purity of Caspian sturgeon species has been threatened by hybridization as a result of contact with sturgeons from the Black Sea, which is connected with the Caspian Sea by the Volga-Don Canal (Dumont, 1995). While hybridization occurs in natural conditions, it is greatly stimulated by artificial connections between isolated waterbodies, such as the linking of the Black Sea with the Caspian Sea, *via* the Volga-Don Canal, which seems to have caused an "avalanche" of hybridizations (H. Dumont, *in litt.*, 21 May 1996).

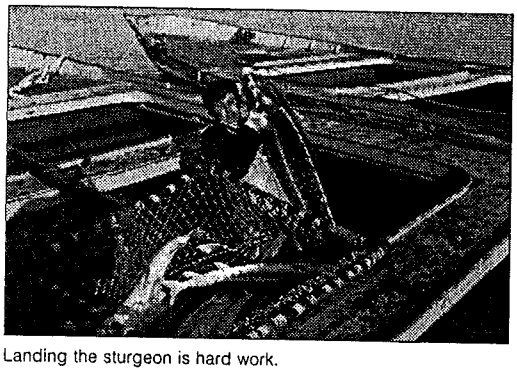
THE REGULATION OF CASPIAN STURGEON FISHERIES

Data on fishing regulations, and sturgeon catches from the producing countries were difficult to obtain, as explained in **Methods**, and often non-existant or untrustworthy, especially in CIS Member States, where management practices in many cases have yet to evolve.

Sturgeons are fished almost all year round. The two principal seasons however are spring and autumn. Belugas and Russian and Stellate Sturgeons are principally fished in the autumn in Iran, when they migrate to southerly parts of the Caspian Sea and in spring in the northern parts of the Caspian Sea.

Regulation in the USSR

After the Russian Revolution in 1917, strict regulations were formulated for the entire sturgeon fishery (Vadrot, 1990). In 1925, one visitor described how "fishermen caught the sturgeon on long lines of bare hooks that lay like a rake before the shallow entrance of this mouth of the Danube. The sturgeon, feeling his way up along the bottom, met these obstructive hooks..... With the ice coating the black skiff these..men pulled a sturgeon almost as big as a man into the boat. They they beat him to death with wooden clubs." (Farson, 1932).



Ptodimex

Landing the sturgeon is hard work.

Within the Caspian region, it became policy to concentrate sturgeon harvest on the lower Volga River, instead of on the sea itself from 1951, and by 1959 a ban on trawling and on targeting sturgeon in the open waters of the Caspian Sea was in place. From that time, sturgeons could only be taken as by-catch in the sea, until 1991, when Soviet control over the fishery began effectively to lapse.

During the peak season of the sturgeon fishery, 10 days of fishing were allowed, followed by 10 days without fishing. Fishing boats travelled upstream to drop fixed nets of about 300m width, in which sturgeons and other fish were caught. The nets were not allowed to touch the bottom and sides of the river, in order to leave clearance for juveniles migrating to the sea, and to prevent the destruction of the benthic communities. No trawling was allowed and fish caught were immediately checked and males or immature females were returned to the water. Ripe females were transferred to one of five factory boats moored in the Volga delta, close to the fishing grounds, for extraction of their oocytes.

Pressure on wild sturgeon populations was believed to be too heavy, despite effective state regulation, and USSR authorities decided that artificial reproduction and stock enhancement programmes for Belugas, Russian and Stellate Sturgeons in hatcheries along the Volga River should be initiated. From the 1950s until 1987, the breeding and husbandry technology used by these hatcheries was considered a state secret (see ***Stock enhancement***).

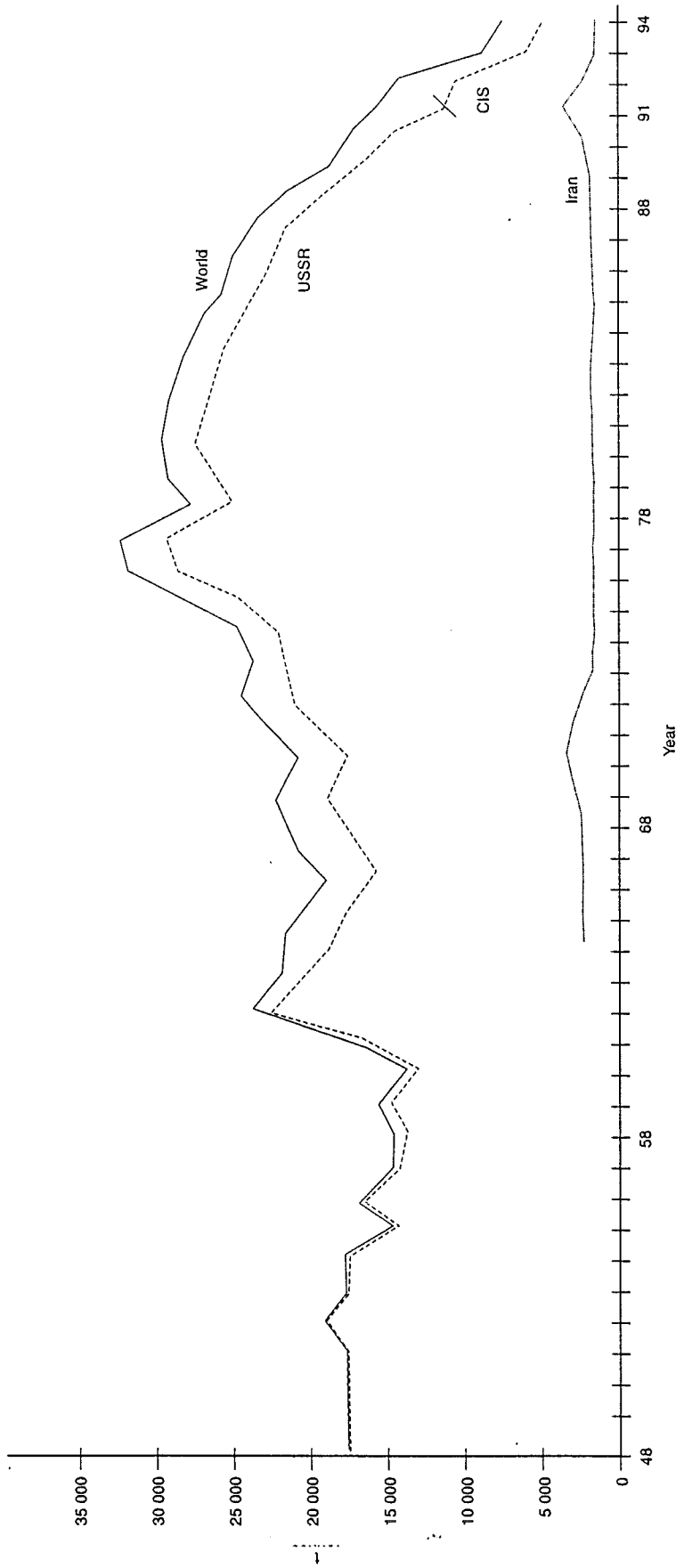
It seems that these management tactics greatly benefitted Caspian sturgeon populations (see Figure 4; Khodorevskaya *et al.*, in prep.), while altering fundamentally the lifestyle among fishing communities. Of 12 000 fishers who had been licensed to fish in the Volga River delta, the lower part of the Ural River, and the small rivers of the northern Caspian Sea basin in 1913, only 2000 were licensed to do so on the Volga River between Astrakhan and the sea, a few on the Ural River, and almost none on other Caspian tributaries by 1990 (Vadrot, 1990).

Official sturgeon catch in the USSR

The largest sturgeon catches recorded from the Caspian Sea were at the beginning of the twentieth century by the USSR fishery. In the 1980s, the Volga-Caspian region of Russia accounted for 80.1% of the total catch of sturgeon in the Caspian basin (Khodorevskaya, *et al.*, in prep.), and for most of the second half of the twentieth century, the USSR fished some 90% of the world's sturgeon, in annual quantities rarely below 15 000t (see Figure 4).

Figure 4

World sturgeon catch, 1948-1994



Source: Anon., 1996a

Uncontrolled fishing in the USSR

An example of evasion of Government control earlier this century was described by one writer, who reported that "fishermen had to "sell" all their sturgeon to the Fish Control – a horrible piece of Government graft – and the big ... [fish] ... was duly taken up to the market at Wilkowo; but the smaller one was walking around all that afternoon, cut up in small pieces, in the fishermen's pockets and down inside their boots." The writer adds that the fishermen he visited were aware they may be killed for no more than careless talk, let alone concealment of fish (Farson, 1932). Indeed, until the early 1990s, illegal catch seems to have been limited in scale on the whole. Nonetheless, some more recent poachers were well organized and equipped with fast boats and must have had to collect significant numbers of sturgeons in order to pay back such an investment in equipment. They were known to have worked at night, to minimize the risk of capture by one of numerous patrols (Anon., 1995b).

Regulation in Iran

In Iran, which has a 700km-long coastline along the Caspian Sea, sturgeon stocks were exploited by Soviet or Iranian/Soviet concessionaires from late in the nineteenth century until 1953, but Iran emerged as the second nation fishing Caspian sturgeon independently in the early 1950s. The Iranian Fishery Organisation (IFO), often called the Shilat, is the national Government institution in charge of sturgeon fishery management and the caviar trade in Iran. The organization has existed since the time of the Shah and allows no private sturgeon fishery or caviar trade, resulting in a state monopoly of these practices. In 1994, the Shilat published a new regulation setting a size limit for all sturgeons caught, namely a minimum of one metre in length. The Shilat also reportedly reduced catch allocations for sturgeon fishers, from 1993 (Anon., 1996c), but current quotas for sturgeon catch are not known apart from a reported 970t in 1994 for Mazadaran Province.

Iranian fisheries operate in the southern part of the Caspian Sea, where numbers of fishing sites along the coast near the river estuaries are limited to 90. There are two fishing seasons, one in October to November, said to be the best season in Iran for Russian Sturgeons, the other mainly during the month of March, which is the main season for fishing Belugas and Stellate Sturgeons in Iran.

As in the former USSR, fixed nets of about 300m width, leaving free space along the bottom and sides of rivers, are the only authorized sturgeon fishing gear in Iran. Trawling is forbidden in the Caspian Sea basin by Iranian authorities. Fishers on their small traditional boats set out each day to check their fixed nets, arranged perpendicularly to the shore. Only 10% of the day's catch will be sturgeons. Within six hours, the sturgeon catch is brought to the only national fish processing plant, on board a ship, where oocytes are extracted and caviar prepared.

Official sturgeon catch in Iran

From 1953 onwards, Iran became an independent producer and exporter of sturgeon products – until then its production of caviar was entirely consumed in the USSR (Bourguignon, 1989). During the twentieth century, sturgeon catches in Iranian waters have fluctuated between 700 and 2500t annually (see Figure 4). After the Second World War, Iranian catches reached a peak of about 2500t towards the end of the 1960s, and dropped off to 1000-1500t in the 1970s until the mid-1980s (see Figure 4). From 1984 till 1991, the annual Iranian sturgeon catch showed a steady increase, however, and reached a high of 3036t in 1991, but has fallen sharply since then (Table 2).

Table 2

FAO-reported world sturgeon catch (t)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Former USSR	25 740	25 570	24 245	22 772	21 817	20 991	19 027	16 880	15 056	-	-		
Russia	-	-	-	-	-	-	-	-	-	9 536	8 806	4 751	4 460
Azerbaijan	-	-	-	-	-	-	-	-	-	108	106	98	95
Ukraine	-	-	-	-	-	-	-	-	-	89	159	294	232
Kazakhstan	-	-	-	-	-	-	-	-	-	1 766	1 708	1 601	635
Total CIS	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11 499**	**10 779**	**6 744**	**5 422**
Estonia*	-	-	-	-	-	-	-	-	-	-	-	8	3
Iran	1 450	1 288	1 557	1 650	1 690	1 759	1 851	2 051	2 645	3 036	2 692	1 710	1 700
Italy*	-	-	-	-	-	-	-	-	250	300	350	310	333
France*	-	-	-	-	-	-	-	-	-	-	-	140	150
Canada*	129	116	163	161	56	50	53	91	42	51	289	444	352
USA*	321	321	480	232	546	519	314	232	277	201	220	217	162
Bulgaria	50	36	12	9	30	21	1	28	13	10	10	1 010	10
Romania	64	76	81	56	42	40	35	26	4	15	15	19	8
Total	**27 718**	**27 407**	**26 538**	**24 880**	**24 192**	**23 391**	**21 291**	**19 318**	**18 297**	**15 126**	**14 376**	**9 594**	**13 562**

* Includes aquaculture production of sturgeon.

Source: Anon., 1996a

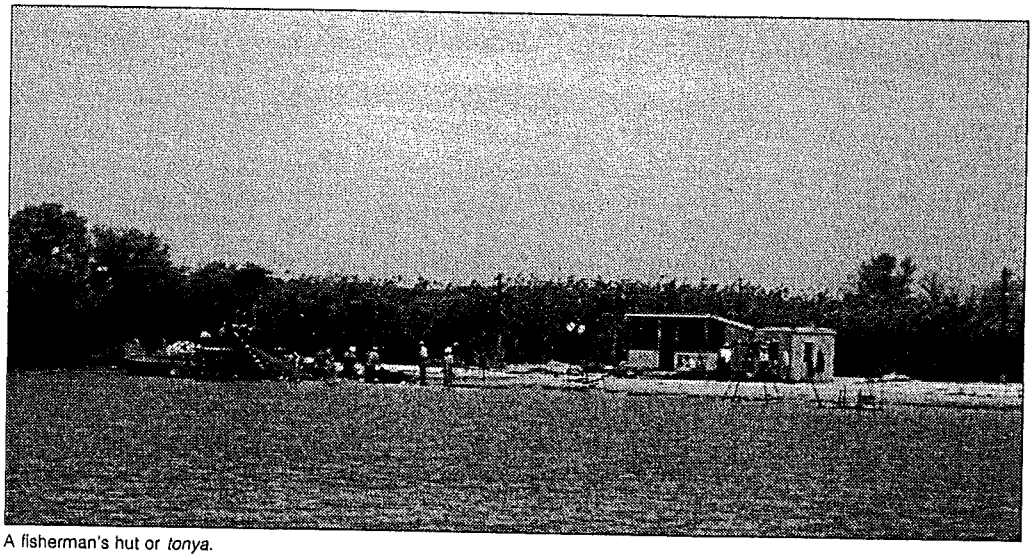
Uncontrolled fishing in Iran

The risk of punishment reportedly prevents most sturgeon poaching in Iranian fishing waters and the Government monopoly of the caviar trade managed through the Shilat is said, by specialist caviar importers, to be a reasonably efficient control system.

Regulation in the CIS

The CIS countries which have shared and exploited sturgeon resources in the Caspian Sea basin since 1991 are Azerbaijan, Kazakhstan, Russia and Turkmenistan.

In Russia, the laws of the former USSR have been kept and organization of the sturgeon fishery in the Volga River delta remains very similar to that prior to Russia's independence, in theory. Trawling is still forbidden in Russia. About 12 teams of legal fishermen around Astrakhan live in traditional temporary huts called *tonya* (meaning "haul of fish"). Just as before 1992, they set their nets every morning and bring them on shore a few times a day. The fixed nets allowed are the same as those allowed in the USSR formerly and do not touch the bottom of the river. Scientists regularly inspect catches to measure and weigh sturgeons, take tissue samples for histological examination, collect fins for assessment of the age of sturgeons caught and to conduct other research. The results of this research and the resultant data which have been compiled since the early 1950s constitute the sum of knowledge regarding the health and status of sturgeon populations in the northern part of the Caspian Sea.



Dr Vadim Birstein

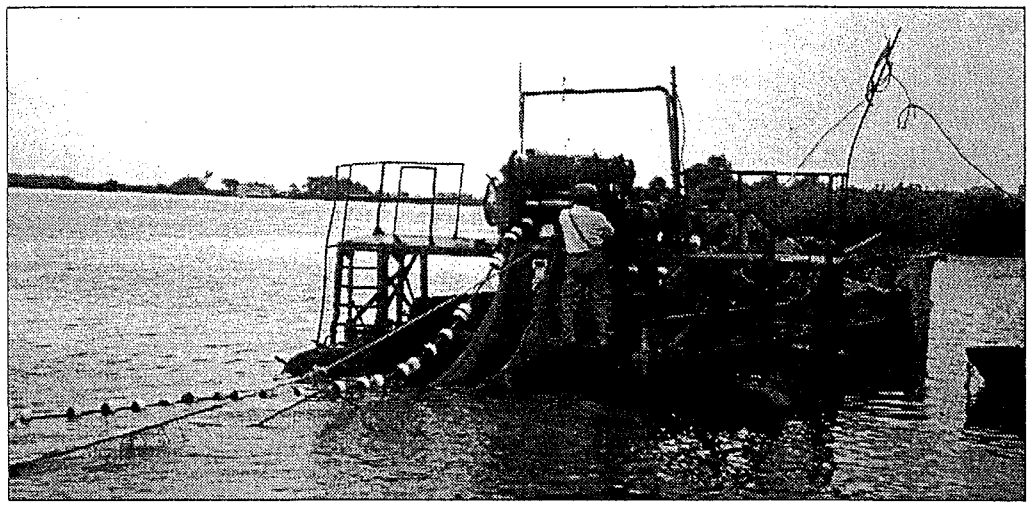
A fisherman's hut or *tonya*.

Fisheries management is regulated by the Russian Federation Committee on Fisheries, or *Roskomrybolovstvo*, (the former Ministry of Fisheries of the USSR). Russia has inherited a complex bureaucracy that is in charge of managing the country's fisheries resources. Within *Roskomrybolovstvo*, the Fish Stock Protection and Restocking Federation Administration, or *Rosrybvod*, and the research institute, VNIRO (the All-Russian Research Institute on Fisheries and Oceanography) are involved in the management of Caspian sturgeon stocks in Russia. *Rosrybvod* is responsible for safeguarding Russia's fish resources, including the aquaculture of some species. The Russian Federation Committee on Fisheries has local branches, of which one named *Kasprybvod* is responsible for overseeing the lower Volga and Caspian Sea waters. The local branch has inspectors (special police) and runs a research institution, whose main research institute for sturgeons, KaspNIRKh, is based in Astrakhan.

Since the USSR was dismantled, most other CIS Member States have not yet formulated their own fisheries regulations, and those which are in place are often unclear. In the absence of clear legislation and enforcement in these states, sturgeon fishing has resumed at sea, and it is common to observe nets and trawlers in the Caspian Sea, while poachers are proliferating and operate openly (Anon., 1995b).

Official catch of Caspian sturgeon by the CIS

After the dissolution of the USSR, the reported annual catch of Caspian sturgeons by CIS countries halved between 1992 (10 620t) and 1994 (5190t) (see Table 2). The Volga-Caspian region remains the most important in the Caspian basin in terms of official commercial sturgeon catch, contributing 75 to 80% of all sturgeons caught, but most experts expect that over the next two or three years, the total Russian Caspian sturgeon catch will fall under the current official total of 1000-1500t per year (Anon., 1995b). The Russian quota for sturgeon catch in 1996 has reportedly been reduced to 45% of the 1995 quota, or 719t (Artyukhin, 1996) and it will most likely be necessary to consider closing the legal commercial fishery completely in one to two years according to some (Ivanov *et al.*, 1995b).



Dr Vadim Birstein

Fishermen with net in the Volga River delta.

Kazakhstan's sturgeon catch comes principally from the Ural River. According to FAO statistics, Kazakhstan recorded catches of around 1700t in 1991 and 1992, from which level the annual tonnage plummeted by two-thirds between 1993 and 1994 (see Table 2).

Azerbaijan has recorded fairly stable annual catches, low compared to those of its Caspian neighbours. The sturgeon catch from the Kura River in Azerbaijan is reported to have plunged from an average 2100-2400t per year during the 1950s and 1960s, to 60t in more recent years, but no up-to-date information is available on the status of sturgeon stocks and the local fisheries (Anon., 1995e).

The species composition of the sturgeon harvest in the northern part of the Caspian Sea fished by countries of the CIS (see Table 3), is little different from that reflected in findings of scientific sampling sets conducted in 1991, which found the relative abundance of the three species to be Belugas (14%), Stellate Sturgeons (33%) and Russian Sturgeons (53%) (Khodorevskaya *et al.*, in prep.).

Table 3

Sturgeon catch in the northern part of the Caspian Sea basin 1990-1995 (t)*

Year	Belugas	Russian Sturgeons	Stellate Sturgeons	Total
1990	100	7800	5700	14 600
1991	900	5400	4700	11 000
1992	900	3900	3900	8700
1993	340	2400	1400	4100
1994	153	1500	1500	3150

Source: *The first two years' data are given in the *Proceedings of the International Symposium on Sturgeons* held in Moscow, 6-11 September, 1993. VNIRO Publishing, Moscow. The last three years' data were provided by Vlasenko, A. (KaspNIRKh).

Uncontrolled sturgeon fishing in the CIS

According to local fisheries experts, illegal catch accounted in 1995 for about 90% of all sturgeons caught in the northern Caspian Sea basin. Certainly, it is said to equal former Soviet commercial catches of sturgeon, which were almost always above 15 000t *per annum* (Ivanov, 1995b; see Figure 4).

Khodorevskaya *et al.* (in prep.) note that since 1990, uncontrolled fishing of sturgeons in the Volga River spawning areas has increased enormously, (while at the same time, stock enhancement programmes have declined). Indeed, in Russia, almost all sturgeons swimming up-river to the remaining spawning grounds south of Volgograd are reportedly caught by poachers (Anon., 1995b; Birstein, 1996). Between Astrakhan and the Caspian Sea - some 500km - almost all villages alongside the Volga River live off sturgeon poaching (Anon., 1995b). Catching the fish, which have already swum several kilometres to reach their spawning grounds is relatively easy.

Sturgeons spawning in the Ural River, the second-most important river in the Caspian Sea for the fish (Birstein, 1996) and the only one where they still reproduce naturally, are similarly being depleted illegally. It seems that since 1991, Ural spawning stocks have been practically destroyed by poachers (Anon., 1995b). As on the Volga, all migrating sturgeons are potentially prey to poachers, who control the relevant stretches of both rivers (Ivanov, *et al.*, 1995b; Birstein, 1996).

Poachers are known to use nets with steel hooks reaching to the river bottom in order to catch low-swimming sturgeons, an illegal use of nets in Russia, where the law requires that spaces below and beside nets should be sufficient to allow some sturgeons to circumvent capture (Anon., 1995b). The number of nets for catching sturgeons in the Volga delta had quadrupled by 1993, relative to the number of nets during the 1980s (Ivanov *et al.*, 1995b).

A unknown portion of the Caspian sturgeon catch is reportedly taken by officials and licensed fishers also. According to Russian tradition, licensed fishers are expected to share their catch with river guards and inspectors, while also being allowed to take some for their own use. Traditionally, these fish are of inferior quality. Until the late 1980s, the "share" was estimated to average about 30% of all fish caught, whereas now it may reach 90% (Anon., 1995b).

In summary, although the control system for sturgeon fisheries set-up during Soviet times remains in place, and is now supervised in Russia by the Government, it is said to be abused at all levels. The lack of

effective police-power prevents the tackling of illegal fishing in Russia, which has been happening in broad daylight since the early 1990s.

Trawlers are again operating at sea off the coast of Azerbaijan and the country seems unwilling to sign up to control measures that would prohibit sturgeon fisheries at sea. As mentioned earlier, the number of nets set in Azerbaijan for sturgeons in 1993 was six times as great as in the 1980s. The catch of sturgeons in the open sea, in particular, by Azerbaijan appears to make little sense economically, not to mention ecologically, since females caught at sea are often immature and thus their roe produces poor quality caviar which cannot be sold legally on the international market (Birstein, 1996). However, as the legal parameters for sturgeon fisheries appear unclear in Azerbaijan and Kazakhstan, little effort is made to control the use of areas for fishing, or the size or sex of the catch. Little is known about sturgeon fishing in Turkmenistan, except that sturgeon poachers operate off its shores (Ivanov, *et al.*, 1995b).

Sturgeon poaching outside the Caspian region

Sturgeon poaching is said to be even worse in the Ob River basin in Western Siberia than in the Caspian region. In 1994, only nine tonnes of Siberian Sturgeon *Acipenser baeri* were legally caught in the Ob River, while 250-300t were illegally sold on the local black market (Ruban, 1996). In the Russian Far East, where the middle reach of the Amur River forms the border between Russia and China, the two endemic sturgeon species, the Amur Sturgeon *Acipenser shrencki* and Kaluga, are suffering seriously from the legal and illegal catches made by fishers from both countries. According to local Russian scientists, the intensity of the catch is ferocious: since 1992, dozens of Russian and hundreds of Chinese boats have operated on the Amur River. Chinese fishermen check their nets every 15 minutes and 80% of the fish caught are mature adults, which means that the broodstock of both species is undergoing quick depletion. In the Russian part of the river (the lower reaches) gangs of poachers were formed in 1994-1995, equipped with powerful motor boats obtained from former military instalations in Komsomolsk-on-Amur. Dishonest guards are said to provide the gangs with the river guards' inspection schedules and several guards have been physically assaulted and threatened with murder. From the numbers of sturgeons caught legally from 1989 to 1993, (Table 4), it is evident that the stock is declining rapidly.

Table 4

Sturgeon catch and caviar production in the Amur River basin

	Year	Sturgeon catch (t)	Caviar production (t)
China			
	1989	410	27
	1990	340	18
	1991	250	16
	1992	200	Not known
	1993	170	Not known
Russia			
	1991	64.0	4.5
	1992	62.6	4.0
	1993	47.3	2.5
	1994	45.0	2.5
	1995	43.0	2.2

Source: Data given by Dr. Victor Svirsky at the workshop *Sturgeon Stocks and Caviar Trade* in Bonn, Germany, October 9-10, 1995.

CASPIAN CAVIAR PRODUCTION

Oocyte extraction and preparation of caviar for sale

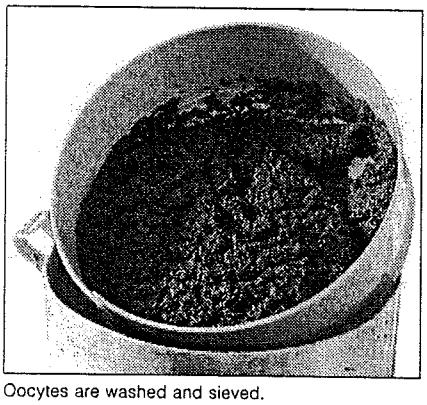
Description of general practice

The fragility of caviar requires that the oocytes are extracted from the sturgeon and processed with great care immediately after the catch. The quality of the final product depends on the degree of maturity of the oocytes (see **Box - Caviar, the delicacy**), and on the working conditions which should follow strict sanitation rules. Refrigeration at below four degrees Celsius should be maintained and oxidization prevented: successive reconditionings (the trade term equating roughly to "repacking") do not always respect these requirements, in which case quality degradation ensues (Josupeit, 1994).

Sturgeons are usually still alive when they arrive at the processing plant. Immediately after the oocytes have been extracted from the gonads of the female, they are washed and sieved to separate them from surrounding membrane, and re-washed. They are then examined by a specialist who will determine their quality according to hardness, size, and colour. If preservation with salt and or borax is intended, the oocytes are then stirred in brine of about 2.8-4.4% salt and borax[5] (a preservative added in a ratio of nine units of salt to one unit of borax) for two to three minutes, until they reach the right firmness. If stirred too long, the caviar becomes too sticky for consumers' taste. Alternatively, a certain proportion of caviar undergoes pasteurization as a means of preservation, for marketing reasons, which are described later.

Pladinex

The sturgeons are transported to the processing factories in tanks of water aboard barges or small boats.



Pladinex

Oocytes are washed and sieved.

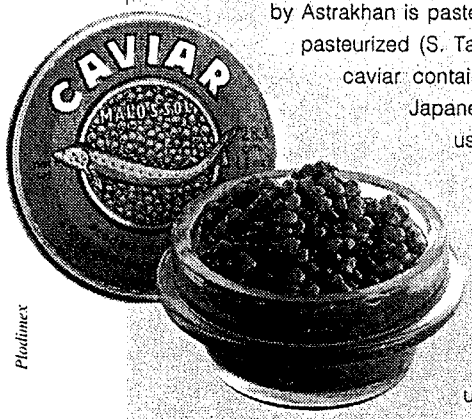
Once preserved, the caviar is packed in tin boxes (standard sizes of 0.5 or 1.8kg, but the net contents varies) coated inside with an anti-oxidant for enhanced keeping qualities. On arrival at its destination, most caviar is re-packed in smaller tins or jars (typically for quantities of 30g, 50g, 125g, 250g, 500g and 1kg) by importers and labelled under their name for retail. In some cases, the importer is the holder of the trademark under which the caviar is traded. Repacking from wholesale containers to retail jars and tins is done by specialists and must be carried out within minutes and according to precise temperature and sanitary specifications. The distribution of caviar in retail packs continues within an uninterrupted cold "chain" to the retail outlet. In Germany, for example, caviar is distributed in isolated parcels surrounded by dry ice, *via* a parcel service.

Different preparations of caviar

Fresh caviar is not salted. It requires optimum refrigeration as well as high skills, and is only handled by delicatessen shops, restaurants and hotels. Once taken out of the original tin, the shelf life of fresh caviar is maximum six weeks.

Malossol caviar is lightly salted. It may be beluga, osietra or sevruga. Almost all the caviar sold in Europe is malossol. It has a salt content ranging from 2.4% (often Iranian caviar) to 4.4% (more common for Russian caviar). Other caviar may contain as much as 11% salt. The lower the salt content, the better the malossol, but the shorter its shelflife. Borax, when used as a preservative, is added to caviar in the ratio of four grammes of borax to one kilogramme of caviar. In such an amount it is often considered to be less dangerous to human health than the amount of salt needed to give caviar a minimum acceptable shelflife. Malossol, transported chilled (between minus two degrees and four degrees Celsius) and then kept refrigerated will last for up to three months.

The majority of all caviar consumed in the world is *pasteurized* (S. Taylor, *in litt.*, 21 May 1996). The practice of pasteurization has existed in Russia since the 1950s. Fifty per cent of caviar produced by Astrakhan is pasteurized and almost 100% of Russian caviar purchased by Japan is pasteurized (S. Taylor, *in litt.*, 21 May 1996). Indeed, since Japan does not import caviar containing borax, pasteurization is the only alternative preparation for Japanese consumers avoiding higher salt levels. Pasteurized caviar is used without exception by supermarkets and airlines (S. Taylor, *in litt.*, 21 May 1996). Pasteurized caviar may undeservedly have earned a poor reputation, by association with the opportunity with which it provides some traders for re-conditioning old or unsafe stock (S. Taylor, *in litt.*, 21 May 1996). Pasteurized caviar will last in edible condition for 12 to 15 months, provided it is stored properly. Some claim that the shelflife of caviar can be much longer if kept at lower temperatures, and that caviar is sometimes stockpiled for months until favourable market conditions prevail, according to importers.



Pladimex

Malossol caviar: malossol is a Russian word meaning 'not much salt'.

Pressed caviar is made with a mixture of oocytes: either unripe, overripe, or from different species of sturgeon, made espcially in Azerbaijan and Russia. The oocytes are heated slightly and then pressed in cloth. Three and a half kilogrammes to four kilogrammes of fresh caviar produce one kilogramme of pressed caviar. A good pressed caviar has a high proportion of Beluga eggs (Vadrot, 1990). It is easy to spread on toasts or blinis (small buckwheat pancakes).

The choice of preparation for caviar depends mainly on the quality of the roe, but is also influenced by import regulations of consuming countries (e.g. whether or not borax is permissable) and by market taste. In some countries consumers prefer pasteurized caviar, while others perceive it as a low quality product, yet others claim to be able to discern between caviar of mature fish taken in the upper river and that of young fish caught before they return to the sea.

Widespread illegal trade in caviar over the last four years, has had dramatic consequences on the quality of most caviar on the world market. Since 1991, the quality of Russian caviar has deteriorated and in some cases not been suitable for sale (Taylor, 1995).

Practice and regulation in the USSR

Processing methods were very similar to those used in Iran now. Once a female sturgeon was on the processing plant, it took only 30 minutes and four people to collect, wash, process and can the caviar. Aboard the processing ship, one worker knocked the fish on the head (a method which prevents the liberation of toxins (Vadrot, 1990)), another extracted and cleaned the oocytes, which were usually dipped for a few minutes in a solution of salt and borax before final packing in 0.5kg and 1.8kg tins. All boxes were numbered. This process was supervised by an engineer trained within the Ministry of Fisheries, which financed research into and quality control of caviar production. Various processing methods existed and caviar varied in saltiness and was obtainable fresh or pasteurized.

Two companies were officially authorized to produce caviar in Astrakhan during Soviet times, one of which was the main producer for the whole of the USSR. In Kazakhstan, a long-established factory was also authorized to process and export caviar, in the city of Guriev (formerly Atyrau). Transport was under strict surveillance and trucks would travel straight from Astrakhan to either Moscow, if containing caviar for local consumption, or to departure points for their foreign destination, from where reputable caviar importers supplied the international market.

Practice and regulation in Iran

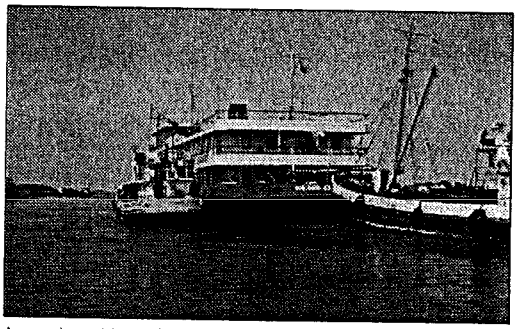
The Iranians were students of the Soviet experts in caviar production at first (Grigson, 1973), and their practice is therefore based on that of the USSR. Sturgeons are measured, weighed and individually registered with a number related to the processing plant and the fish, and this number is marked on the side of each can of Iranian caviar. According to information from renowned companies importing caviar, the commodity in Iran is packed at the plants in tins which preserve the contents for 12 to 18 months. Iranian exporters use 0.5 and 1.8kg-size tins mainly, but retail packs of 100, 200 or 300g are emerging in Iran and gaining in popularity (Josupeit, 1994). The tins are stored at minus two or three degrees Celsius (the caviar does not freeze because of its natural oil content and the salt additives) (S. Taylor, *in litt.*, 21 May 1996).

The entire process within Iran, from oocyte extraction to departure of the caviar from the country's national borders, is regulated by the Shilat, as no private enterprise in this trade is permitted.

Practice and regulation in the CIS

The "caviar boats" (floating craft aboard which caviar is processed), which are moored in the middle of the Volga River, as in Soviet times, are virtually inaccessible. Often four such official ships are operating in the Volga delta area and these facilities can only be visited by select delegates of foreign importers. According to these observers, the techniques used today to treat oocytes on board these processing plants are very similar to the traditional Soviet methods (Anon., 1995b; S. Taylor, *in litt.*, 21 May 1996).

A greater number of facilities are granted sturgeon quotas and are authorized to process caviar than within the former USSR, but detailed information is difficult to obtain. In principle, all Russian businesses are required to have official quotas for caviar production, but information regarding these is not widely available. The Russian Government also establishes quotas for caviar production for two of the Autonomous Republics within Russia - Dagestan and Kalmykia. Information on licensing requirements for production facilities was not made available. Quotas and other regulatory measures in force for Azerbaijan, Kazakhstan and Turkmenistan are not known. Turkmenistan does not appear to produce caviar for export, at least.



Dieckmann and Hansen

An anchored large factory ship near Astrakhan.

Packaging has allegedly undergone serious changes since the days of the USSR. The traditional 1.8kg- or 0.5kg-tins are slowly being replaced as Russia and Kazakhstan try to introduce their own retail packaging. Conveyer belts have been installed for packing caviar in glass jars and tins for retail sales. About 50% of Russian caviar is pasteurized, before being vacuum-packed in glass jars of 56g or 113g capacity, or in 90g-tins. In the long run, this new trend could eliminate repacking by importers, making quality control more difficult for them. No regulation

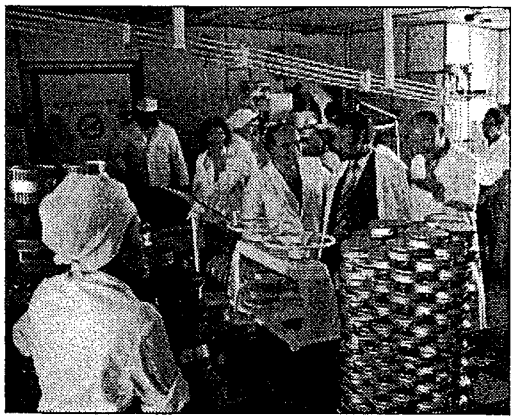
specifies that the caviar sold locally must be identified by species, all labels declare the same contents: "caviar from sturgeon fish".

Summary of practice and regulation of caviar processing

Based on observations and information gathered in the field, several organizations produce small quantities -less than 500kg- of caviar a year. Many such must be in operation in order to process the large quantities of caviar which must be available from illegal fishing. Not only is it not known for certain how many plants are involved in caviar processing in the Caspian basin at present, but those that are known to exist bar most from visiting them. The quantities of caviar handled, sanitary conditions and quality control of Caspian caviar are thus impossible to monitor, in general, in the present circumstances, although access is permitted to importers' representatives in some cases.

Volumes of Caspian caviar produced

Volumes of caviar produced from the Caspian basin are not currently known, but FAO data are available for the years 1961-1984 (see Figure 5), and thereafter estimates have been made based on recorded sturgeon catch data (see Figure 4) and intelligence from the supply countries reported to an experienced and reputable importer.



Plodimex

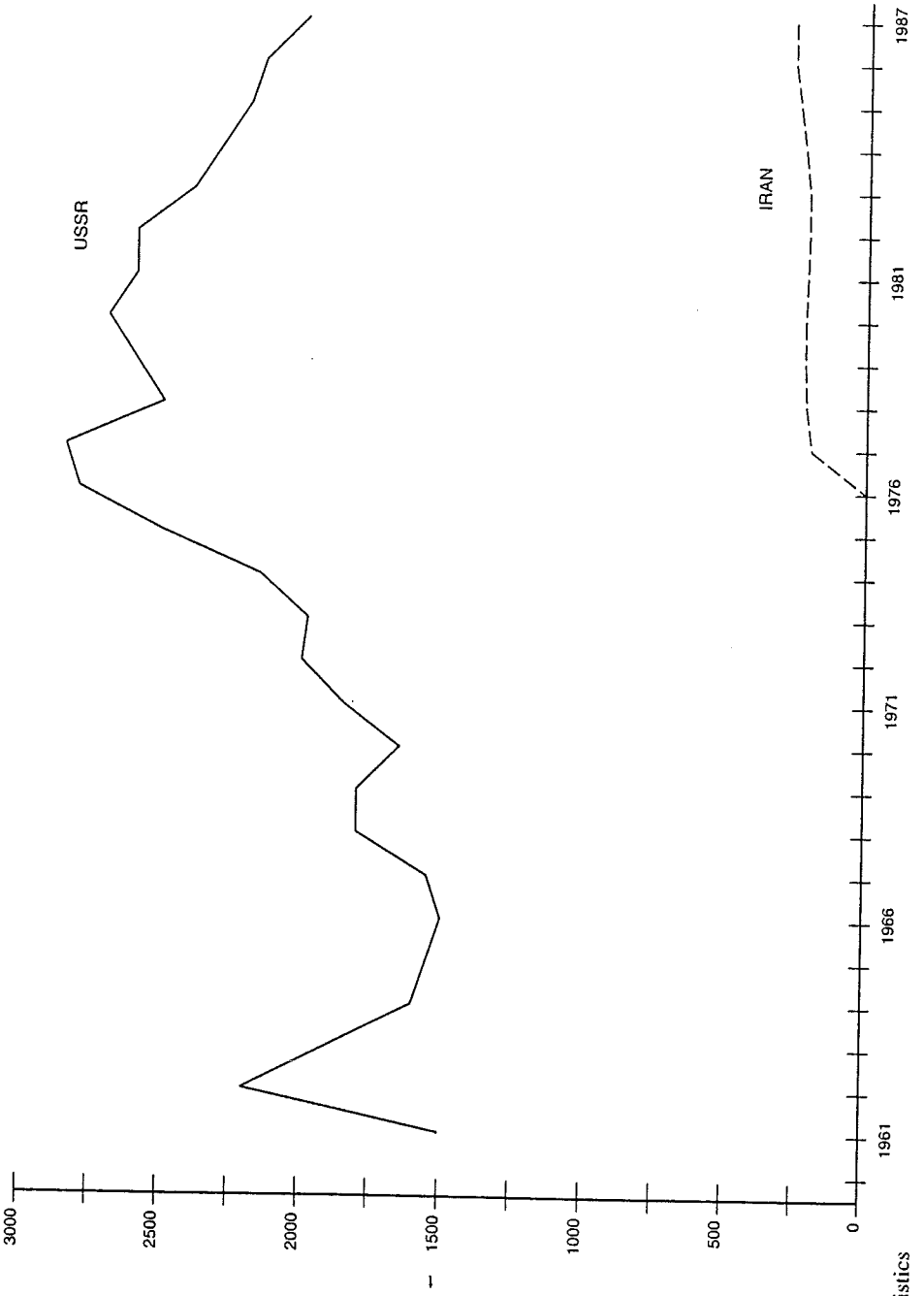
A delegation of European importers in Astrakhan inspects caviar preparation and packing in the USSR.

From 1961 to 1976, the production of caviar in the USSR doubled, but thereafter followed a general downward trend until 1987, as shown in Figure 5. According to sturgeon catch data it appears that this trend continued at least until 1994 within the CIS (see Figure 4). Iranian caviar production, first recorded in FAO statistics in 1976, rose from 25t in that year to 300t in 1987 (Figure 5). Sturgeon catch by Iran rose between 1987 and 1991 (see Figure 4) before falling again, which suggests that caviar production may have followed a similar pattern. After 1987, recorded caviar export volumes for the USSR and Iran rose and remained relatively high for some years (see Figure 6), but these levels do not necessarily reflect increased production. This is chiefly because domestic consumption levels are unknown - the world's largest supplier of caviar (the former USSR) was also reputedly the largest consumer, exporting only 10 or 15% its total production (S. Taylor, *in litt.*, 21 May 1996). Therefore, it is clear that international trade data probably miss an important share of the total Caspian caviar production on this count. Certainly, immense discrepancies exist between various sources on the volume of Caspian caviar produced. For 1990, for example, estimates of 13.300t (Dumont, 1995) and 2000t (Anon., 1994d) illustrate the range of calculations for that year's production.

One possible way to calculate Caspian caviar production volumes is to extrapolate from reported volumes of sturgeon catch, using as a basis for estimatation, the statistic that one mature female sturgeon carries between 7 and 14% of her weight in oocytes (see **Description of Caspian sturgeons**). Based on recent information from caviar producers approximately 7.5% of the tonnage of Caspian sturgeons currently caught is estimated to equate to caviar (S. Taylor, *in litt.*, 1 August 1996). Although this figure may then be used to evaluate caviar produced from reported catch of sturgeons, it is still difficult to arrive at an overall estimate for Caspian caviar production, since the amount derived from unreported sturgeon catches cannot be taken into account.

Figure 5

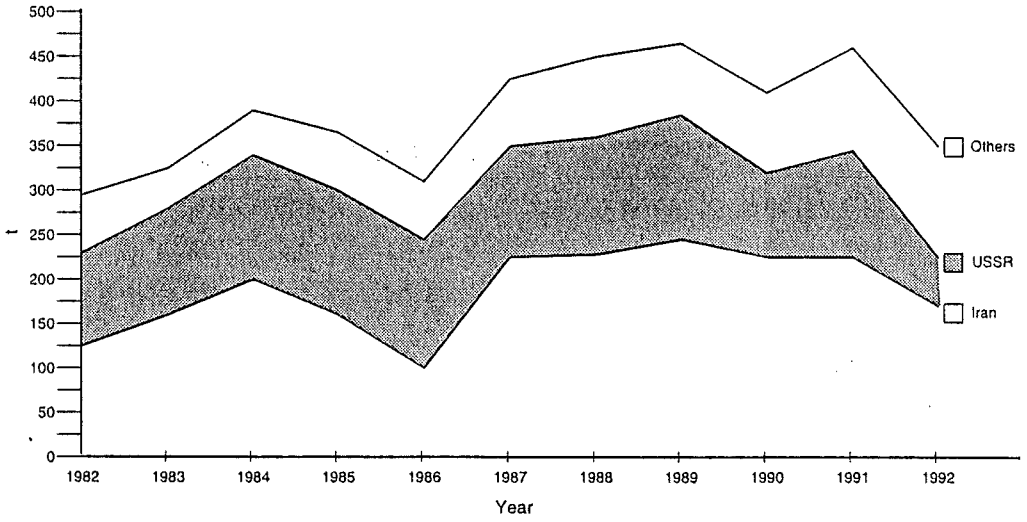
Production of caviar in the USSR and in Iran, 1961-1987



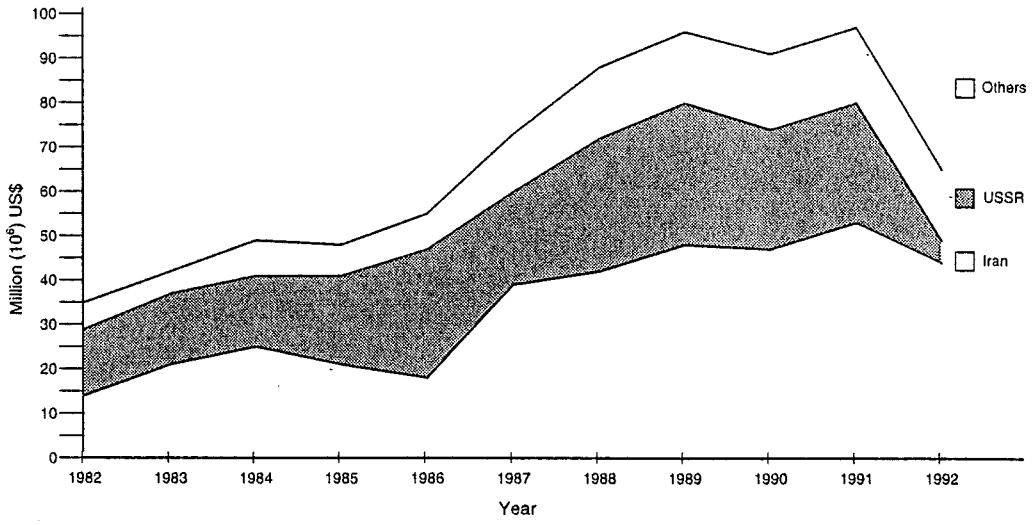
Source: FAO statistics

Figure 6

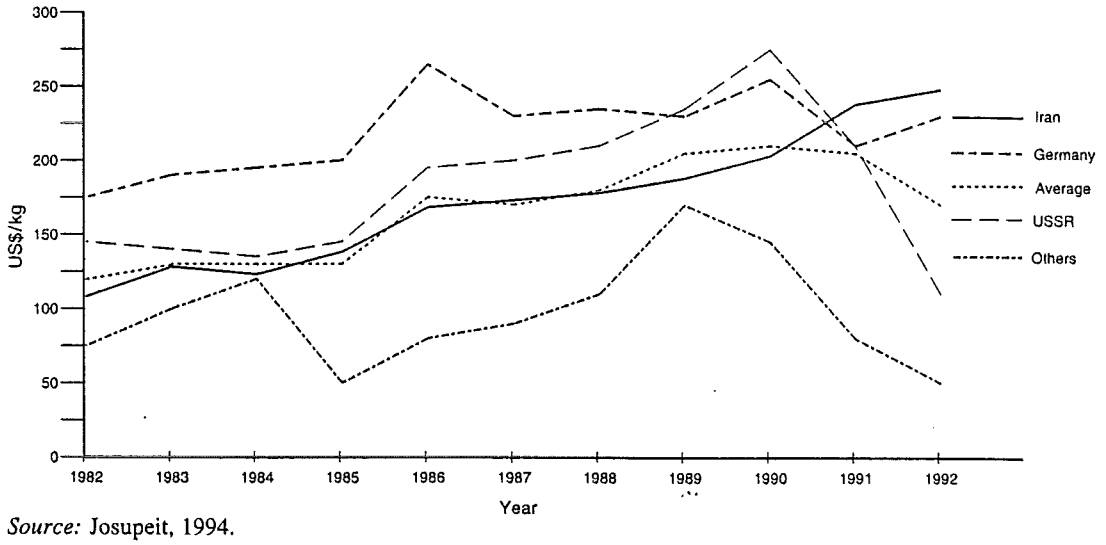
Cumulative world caviar exports (quantity)



Cumulative world caviar exports (value)



World caviar exports (unit value)



Source: Josupeit, 1994.

Some reports of the volume of illegal caviar production are alarmingly high: Moscow reported the illegal production of 1200t of caviar in Russia in 1990 and of 200t in 1992 (Lindberg, 1994). Despite gaps and discrepancies in available information, the following estimates of Caspian caviar production for 1996, based on numerous sources of information, may provide a useful indication of the order of magnitude of the trade. Caviar production from non-Caspian producers are also given, for comparison.

Table 5

Estimated caviar production for 1996

Source	Legal production (t)	Illegal production (t)
Volga area	45	
Kazakhstan	20	
Azerbaijan	5?	
Iran	120	
Total	**190**	**70-80**
Azov Sea	15	3
Black Sea	1	
Siberia	1	2
China	7	3
USA/Canada	8	2
Total	**32**	**10**
Estimated total Caspian production: 270t; estimated total production from other sources: 42t		

Source: S. Taylor, *in litt.*, 1 August 1996.

The quantity of caviar which has so far appeared on the market from 1996 catches is, according to a leading caviar importer, surprisingly high (S. Taylor, *in litt.*, 1 August 1996), which may suggest that sturgeon stocks in the Caspian are not quite as depleted as thought, but equally, may only mean that fishers are expending ever greater effort to earn their living from the catch.

The impact on sturgeon species of current caviar processing practices

Not only do unscrupulous or ill-equipped caviar processors contribute to the depletion of sturgeon stocks, by providing the next step in the caviar trade chain after the catch, but they may compound any negative effect on sturgeon numbers as a result of certain practices. Owing to the fragility of fish eggs, it is easy to produce poor-quality caviar, which falls below market standards. This has the effect of leaving demand unmet among consumers, in turn prompting renewed fishing effort and a redoubled exploitation of the donor species (see **Box - Different preparations of caviar**).

Typical factors leading to sub-standard caviar include:

- use of oocytes which are either too mature, or not ready to be harvested from immature females;
- poor preparation, for instance, through insufficient washing and sieving, which leaves traces of blood and membrane, or by using dirty salt, or too much salt;
- use of unclean water for washing the oocytes;
- use of poor packaging, which arrives at its destination rusted or with holes;

- inappropriate temperature control, for instance, interruption of the cold-chain, where temperatures rise above four degrees Celsius;
- repacking of caviar under careless sanitary and temperature conditions on importation;
- the mixing of oocytes from different sturgeon species.

Such conditions occur mostly with caviar produced and transported illegally by smugglers who do not have proper facilities for the trade, and by new "official producers" who may lack the necessary expertise (S. Taylor, *in litt.*, May 1996). Once again, therefore, the chaotic regulation of the caviar industry in parts of the Caspian basin has created a situation which is potentially or actually threatening the viability of sturgeon populations there.

TRADE IN CASPIAN CAVIAR

In view of the fact that recent production and export data were not, on the whole, available from supply countries, evaluation of the scale of the caviar trade has been made based on imports into the main consuming countries, according to Customs import data (see **Methods**). Some supportive, unofficial information was obtained from reliable scientists and importers relating to export from supply countries, however.

Domestic trade

Iran is said to consume domestically only about five per cent of the caviar it produces, which it markets as an exclusive delicacy (Vadrot, 1990). The proportion of caviar production exported by Iran is said to have increased yearly, from 38.7% in 1978, to 54.6% in 1984 (Gödecken, 1985) to reach the current proportion of around 95%, or more (H. Dumont, pers. comm., May 1996). Of the 120t of caviar which Iran expects to produce from the 1996 sturgeon catch, the Government has announced that 95t are expected to be exported (S. Taylor, *in litt.*, 21 May 1996).

In the former USSR, it seems that most of the national production was pasteurized and sold locally (Vadrot, 1990). Indeed, maybe only as little as 10-15% of caviar production was exported by the USSR prior to 1991. In the present day, refrigerated tins of caviar for the Russian market leave for Moscow by train or aeroplane from the city of Astrakhan, which produces the largest amount of caviar in the CIS. Although most consignments are destined for the capital, others are for St. Petersburg, or other large cities (Vadrot 1990). Current domestic levels of consumption within CIS sturgeon fishing countries are unknown, but estimated to be at about 100t per year (Anon., 1995b), in contrast to around 1800t per year in the 1970s and 1980s in the USSR (i.e. 85-90% of production). As a result, it may not be assumed that the increase in imports of caviar from the CIS (relative to those from the USSR) (see Table 8) reflects only a surge in caviar producton from that area, since there has also been an apparent shift in trade from local to foreign markets.

Reported international trade in Caspian caviar

Of the total Caspian caviar production, which in 1996 is estimated to total about 270t (see **Volumes of Caspian caviar produced**), most will be traded on the international market, judging from previous years' trade records (e.g., see Tables 6 and 7).

As explained in **Methods**, the only available official export data for caviar from the USSR/CIS and Iran, are from FAO, up until 1992. From 1992 to 1995, the most reliable data indicating exports of Caspian[2]

caviar are the import statistics of consumer countries. The following section draws therefore on FAO statistics, including Josupeit (1994), and on the import data of the main consumer countries: the EU, USA, Japan and Switzerland (Bourguignon, 1989; Josupeit, 1994).

It should be noted, however, that areas of caution exist in interpreting the international trade data examined here.

- Firstly, Customs records of some countries may use the term caviar to include roe of fish other than sturgeon. Swiss Customs import statistics, for example, were found not to distinguish between caviar and other fish roe, despite their being a contracting Party to the Harmonized Commodity Description and Coding System, as are all the main importers of Caspian caviar (Gaski, 1993). Similarly, the US import statistics for 1993 to 1995, suggest that consignments of non-sturgeon roe have been incorrectly assigned the tariff for caviar (S. Taylor, *in litt.*, 19 April 1996). The application of the name caviar to roe other than that of sturgeons, could cause mis-calculations in assessing the caviar trade.

- Secondly, clear discrepancies exist between principal sources of data consulted for this study, namely FAO statistics and import statistics of the principal countries receiving caviar from the USSR/CIS and Iran. For example, FAO statistics record that Russia exported 55t of caviar in 1992 (Table 6), whereas Eurostat data record that the EU alone imported 68t from Russia in that year. The differences between FAO and Eurostat data in particular are clearly shown in Table 7.

  One cause for discrepancy between data sets could be the erroneous allocation of tariff headings, as mentioned above. Otherwise, it could be owing to differing proportions of illegal trade registered by each set of statistics.

- Thirdly, caviar imports must be of at least one tonne to be recorded in Eurostat data, and thus as a source of information for calculating trade volumes, they will in theory under-record total amounts imported.

In the case of entrepôts in a given trade, there is always a risk of double-counting volumes. Switzerland is largely an entrepôt for caviar and thus Swiss import data may duplicate some of those of the EU. (Germany also serves as an entrepôt for Caspian caviar within the EU, but intra-EU trade of caviar was not calculated.) Since it is also known that Switzerland may record imports of roe of non-sturgeons as caviar, the volumes it handles are not addressed in this analysis, even though it is counted as a main importer of Caspian caviar (Bourguignon, 1989; Josupeit, 1994).

Table 7

Caviar imports by main importing countries (t)

	1988		1989		1990		1991		1992		1993		1994		1995 (Jan-June)	
	FAO	(1)	FAO	(1)	FAO	(1)	FAO	(1)	FAO	(1)	FAO	(1)	FAO	(1)	FAO	(1)
EU	242	191	212	172	203	154	258	210	273	202		265		192		59
Japan	86		90		103	58	119	70	92	55		52		56		
USA	47		72		57		48	32	74	54		59		61		28
Total	**375**		**374**		**363**		**425**	**312**	**439**	**311**		**376**		**309**		

(1) *Sources:* Eurostat, Japanese import and US National Marine Fisheries Service statistics.

Table 6

Caviar exports

	1988	1989	1990	1991	1992
	Caviar exports (t)				
Iran	225	249	226	225	169
USSR	143	141	96	126	
Russia					55
Others	204	105	103	152	142
Total	**572**	**495**	**425**	**503**	**366**
Caviar exports (1000 US$)					
Iran	42 155	47 865	46 005	53 800	42 004
USSR	29 817	32 557	26 777	26 896	
Russia					6 584
Others	14 221	16 250	17 150	16 563	15 141
Total	**86 193**	**96 672**	**89 932**	**97 259**	**63 729**
Caviar exports (unit value, US$/kg)					
Iran	187	192	204	239	249
USSR/Russia	209	231	279	213	120
Germany	228	226	256	208	223
Average	**151**	**195**	**212**	**193**	**174**

Source: Josupeit, 1994.

Volumes

As mentioned previously, the Caspian Sea has provided some 90% of the caviar in world trade, as revealed by an examination of statistics from numerous sources, including Customs records of the main importing countries (see Figures 5 and 6; compare Tables 7, 8 and 9; see Tables 12 and 13; S. Taylor, *in litt.*, 1 August 1996). In comparing the data presented in these tables, Iran and the CIS emerge clearly as the primary sources of caviar imported and moreover, other sources cited may not always be exporting true caviar. Switzerland — see above — Poland, Norway, Denmark, Sweden, Iceland and Greenland are known or thought not to distinguish between roe of sturgeons and that of other fish in their Customs records: all these countries show inconsistent export prices for their "caviar" trade.

From 1987 to 1990 (inclusive), the reported export totals of Iran and the USSR caviar remained relatively stable, fluctuating between 322 and 390t, according to FAO statistics (see Table 6). After 1990, however, the total volume of caviar from the USSR/CIS and Iran reported in trade by the principal importers (the EU, USA and Japan) (Bourguignon, 1989; Josupeit, 1994) increased markedly, by about 40t from Iran and the CIS, each, for the year 1991 (see Figure 6 and Tables 8 and 9). Collective volumes of caviar traded from the CIS and Iran by these importing countries after 1990 are recorded or estimated to be:

- 1991 - 265t
- 1992 - 286t

- 1993 - 318t
- 1994 - 269t (Tables 8 and 9); and
- 1995 - 228t (Taylor, 1995).

Germany and the USA recorded steep rises in imports of caviar from the USSR in 1991, while Belgium, Luxembourg and Japan increased their imports of Iranian caviar dramatically in that same year (see Table 9). (At the same time, reported sturgeon catches by Iran increased, but those within the CIS were in a steady decline - see Figure 4.) In 1992, amounts of caviar imported from the CIS were increased by all main importers of the product and indeed, from 1991 to 1992, both the EU and the USA doubled their imports of caviar from this source (see Table 8). Of Iran's main importers in 1992, however, only France increased its imports of caviar from that country in, relative to amounts imported in 1991 (see Table 9).

Published data specifying particular countries within the CIS as exporters of caviar are available only for the EU for 1992-1995, inclusive (see Table 10). These mirror the pattern drawn by imports of CIS caviar in general for these years and also illustrate that most, and sometimes seemingly 100%, of caviar imported by the EU from the CIS during this period was in fact from Russia and Kazakhstan (see Tables 8 and 10).

While it is not possible to identify a current trend in volumes imported from the CIS and Iran for the 1990s, given that data for only a few years are available, it is clear that volumes imported from Iran reached a high in 1991 since when they have fluctuated, and that volumes imported from the CIS climbed from 1991 to 1993, inclusive, and since then have fallen overall (Table 8). Perhaps most striking when considering volumes of caviar traded from these regions is the amount by which volumes of caviar imported from the CIS have outstripped those imported from the USSR by the same consumers, during the period 1988-1994 (Table 8).

Destinations

As stated earlier, the major import markets for caviar from Iran and the USSR/CIS are (and have been since the early 1960s) the EU (principally Germany, France, Belgium and the UK), Japan, the USA and Switzerland (Bourguignon, 1989; Josupeit, 1994). Trade data from 1988 until 1994 indicate that these destinations ranked in that order in terms of average annual amounts of caviar from Iran and the USSR/CIS, namely, 200t, 100t, 70t and 65t, respectively, (Josupeit 1994).

Europe

The EU

According to Eurostat and FAO data, the EU imported roughly half of all Caspian caviar produced, but re-exported 24% on average between 1988-1994 (Figure 7). Within the EU, Germany is the main importer overall of caviar from the CIS and Iran, but approximately 45% of this is re-exported to neighbouring countries or to the USA (Taylor, 1995). France is the main European consumer of Caspian caviar, approximately 30% of which is imported from other EU Member States, mainly Germany and Belgium. The UK and Belgium/ Luxembourg follow Germany and France in importance as importers of Caspian caviar within the EU (see Tables 8, 9 and 11).

Iran is the chief exporter to the EU overall, but different countries within the EU show a preference for either Iranian or CIS caviar. Thus, although Germany is the main importer of all caviar from the CIS and Iran, France imports more caviar from Iran than does Germany, (since French importers report that they

Table 8

USSR/CIS caviar imports by primary importers, the EU, Japan and the USA, volumes (t) and unit values (1 ECU = 1.4 US$)

	1988		1989		1990		1991		1992		1993		1994		1995 (Jan-June)		*Total	Average
	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg
Germany	27	170	20	211	22	184	49	129	70	96	81	75	53	116	20	138	362	140
France	18	145	15	161	15	184	8	215	19	80	10	148	7	111	1	130	94	147
Belg./Lux.	0	-	0	-	0	-	0	-	2	92	7	55	12	112	3	102	27	90
UK	5	256	6	196	5	206	4	247	8	172	7	297	4	196	0	-	39	195
EU others	5	-	2	-	0	-	2	-	1	-	0	-	0	-	2	-	14	-
EU total	**55**		**43**		**42**		**63**		**100**		**105**		**76**		**26**			
Japan	-	-	-	-	34	-	32	-	36	-	35	-	22	-	-	-	-	-
USA	-	-	-	-	-	-	21	-	43	-	43	-	44	-	12	-	-	-
Total							**116**		**179**		**183**		**142**					

Sources: Eurostat, Japanese import and US National Marine Fisheries Service statistics.

*1995 volumes are doubled in order to estimate the total volumes.

Table 9

Iranian caviar imports by primary importers, the EU, Japan and the USA by volume (t) and unit value (1 ECU = 1.4 US$)

	1988		1989		1990		1991		1992		1993		1994		*1995 (Jan-June)		Total
	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	(t)
Germany	42	130	27	160	30	155	29	148	18	175	10	185	25	103	6	130	193
France	25	166	38	195	44	163	39	182	42	204	42	182	40	174	10	128	290
Belg./Lux.	11	150	17	164	6	164	35	159	18	176	19	145	14	186	2	190	124
UK	22		7		7		5		3		44		9		5		102
EU others	12		10		10		17		14		8		14		3		88
EU total	**112**		**99**		**97**		**125**		**95**		**123**		**102**		**26**		**854**
Japan	–		–		17		24		12		12		25		–		
USA	–		–		–		0		0		0		0		0		
Total							**149**		**107**		**135**		**127**				

*1995 volumes are doubled in order to estimate total volumes.

Sources: Eurostat, Japanese import and US National Marine Fisheries Service statistics

have experienced problems with Russian caviar quality). Within the EU, the main destinations for Iranian caviar exports appear to be the following, according to averages for the years 1988-1994) (approximate percentages of total imports of caviar from Iran by its main importers in brackets): France (25%), Germany (20%), Belgium-Luxembourg (15%) and the UK (10%) (see Table 9). France has been the most stable importer of Iranian caviar during the 1990s, while other primary importers have dealt in widely varying amounts, the UK, for example, importing three tonnes of Iranian caviar in 1992, but 44t the following year (Table 9).

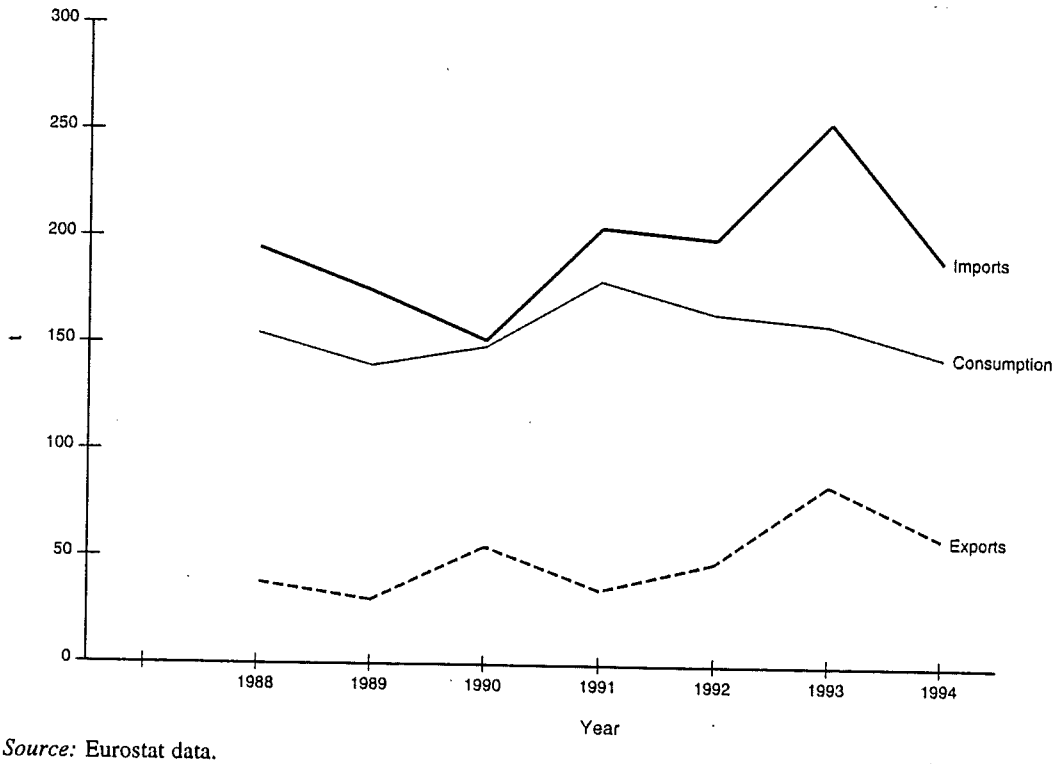
Germany has long been the main destination within the EU for caviar from the USSR/CIS, for many years followed closely by France, but in 1994 by Belgium/Luxembourg for the first time (see Table 8). Both Germany and France are reportedly importers of Kazakhstani caviar, that state having worked to establish commercial ties with those countries, according to importers interviewed, but its caviar often still has to transit Russia.

Eurostat data show that Turkey started to export caviar to EU states in 1993 (Table 10). Turkey borders the Black Sea, where only remnant sturgeon populations remain, that would be unlikely to support these trade levels, and thus it is possible that Turkey re-exports Caspian caviar. Some reports heard during research for this report cited Istanbul as a direct destination for caviar from Azerbaijan.

Consumption of Caspian caviar in the EU has been relatively stable (between 140t and 175t per year, from 1988 to 1994), even as imports and exports have fluctuated widely (see Figure 7).

Figure 7

Imports, exports and caviar consumption of the EU (t)



Source: Eurostat data.

Table 10

Suppliers of caviar[1] imports to the EU, volumes and unit values (1 ECU = 1.4 US$), 1988-1995

Suppliers	1988		1989		1990		1991		1992		1993		1994		1995 (Jan-June)	
	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg
USSR/CIS	55	164	43	188	42	192	63	150	23	116[2]		89[2]		120[2]		130[2]
Russia									68	152	105	84	51	114	21	124
Kazakhstan									9	145	10	139	25	132	5	150
Iran	112	119	101	177	97	163	142	147	95	197	123	118	102	155	26	137
China	21	75	15	135	8	121	8	138	3	152	2	217	2	184	3	113
Poland							1	114	1	19	1	54				
Switzerland			2	140	2	55	1	70			1	264	1	207		
Iceland	5	9			51	3	6	5	2	11	7	13	1	13		
Norway			1	7	3	13										
Turkey											8	90	5	103	3	161
Greenland			2	3			4	2								
United Arab Emirates													1	122		
Saudi Arabia			1	37	1	45	1	57	1	48			1	37		

[1] Imports from some countries, although recorded as caviar are not necessarily of sturgeon roe — see **Reported international trade in Caspian caviar**

[2] Average unit value for the CIS

Source: Eurostat data

Table 11

Total imports of caviar to the EU by state*

	1988		1989		1990		1991		1992		1993		1994		1995[2] (Jan-June)		Total/average	
	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg	t	ECU/kg
Germany	79	145	56	174	58	161	87	134	91	132	113	80	85	112	31	134	631	134
France	46	155	55	184	62	165	48	186	61	165	52	177	47	168	11	133	393	167
Belg./Lux	12	145	24	134	6	195	35	160	21	160	34	95	28	149	7	120	174	146
UK	35	60	20	158	15	150	11	195	12	177	52	60	17	137	6	154	174	137
Spain	5	178	8	152	8	209	11	179	9	227	2	207	3	187	3	66	52	176
Others[1]	22	-	9	-	5	-	18	-	8	-	11	-	12	-	1	-	87	-
Total	**199**	**129**	**172**	**166**	**154**	**163**	**210**	**152**	**202**	**155**	**264**	**100**	**192**	**139**	**59**	**134**	**1511**	**142**

[1] Mainly Denmark and the Netherlands.

[2] 1995 data were doubled to estimate the total.

*This table does not include the caviar trade inside the EU

Source: Eurostat data

Outside the EU

Switzerland, whose caviar importers have links with Iranian exporters, and which serves as an entrepôt for caviar within Europe, itself consumes a fairly constant eight tonnes of caviar annually (S. Taylor, *in litt.*, 21 May 1996) (see *caveat* regarding Swiss caviar data at the beginning of this chapter).

According to several reliable sources, caviar is sometimes illegally exported from Russia, repacked in eastern Europe (e.g. in Poland), and retailed in Germany. If this is so, then the amounts exported by Poland, shown in Table 10, could be of Caspian caviar.

Japan

The Japanese market accounted for around 16% of Caspian caviar exports from 1991-1994, inclusive (between 45 and 57t a year) and (see Tables 8 and 9). Japan imported more caviar from the USSR/CIS during this period than from Iran (see Table 12), accounting for an average of 26% of caviar reported in trade from that region by the main importers.

Table 12

Caviar imports (t) into Japan, 1990-1994

	1990	1991	1992	1993	1994
USSR/CIS	34	32	36	35	22
Iran	17	24	12	12	25
China	7	14	5	3	7
Others	0	0	2	2	2
Total	**58**	**70**	**55**	**52**	**56**

Source: Japanese import statistics

USA

Russia supplies the USA with 70% of all its caviar imports (see Table 13). Excellent links between renowned US caviar importers and caviar processors in the CIS have existed since Soviet times and this fact, combined with US trade sanctions against Iran, has brought about a near monopoly of the US market for caviar by Russia (see Table 13).

A US commercial embargo against trade with Iran explains why less than 500kg of Iranian caviar have entered the USA since 1991. (These small imports are said to have been made *via* France, Switzerland, according to those countries national Customs statistics, and more recently *via* Dubai, according to reliable sources.)

Table 13

Caviar Imports (t) into the USA 1991-1995

Exporter	1991	1992	1993	1994	1995[1]
USSR	21	10			
Russia		34	42	41	11
Other CIS States		(<1)	1	2	
Sweden				2	
Lithuania		3	3	2	
Poland			2		
Other European States	1	1		(<1)	1
China	3	4	2	3	(<1)
South Korea			6		
Other Far Eastern States			(<1)		
Thailand	1				
Canada		2		6	
Chile			1	4	1
Other American States			(<1)		
Total	**26**	[2]**54**	[2]**59**	[2]**61**	[2]**14**

[1]Jan.-May.

[2]Margin of error set at one tonne.

Source: US National Marine Fisheries Service statistics

United Arab Emirates (UAE)

The Shilat has entered into five-year agreements with some importers, including in the UAE, according to research conducted for this study.

There are allegations that caviar is also traded direct from Baku, the capital of Azerbaijan, by air to Dubai. An absence of commercial agreements with importing countries has conspired to induce Azerbaijan to sell almost its entire caviar production either through Russia or Dubai, according to this report's findings.

One company in Dubai has been notable in establishing a name for itself in re-exporting caviar, having set up the means for processing and packing caviar to international standards. The company exports sevruga, osietra and beluga to Europe (see Table 10), USA, Australia, and other countries in the Gulf, such as Saudi Arabia, Bahrain and Kuwait and handles possibly 15t of caviar a year (S. Taylor, *in litt.*, 21 May 1996).

Illegal export trade

Undeclared trade in caviar

In addition to reported international trade in Caspian caviar described above, there is evidence of an unreported trade, which provides one means of selling caviar from the illegally fished sturgeon from the Caspian basin (see **Threats** and ***Uncontrolled sturgeon fishing in the CIS***).

Although Iranian media occasionally report cases of illicit trade in Iranian caviar (e.g. smuggling of caviar

by the Iranian community in France is said to have occurred during the Iran-Iraq conflict (1989-1990) (Chalamon, 1996), officials state that such incidents are very rare, and that punishments include gaol and heavy fines, to deter both smugglers and sturgeon poachers (Anon., 1993a). However, smuggling of caviar from Iran into Dubai, (see ***Destinations***) has allegedly become a common route and bulk quantities of caviar are said to be transferred from Bander Anzeli in the Caspian Sea to Bander Abbas in the Persian Gulf, where small boats take the cargo on to Ras Al Khaima, a port in Dubai. At this point, although Customs check caviar consignments in order to collect duty, no sanitary or quality checks are made, thus preventing the detection of caviar of dubious legal origin (Anon., 1995b).

Many thousands of incidents of sturgeon poaching have been recorded in CIS countries, by contrast (see **Threats** and ***Uncontrolled sturgeon fishing in the CIS***). Some Caspian caviar thus produced is said to be smuggled aboard cargo ships visiting French, Belgian, Danish or German harbours (Chalamon, 1996; S. Taylor, *in litt.*, 1996). There are numerous stories of covert sales of caviar in consumer countries, suggesting its preceding covert importation. For example, in New York, recent Russian immigrants are said to sell caviar from suitcases; in France, east European participants at an international bridge tournament offered caviar at suspiciously low prices; and students who have visited Russia sell caviar to restaurants in Paris (Chalamon, 1996).

Mis-declared trade

Traders in caviar produced unofficially, wishing to mask the poached origins of their product, or its unauthorized preparation and packing, may choose to avoid smuggling *per se* and instead export caviar which purports to be legal in all respects, by using false documentation. Specifically, the provision of false documentation relating to country of origin and sanitary standards is said to constitute the usual means of trading caviar illegally from the CIS (Chalamon, 1996), as outlined below.

The official Customs tariff no. for caviar according to the Harmonized Commodity Description and Coding System, or Harmonized System, is "16043010000: sturgeonroe". This Customs codification system is used for sturgeon roe by the EU, Japan and the USA. Further, each importing country may have its own specific requirements applying to incoming caviar.

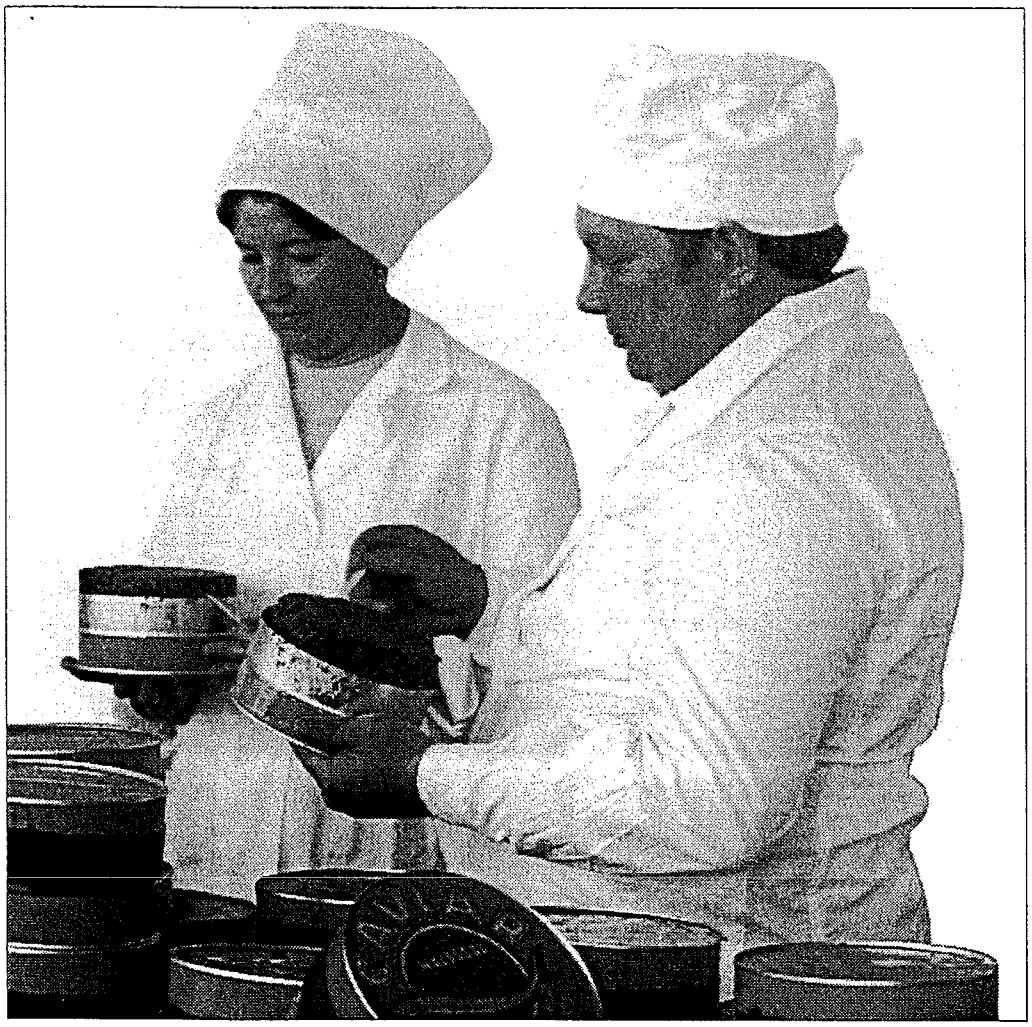
In the EU, caviar must be imported chiefly in compliance with *Council Directive 91/493/EEC*, of 22 July 1991, which stipulates sanitary conditions for the product (Anon., 1991). It contains requirements pertaining to hygiene, preservation (borax, for instance, is allowed in quantities of up to four grammes per kilogramme (Anon., 1994e)), packaging, labelling, storage and transport. Moreover, only sturgeon roe may be imported under the term "caviar" (Anon., 1991). Further, according to a *European Council Decision* of 25 July 1995, relating to *Council Directive 90/675/EEC* of 10 December 1990 laying down principles governing the organization of veterinary checks on products entering the EU, fishery products from non-EU Member States should be accompanied by a detailed, standard certificate of hygiene (Anon., 1995c). If imported caviar from Azerbaijan, Iran, Kazakhstan or Russia does not comply with the sanitary norms established by the European Commission, it is up to individual importing Member States to react by, for example, rejecting the goods, or requesting that the European Commission implement an investigation.

In the USA, sanitary standards for food are controlled by the Food and Drug Administration (FDA). Borax is forbidden in caviar imports, but enforcement of quality control regulations for caviar at US borders does not appear to prevent poor-quality caviar (nor caviar containing borax) from entering the country and it is possibly the largest "dumping" ground for substandard caviar in the world (S. Taylor, *in litt.*, 21 May 1996).

In Japan, the Ministry of Health and Welfare controls food import regulations and consults with the Food

Sanitation Investigation Council for specific decisions (Anon., 1995d). Japan forbids the entry of caviar prepared with borax, both in theory and apparently in practice – import controls in this country appear to be effective in this regard, at least, for caviar (S. Taylor, *in litt.*, 21 May 1996).

Caviar processing facilities in within the CIS have not been inspected by health officials from importing countries, with the exception of Russia. As a result, it is not known if any these complies with the sanitary requirements of the importers, but illegal exporters may in any case circumnavigate this trade obstacle by obtaining false papers from Russian operators, who hold acceptable sanitary credentials and trade agreements with caviar importers. According to importers, most forged documents accompanying caviar from the CIS are produced by middlemen who seem to adapt very quickly to any change in regulatory requirements. It is not advisable to try to pursue investigations in this field (see **Methods**), but it appears that this type of fraud allowed low-quality caviar to flood at least west European markets in 1992 and 1993 (Lindberg, 1994).



Plodimex

Strict sanitary conditions were observed at this packing factory in the USSR.

Falsification of documentation relating to country of origin may also be in order to gain a better price — Iranian caviar fetches higher prices than that of CIS origin (see **Prices for Caspian caviar**), and researchers for this report were informed that some CIS traders are said to market their caviar with counterfeit Iranian labels (Anon., 1995b). Conversely, caviar is rumoured to be smuggled from Azerbaijan to Iran, where it is

labelled "Iranian caviar" in order to fulfil Iran's contractual obligations to trading partners overseas, (e.g. the UAE (see ***Destinations***)) (S. Taylor, *in litt.*, 1 August 1996).

Other types of fraudulent papers relate to sell-by dates; declaration of sturgeon species of origin; and values declared to Customs. High import duties for caviar in the EU provide an especial incentive for this (if not for plain smuggling). Within the EU the same duty rate of 24% of the Customs value of caviar imported has applied for every Member State since 1995. (However, it may be lower as long as both the exporting and importing parties agree, and Iranian (and Chinese) caviar imported to the EU enjoy a preferential duty of only 12%, if accompanied by a form "A", a certificate of country origin and of direct transport from there to the EU (S. Taylor, *in litt.*, 21 May 1996).) Import tariffs in the other principal countries importing Caspian caviar are lower than in the EU. In the USA and Japan (expressed as a percentage of the Customs value of the consignment) they are 15% and 10%, respectively, and in Switzerland, SFr80 (US$65)/100kg.

Identification methods for distinguishing species of origin of caviar have not been standardized (Birstein, 1995), but it is known that the sturgeon species of origin has been mis-declared in some cases of internationally traded Caspian caviar, and it is suspected that this has occurred in other cases. Twenty-three samples of caviar purchased in the USA were tested in 1995 and 1996, according to a recent method for identifying the specific origin of caviar (see ***Identification of caviar to species level***). Five of the 23 samples were found to have been mis-labelled and in three instances, the revelations were alarming in the light of the conservation status of the actual donor species. One sample, labelled "beluga malossol", contained Siberian Sturgeon, a species recently subjected to a manifold increase in poaching in Siberia (Ruban, 1996); a second sample, labelled "eastern beluga" contained caviar of the Amur Sturgeon, a highly threatened species (see Table 1); while the third, labelled "Caspian osietra" contained Ship Sturgeon caviar. This species is extinct in the Aral Sea and threatened in the Caspian Sea (see Table 1). Although only a very few samples of caviar in trade have been tested in this way for the reliability of their labelling, some crude estimations of the amount of caviar from a given species in trade in a given year may be made, and from these, the suggestion of a conscious practice of mis-declaring species emerges. For example, according to official Russian data on sturgeon catches (Table 3), 153t of Belugas were caught in 1994. KaspNIRKh estimates that only 15% of any catch consists of mature adults, of which half, on average, may be presumed to be females. A very generous approximation of the weight of roe in a mature female Beluga is 50% (usually less than 20%) of the total body weight of the fish. Therefore, three to four per cent of the total tonnage of Belugas caught in 1994, or five tonnes, might be the maximum weight of caviar from that species produced during that year[6]. If one considers the caviar exported to the USA alone in 1994, which is reported as roughly 60t (see Table 13), a seeming inconsistency appears. Observations in New York in 1995 suggest that at least a quarter of caviar on retail sale is from Belugas. One quarter of 60t is 15t, as opposed to the five tonnes calculated to have been produced by Russia in 1994 (the USA does not knowingly import caviar direct from Iran and amounts imported indirectly from that country are said to be in the order of kilogrammes - see ***Destinations***). This means that either the catch is seriously under-reported, and/or some of the caviar sold as "beluga" is not that which it claims to be.

According to several importers in France, Germany and Belgium, Astrakhan, in Russia, and the State of Azerbaijan may be the two major suppliers of illegal Caspian caviar in trade (in 1993, more than 15t of caviar were illegally exported from Azerbaijan (Josupeit, 1994), while Kazakhstan reputedly has a more controlled trading structure, according to information gathered for this report. The seizures made by French Customs from 1988 to 1995 (see Table 14), may have been made on sanitary grounds, for reasons of duty evasion, or other discernable fraud. The decline in these types of seizure by French Customs since 1993

Table 14

Customs seizures of caviar at the French border

	1988	1989	1990	1991	1992	1993	1994	1995
Volumes (kg)	190	705	227	1 100	1 700	955	247	88
No of seizures	10			50	178	152	74	24
Origins (1)		Iran Iraq	Iran USSR Poland	Hungary Poland	Eastern Europe			Poland

(1) Not always reported

Source: French Customs Service data

(Table 14) does not necessarily mean that the proportion of illegal trade is levelling off, but may reflect depleted sturgeon stocks and/or better organization of the illegal trade.

Not only are sturgeon stocks, and thus the supply of caviar, under threat from unregulated fishing of sturgeons (see **Threats**), therefore, but so are they also as a result of the illegal processing plants, which in turn circumvent appropriate quality control measures for caviar production (see **The impact on sturgeon species of current caviar processing practices**). Caviar prepared in such unofficial processing plants more often than not then constitues an illegally traded commodity in most importing countries. Although preparations of caviar conforming with the sanitary standards required by reputable importers and/or importing countries are very rare in the illegal trade (Taylor, 1995), in general, most countries are pitted against great obstacles with regard to regulating this trade across their borders, largely as a result of the scale of illegal trade in the commodity.

PRICES FOR CASPIAN CAVIAR

Most information recorded here comes from interviews with importers in Europe and retailers in Europe (including Russia) and the USA.

Prices in Russia

Wholesale prices were found to range widely, but the sturgeon species of origin of the caviar was not declared. Within Russia, according to producers in Astrakhan, the development of the black market for caviar caused prices during 1991 and 1992 to drop by around 30% (Anon., 1993b). Thereafter, prices may have climbed again - in Vladivostok, "caviar of sturgeon fish" was sold legally at a wholesale price of ?R8740 (US$2 or US$22 per kg) per 90g-can in 1994, but R21 180 (US$4.7) per can in 1995 (or US$52 per kg), a 242% price rise between the two years.

At a retailing outlet in Moscow, a 90g-can identical to that on sale wholesale in Vladivostok cost R11 500 (US$2.8 or US$31 per kg) in 1994 and R38 000 (US$8.4 or US$94 per kg), in 1995, the retail price rise in one year thus being at a rate of 330% (Anon., 1995e). Retail prices in Moscow were therefore 31.5% higher than wholesale prices in Vladivostok in 1994, but 79% higher in 1995.

Another source in Russia in 1995 noted a wholesale price three times that reported in Vladivostock and a retail price more than double that noted in Moscow (see above), as shown below. Prices are in roubles, with approximate US dollar equivalents per kilogramme given underneath.

Wholesale in Astrakhan	Wholesale in Moscow	Retail in Moscow	US$ equivalent retail price
R62 467 US$154/kg	R75 033 US$185/kg	R90 040 US$223/kg	19.84

Source: Zaitsev (1995).

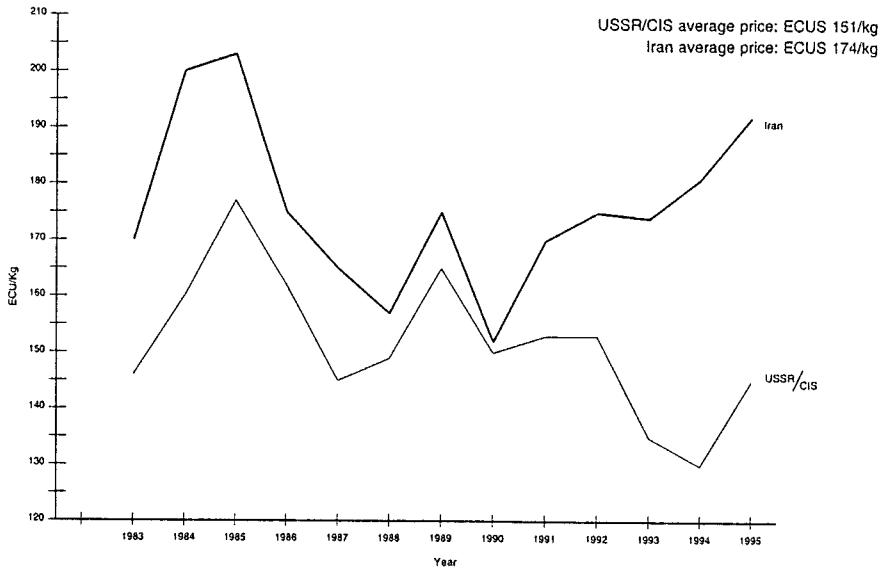
A black market price of US$200 per kg, also in Moscow in 1995 has been reported (S. Taylor, *in litt.* to V. Birstein, 14 November 1995).

Clearly, comparison of prices is difficult if the species involved is not known, but the legal wholesale price rise from 1994 to 1995 for the same apparent can of caviar within Russia doubled, while the retail price for the same nearly quadrupled.

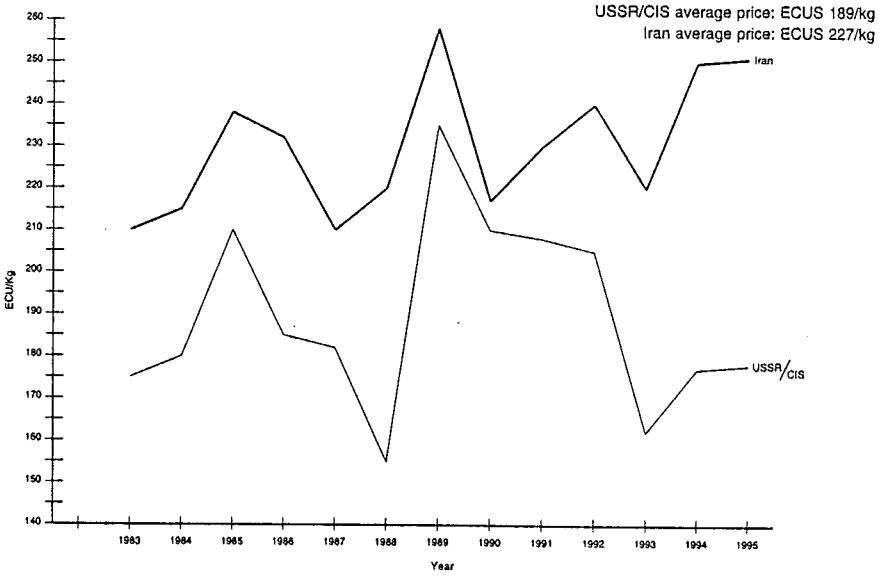
Figure 8

Import prices of caviar in Germany, 1983-1995 (1 ECU = US$1.4)

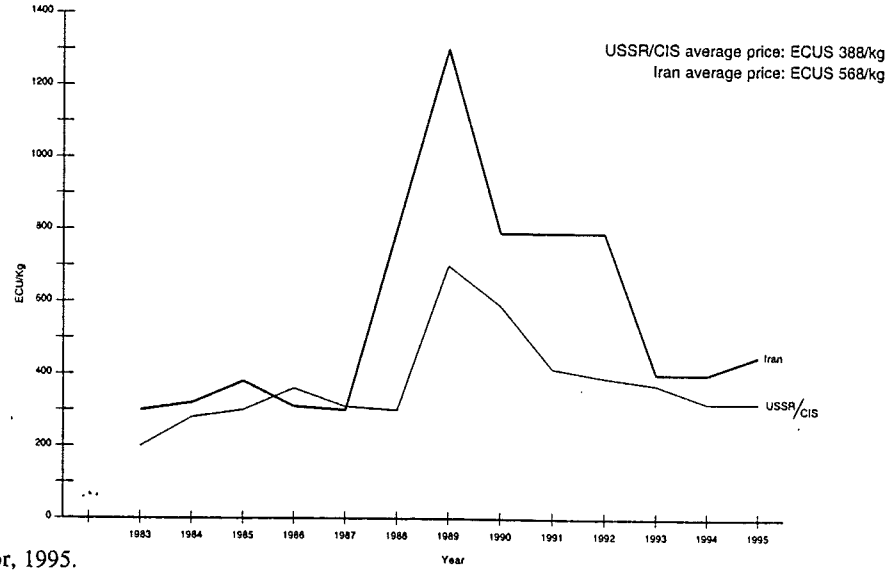
a. Sevruga



b. Osietra



c. Beluga

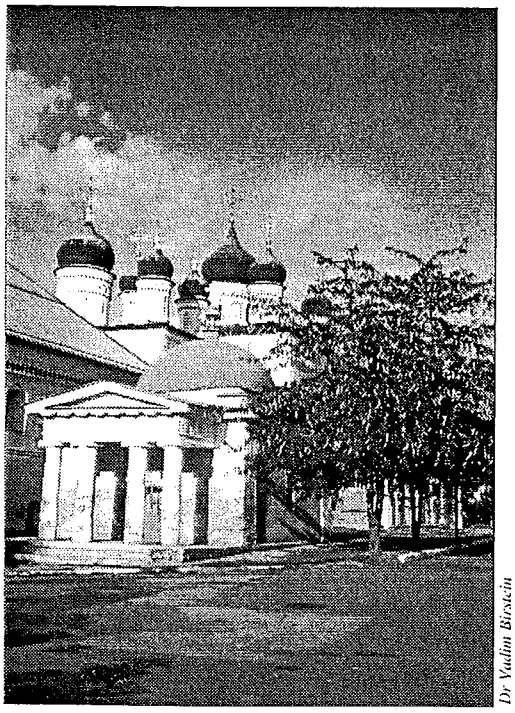


Source: Taylor, 1995.

Import prices

According to Eurostat data, the average import price, for all types of Caspian caviar, was highest in 1989 at ECU166 (US$232.4) per kg and lowest in 1993 at ECU100 (US$140) per kg.

Import prices have also been recorded by the world's longest established caviar trading company, in Germany (Figure 8). For all three types (beluga, osietra and sevruga), Iranian caviar was more expensive than Russian caviar. Prices for Iranian beluga were on average 46% higher than those for Russian beluga, for Iranian osietra 20% higher than for Russian osietra, and for Iranian sevruga 15% higher than for Russian sevruga. A comparison of prices for caviar from different species shows that the price differences are more pronounced for Iranian caviar than for Russian caviar. Iranian beluga is on average 220% of the price of Iranian sevruga, while a Russian beluga is on average only 150% of the price of Russian sevruga. As expected, beluga is always the most expensive caviar, in its best year, 1989, its price in Iran being five times the price of the Iranian osietra, and seven and a half times the price of Iranian sevruga.



Dr Vadim Birstein

Astrakhan, spanning the Volga, is built on eleven islands. As long ago as the sixteenth century, Astrakhan was a centre of expertise for sturgeon fishing.

Prices for Iranian and Russian caviars have followed similar trends. Fluctuations over time have been sharper for beluga since 1987, having increased by two to three times from that year to 1989, and since seemingly stabilized. Since 1990, Iranian sevruga and osietra prices have been generally rising, while prices for Russian equivalents have been generally falling during the same time period (Figure 8). As suggested earlier, the market seems to prefer the Iranian label, and the drop in import prices for caviar under the Russian label between 1990 and 1993 appears to have been the result of illegally produced caviar flooding the European market and undercutting customary prices (Lindberg, 1994; Anon., 1994). The German import data in Figure 8 show prices for caviar from the CIS rising again after 1993 for osietra and sevruga, however.

Prices have traditionally been lower for airlines: Russia supplied German importers with low-price retail cans intended for the national airline company and the Shilat has granted discounts direct to airlines purchasing Iranian caviar (S. Taylor, *in litt.*, 17 May 1996).

Prices within consumer countries

Retail

Retail prices in four main consumer countries were gathered during 1995 (see Table 15). It was found that pressed caviar seems to be appreciated by some conoisseurs (and is traded by some famous importers at quite high prices, for instance, in France, at US$600 or US$540 per kg), but was not found in supermarkets. Pasteurized caviar, on the other hand, was for sale in some supermarkets at extremely low prices (in France, for example, at US$255 per kg), but absent from luxury shops. On the whole, wide variations in price for apparently identical products were seen.

Table 15

Retail prices of caviar in 1995 (except where shown otherwise), in US$/kg

	Sevruga		Osietra		Beluga		Others
	Russian	Iranian	Russian	Iranian	Russian	Iranian	
UK:							
Harrods "Fresh Russian"	1170		1330		2820		
Belgium:							[1]1200
Caspian Tradition		780		990		1870	[2]4200
France:							[3]590
Petrossian	810		1220		1780		
Fauchon	1080	1310		1640		3670	
Monoprix	185						
Intermarché	440	470					[4]250.5
	330	370					
Leclerc		950	290	380	1400		
Auchan					1510		
Rallye	550	810					
	580	(50%) 470					
Prisunic	340	530		670			

Table 15 continued

	Sevruga		Osietra		Beluga		Others	
	Russian	Iranian	Russian	Iranian	Russian	Iranian		
Year	1994	1995	1994	1995	1994	1995	1994	1995
USA:								
Petrossian	740	790	1030	1040	2 040	2 320		
		[5]760		[5]1 000		[5]2 230		
Caviateria	780	890	890	990	1 600	1 740	[7](1994) 390	
		[5]710		[5]880		[5]1 760		
Balducci	530	640	710	780	1 240	1 420	[6]710	890
Russ & Daughter		500		630		1260		
Citarella		310		420		670		
Macy's		270		310		600		
Urbani		320		410		660		
Vinegar Factory		320		430		680		
Zabar's		320		420		680		

[1]Osietra Gold.

[2]Osietra White.

[3]Pressed Caviar.

[4]Pasteurized.

[5]Christmas Promotion.

[6]Amur Sturgeon.

[7]"American Sturgeon".

Sources: wholesale and retail suppliers

NOTE: Quoted prices per 100g have been multiplied to arrive at approximate prices per kg, for ease of comparison with prices elsewhere in the report.

Several of those retailers shown in Table 15 have a worldwide reputation, have created their own supply channels and are believed to be very cautious about products they market. Nonetheless, their prices ranged widely for goods which were ostensibly the same and were noted to be twice as much for sevruga and osietra at one retailer as at another, and three times as much for beluga. These variable prices pose again the question of the authenticity of species of origin declared on caviar labelling.

Crawford Allan

Caviar on retail sale at Nice airport, France.

Surprisingly inconsistent prices were encountered overall in French supermarkets, some apparently trying to sell cheaply and others to sell good quality caviar at seemingly little profit. Less well-established or less experienced retailers may base their choice of caviar purchases mainly on price, possibly being less aware of the risk of purchasing smuggled stocks, which are often of inferior quality (see **Oocyte extraction and preparation of caviar for sale**). The extremely low prices of caviar sold in some supermarkets, may suggest that such stocks come from illegal sources. According to several sources, illegal caviar repacked in eastern Europe can retail at half the usual price for the legally produced equivalent. In 1993, sub-standard caviar from Poland, illegally imported from Russia and repacked in jars and cans with falsified labels, was recorded as retailing in Germany at 20% of the usual market price for the apparent product. In one case, caviar which should fetch US$700 per kg is known to have been sold for as little as US$150 per kg.

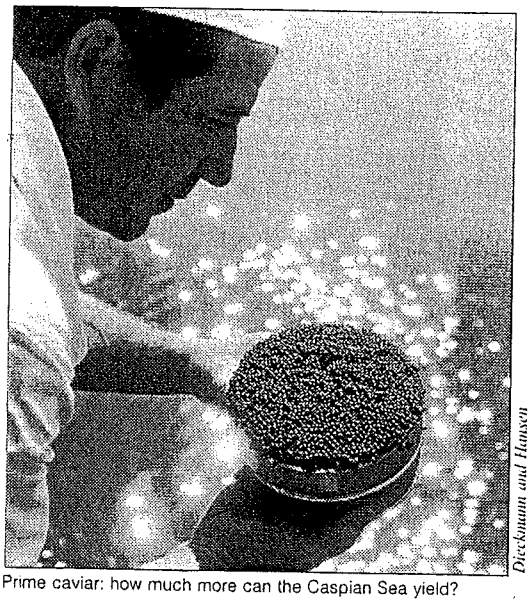
Retail prices in New York between December 1994 and December 1995 at three reputable outlets showed increases in their prices: prices for sevruga and beluga showed the most notable rises, increasing variously by 6.7%, 13.75% and 20%, and by 13.7%, 9.39% and 14.3%, at the three shops over the one-year period (see Table 15).

In summary, by the end of 1995, although German import prices and US retail prices for caviar had apparently not only held, but increased over the previous year, there were general concerns, on the European market at least, about the relative scarcity of accurately described and hygeinically prepared caviar supplies. Reflecting this (and the amount of cheaper, substandard caviar on the international market), the import price increases from 1994 to 1995 left prices low relative to 1989 for all caviars except

Iranian sevruga and osietra (Figure 8). Retail prices also suggest that a range of products might have been on sale as ostensibly as the same commodity: in the case of Russian sevruga, for example, prices fell anywhere between US$185 and US$1080 per kg.

FUTURE OF THE CASPIAN CAVIAR TRADE

Top-quality caviar has become extremely rare, or is unobtainable. Not only is the specific origin and means of preparation harder to guarantee in view of the degree of illegal practice in the trade, but it is simply more difficult, if not impossible, to obtain certain prized types of caviar now, for example, that from Belugas of 100 years, "gold" osietra, or white caviar (see **Box - Caviar, the delicacy**). Belugas are now unlikely to live as long as 100 years in the wild and it would be uneconomical to keep a fish that long in captivity for its caviar, while the rarity of white caviar and "gold" osietra is linked to the increasing rarity of the proportion of those sturgeons producing such a caviar from a dwindling overall population of sturgeons in the Caspian basin.



Dieckmann and Hansen

Prime caviar: how much more can the Caspian Sea yield?

According to importers, the trade figures for 1996 will show drastic changes in the volume and value of caviar exported from Iran. At the end of 1995, the Shilat decided that Iran would limit its 1996 sturgeon catch, and consequently its caviar production, to 60% of 1995 levels. Although the Iranian industry intends to continue actively to promote Iranian caviar, displaying it at all major food fairs, and conducting testing sessions with clients and consumers, it will increase the export price of Iranian caviar by at least 50%, according to official sources. Importers of Iranian caviar will therefore be forced to revise their own practice to accommodate the changes proposed by the Shilat. One west European trader, for example, imported five to six tonnes of caviar from Iran in 1995, but can only afford three and a half tonnes in 1996, since wholesale prices for Iranian caviar will allegedly have been increased by 65%, according to informed importers. The same importer has also decided no longer to supply caviar to airlines and supermarkets, but instead to restrict sales to more exclusive and lucrative customers. Retailers will most probably apply the same percentage price rise, or possibly stop selling Iranian caviar.

Until 1995, one of the largest markets for caviar was airlines, annual tonnages for that year being: Air France, 20t; British Airways and Lufthansa, 8-10t each; Swissair, seven tonnes; (Anon., 1991). Despite the discount in price still thought to be afforded several airlines, *via* importers, by Iran, the portion size of caviar served to some first-class airline passengers was reduced from 50g in 1994, to 30g in 1995, and will presumably be even smaller in 1996 (Anon., 1995f).

Wholesalers may be able to compensate by decreasing their margin of profit, but this will only be possible to a certain extent. If the legal harvest of sturgeons from the CIS and Iran continues to decline and unregulated fishing at the present perceived rate is not checked, the risk of a crash in sturgeon stocks cannot be excluded. If and when any recovery of Caspian sturgeon stocks in the wild occurs, it will take decades

to rebuild numbers of adult fish to former levels, given their late maturation. Meanwhile, the amount of caviar coming from sturgeon aquaculture is expected to remain modest in the foreseeable future (see *Stock enhancement*).

In short, it seems inevitable that trade in caviar, both legal and illegal is bound to shrink in the coming years and fail to supply demand, while a remnant well-controlled trade will attract increasing prices. This much is testified to by a spokesperson from one of the most reputable shops in the UK, who reported in 1995, that it was the better quality caviar that sold in preference to cheaper alternatives (Woolf, 1995). Increasingly, certain guarantees will be expected in order to justify higher prices connected with controlled production, ensuring genuine and expertly prepared caviar. To date there is one known guarantee that certain standards of product quality and handling may be expected by the purchaser, which applies to the caviar trade, the so-called *DIN ISO 9000 ff. Certificate* (see Figure 9). The ISO norm is a quality management system which requires adhesion to certain documented procedures. A given company may have received ISO certification of a part, or all, of its business, and in the case of one long-established German importer, at least, this certification has been granted for its "processing and marketing of caviar" (S. Taylor, *in litt.*, 17 May 1996). Although such certification does not provide proof of the quality of caviar in itself, it acts as a guarantee that a certified company achieves certain management standards, including usually product quality control, including, in turn, the quality of the product purchased and processed. In terms of the caviar trade, certification of a company according to ISO procedures would at least require that suppliers and producers of caviar were "permitted" and listed as such with that company (S. Taylor, *in litt.*, 1 August 1996).

Figure 9

ISO certificate of quality awarded for the processing and marketing of caviar

TÜV CERT

CERTIFICATE

The TÜV-Zertifizierungsgemeinschaft e.V.
hereby certifies that

DIECKMANN & HANSEN GmbH
D-22767 Hamburg

has established and applies
a quality system for

Processing and Marketing of Caviar and other Fishroe

An audit was performed, Report No. **0117CE22250**
Proof has been furnished that the requirements according to

EN ISO 9002

are fulfilled.

The certificate is valid until
October 1998
Certificate Registration No.
QA 07 100 226

Bonn, 14.11.1995

TÜV CERT Executive Board

TÜV NORD

Hamburg, 14.11.1995

TÜV CERT Certification Body of TÜV NORD

In the future, caviar of the quality expected by connoisseurs for many years may become more than ever, therefore, a dish that can only be afforded by the extremely rich, who can pay the high prices which buy the assurance of a delicacy properly prepared, authentically labelled, and appropriately transported.

CURRENT CONSERVATION ACTION

Population monitoring

The data collected by KaspNIRKH, in Astrakhan, on the catch, natural reproduction and release of artificially bred sturgeons is of prime importance as almost the only official information on the population size of sturgeons in the Caspian Sea basin. Presently, KaspNIRKH enjoys good relations with the Iranian authorities. The Iranian Fisheries Research and Training Organization invites Russian specialists from Astrakhan to collaborate on various aspects of sturgeon research in Iran. In addition, Iran is said to subsidize some joint Russian-Iranian work on assessment of sturgeon stocks in the Caspian Sea.

KaspNIRKH has a fleet for research work on the Volga River consisting of five ships equipped with laboratories for about eight scientists, at least one bigger ship for work in the Caspian Sea, and many smaller boats for various purposes. However, methods used to collect data are known to be obsolete, resulting in very roughly approximate figures only. For example, counts of fish and/or fishers are only carried out in one location, and simply multiplied to obtain a calculation for the whole of the Caspian Sea.

Stock enhancement

The technology and expertise for breeding and raising sturgeons was developed in the 1950s, and long considered a state secret in the former USSR. There appear to have been 28 hatcheries in total in the USSR and, according to certain sources consulted during research, 20 are said to be still in existence, including 10 on the Volga, but others put the figure at 14 (Levin, 1995) and 17 (Dumont, 1995) in the area of the former USSR.

The hatcheries operate only during a few months of the year, mainly in May and June. To supply hatcheries initially, mature fish are captured and transported to special water tanks, where some spawners are kept for long periods. The collection of fry is automized in Russia. "Ripe" fish are hormonally stimulated, and eggs from one female mixed with sperm from several males. The resultant fry are kept in permanently circulating water, which improves the survival rate, but only some 20% survive this stage. Young fish are next transferred to ponds and fed a special diet for 35 to 40 days until they reach a weight of two to three grammes. The main stock enhancement activities were around the Volga-Caspian conjunction and the standard method in the USSR was then to release the juveniles in the Caspian Sea, but they are now often released into the Volga River, with a consequent lower survival rate (Anon., 1995b).

Data from the Russian Federation Committee on Fisheries, *Roskomrybolovstvo*, indicate that from 1978 until 1989, an average number of 19 100 000 juvenile Belugas, 18 100 000 juvenile Stellate Sturgeons and 45 700 000 juvenile Russian Sturgeons were released annually in the Volga delta (Khodorevskaya *et al.*, in prep.), accounting in 1989 for an estimated 30% of mature Russian and Stellate Sturgeons, and 90% of mature Belugas in the Caspian basin. The survival of Belugas, in particular, in the Caspian area, therefore, seems to have depended on the continuous release of significant numbers of fry (Pirogovskii *et al.*, 1989; Malutin, 1995), but since 1990, the number of juveniles dispersed from hatcheries has dropped (Table 16a) and hatchery production has failed to compensate for the fall in rates of natural reproduction and the loss of juveniles, particularly those set free in the Volga River (Keenlyne, in prep.; Malutin, 1995). The

construction of a new, specially designed ship for the transportation of young sturgeons to the Caspian Sea from Volga hatcheries was initiated at the Sudoverph wharf in Astrakhan before the collapse of the USSR, but was stopped owing to budget cuts (a further US$100 000 is needed to finish the ship) (Anon., 1995b).

Numbers of sturgeons released may in reality be even lower than those recorded in Table 16a, and according to some sources the number of young fish released in 1993 and 1994 was about three times less than official data indicate (Anon., 1995b). Only four of the hatcheries along the Volga are currently functional, as economic constraints have made it difficult to maintain facilities in efficient working order (Keenlyne, in prep.). Moreover, restocking often only involves Stellate and Russian Sturgeons because Beluga spawners have become too rare and indeed, hatcheries experience increasing difficulty in obtaining enough brood stock in general (Birstein, 1996). During the 1995 spawning season, only 35 Beluga females were captured for artificial breeding programmes in Astrakhan (Anon., 1995b; Birstein, 1996). The same spawners may not be kept and used repeatedly, owing to various technical and biological difficulties in doing so, for example, the provision of suitable facilities for housing these large fish and for feeding them.

Table 16a

Number of juveniles artifically raised and released into the Volga River (millions)

Year	Belugas	Russian Sturgeons	Stellate Sturgeons	Total
1990	16.070[1]	59.894	17.919	93.883
1991	8.087[1]	53.895	18.372	80.354
1992	10.699[1]	55.364	11.961	63.380
1993	10.180[1]	40.720	11.660	62.560
	9.682[2]	36.956	10.132	56.770
1994	12.660[1]	48.720	7.070	68.450
	12.303[2]	45.219	3.986	61.508

[1]Data from a KaspNIRKh report.

[2]Data received from A. Vlasenko, 1995.

Source: Khodorevskaya *et al.* in prep.

Table 16b

Numbers of juvenile sturgeons (species not recorded) produced by Iranian Government hatcheries (millions)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1.03	1.11	1.13	2.28	3.1	3.16	3.15	4.34	6.61	3.46

Source: Shilat statistics.

In Iran, which began hatchery production in the 1980s, it has become difficult to find mature adult sturgeons, too. A demonstration catch by the Shilat in April 1995 at Nowshahr, for representatives of the World Bank, the United Nations Development Programme and the United Nations Environmental Programme, failed to capture a single spawner. Other Iranian catch stations fared no better (Dumont, 1995) and Russian experts doubt the effectiveness (and some even the existence) of the Iranian hatcheries, which

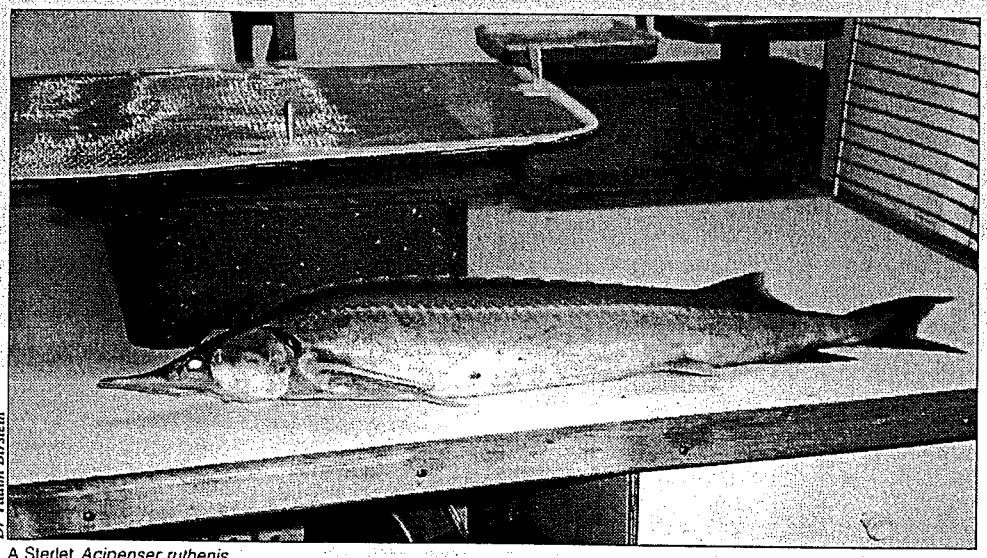
are much smaller than the Russian ones. However, a recent reliable first-hand report from Iran documents an expanding hatchery at Gilan, with the capacity currently for seven million young fish per year (Dumont, *in litt.*, 21 May 1996). Iranian hatcheries may be lacking high-level expertise which, prior to 1992, they had official access to from the Russians (Dumont, *in litt.*, 21 May 1996), but Iranian yearly production of young sturgeons from Government hatcheries rose steadily until 1992 (see Table 16b). The sudden decrease in that year is noteworthy and indeed strengthens the credibility of these official Government figures.

Sturgeon aquaculture enterprise has included experimentation with hybrids. Several artificial hybrids occur, including Beluga x Sterlet, the Bester (Burtzev, 1995). This hybrid, which was "created" in the USSR in the 1950s to produce a new type of caviar, has been the subject of extensive research. Besters are fertile and four generations have already been raised in captivity. They grow fast, and are well established in aquaculture. Attempts were made in Russia to make caviar from roe released by Bester females without killing the animals. The process included the treatment of the eggs with synthesized preservatives to condition the eggs and create a typical caviar taste. However, results were not good – caviar produced from captive sturgeons in general is said to taste different from that from wild fish – and the initiative, which could potentially have offered valuable alternatives to traditional methods which kill female sturgeons to obtain caviar, if not an alternative source species, seems now to have been abandoned.

Thus, although aquaculture of sturgeons in the Caspian region was a thriving and successful means of stock enhancement for some years, critical to maintaining numbers of Belugas, Russian and Stellate Sturgeons in the area, production has declined as a result of diminished funding and supplies of breeding stock.

Aquaculture of other species of sturgeon

Modern commercial sturgeon culture outside Russia began in the late 1970s, and is thus a relatively new business, which started in Bulgaria, Hungary and Germany, and was practised later in Japan, USA, Italy, France, Poland, Belgium, Denmark, Austria, Spain and Israel, among other countries (Faber, 1994).



Dr Vadim Birstein

A Sterlet *Acipenser ruthenis*.

Sixteen other species of sturgeon have been the subject of breeding efforts in captivity, besides Belugas, Russian and Stellate Sturgeons. Commercially, the most important results have been obtained with Siberian Sturgeons (in France and Hungary); Adriatic Sturgeons *Acipenser naccarrii* (Italy); White Sturgeons *A. transmontanus* (Italy); Sterlets (Russia); and Ship Sturgeons (Russia) (Thurén, 1992;

Faber, 1994). In France, four private companies farming Siberian Sturgeons produced a few 100kg of "Caviar d'Aquitaine" in 1995, and hope to reach an annual production of five tonnes in the not too distant future (Anon., 1996b). In the USA and Canada, Atlantic Sturgeon *A. oxyrhynchus* hatcheries have been built to re-stock rivers and bays with juveniles, while White Sturgeons are farmed for meat.

The FAO recorded a gradual increase in meat production from world sturgeon aquaculture, from 150t of in 1984, to 437t in 1992 (Table 16). The volume is likely to expand further. Major producers are Russia (seven tonnes in 1992), Ukraine (34t in 1992), the USA (25t in 1992), France (100t in 1995) and Italy (450t in 1994), but the amount of caviar produced from farmed sturgeon remains modest (Anon., 1996b). Some shops in New York sell caviar from "American Sturgeon". This is probably produced by the growing aquaculture business in the USA and Canada and is relatively cheap, selling, for example, at US$355 per kg in December 1995.

Preservation of genetic stock of Caspian sturgeon species

One course of sturgeon conservation action focuses on preserving biodiversity by freezing sperm and oocytes for future aquaculture. To this end, the building of a bank for sturgeon sperm and a new collection of live sturgeon stocks in Mozhaisk, about 100km from Moscow, is under construction. Meanwhile, the Centre for Preservation of Genetic Stocks of Fish in Krasnodar (see Figure 3) has a unique collection of live stocks of eight different sturgeon species.

Russian scientists have introduced Caspian sturgeon species to various areas of former Soviet territory, for example, Stellate Sturgeons to Lake Balkach (in southeastern Kazakhstan, close to the Chinese border), where they seem to have survived well. The establishment of such introduced populations may be important for the conservation of the species.

Identification of caviar to species level

Traditionally, caviar traders rely upon oocyte size and appearance, smell, texture, and colour, to identify or verify the species of origin of a particular shipment of caviar. Such identification provides potentially important intelligence for sturgeon conservation, by helping to assess levels of exploitation per species and allowing enforcement of any species conservation and management effort. Trade control of caviar from sturgeon species listed in the CITES Appendices, for example, ultimately requires an irrefutable method of identification of the specific origin of caviar (see **International agreements**), unless perhaps all species are listed in the future.

Such a method, based on the peculiarity of nucleotide sequences of mitochondrial genes to a given species, has been developed at the Molecular Laboratory of the American Museum of Natural History (AMNH) in New York and Yale University and allows routine analysis of caviar in a comparatively quick and inexpensive way (De Salle and Birstein, in press). In 1995 and 1996, 23 commercially available samples of caviar were tested, among which five were found to be mislabelled (see *Mis-declared trade*). If funded, work on determining the origin of caviar may result in a means for identifying even the geographical source of caviar, distinguishing, for example, between caviar from the Caspian or Black Sea.

Other research

Techniques to collect eggs from mature sturgeon females without killing them have been explored, using fibre optic probes to assess the ripeness of the roe, but are not fully developed.

Table 17

Sturgeon aquaculture production (t)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
France	-	-	10	10	10	10	10	10	20	140
Italy	-	-	-	-	-	-	250	300	350	310
USSR	150	150	170	150	170	250	68	74	-	<8
Estonia	-	-	-	-	-	-	-	-	-	8
Russia	-	-	-	-	-	-	-	-	7	28
Ukraine	-	-	-	-	-	-	-	-	34	8
USA	-	-	-	5	25	25	30	25	25	30
Total	**150**	**150**	**180**	**165**	**205**	**285**	**358**	**410**	**437**	**524**

Source: FAO statistics.

International agreements relevant to Caspian sturgeons

CITES

The treaty designed to control international trade in endangered species of fauna and flora, CITES, lists three species of sturgeon in its Appendices, none of which is of Caspian origin. There are currently 132 Parties to CITES, each of which designates a Management Authority and Scientific Authority jointly responsible for issuing permits and certificates to authorize international trade in wild fauna and flora, contingent upon certain conditions being met. These documents must then accompany the shipments of wildlife and be presented at Customs points. Depending on the category of threat perceived to apply to a given species of fauna or flora, it is listed in one of three appendices to the Convention. Appendix I is appropriate, in general, for species threatened with extinction, international commercial trade in which is effectively banned. Appendix II lists species of actual or potential conservation concern, for which international trade is strictly regulated with a view to keeping it at levels which are not detrimental to those wild populations of species. Appendix III lists species of especial conservation concern to a particular Party or Parties, which seek the co-operation of fellow Parties in monitoring or restricting their international trade.

Several sturgeon species other than the three already listed may be eligible for inclusion in CITES Appendices I and II. However, only Russia and Iran of the states fishing Caspian sturgeons are CITES Parties and thus, those which are not could become entrepôts acting as laundering centres for caviar illegally exported by their Party neighbours. An added potential problem relating to regulation according to CITES requirements is that of inaccurately labelled caviar shipments. These would make it difficult to record trade in caviar according to species and the technique for identification of sturgeon species is sophisticated, and would be expensive and time-consuming to apply in random sampling and analysis of Caspian caviar in international trade.

Bern Convention

The Bern Convention, or Convention on the Conservation of European Wildlife and Natural Habitats, has 29 signatory countries, including all EU Member States. Belugas and Stellate Sturgeons are listed in Appendix II of the Convention and as such are species for which contracting Parties are expected to take appropriate and necessary legislative and administrative measures to ensure their protection. These measures include a) closed seasons and/or other procedures regulating their exploitation; b) the temporary or local prohibition of exploitation, as appropriate, in order to restore satisfactory population levels; c) regulation as appropriate of their sale, keeping for sale, transport for sale or offering for sale, alive or dead.

Of the countries fishing Belugas and Stellate Sturgeons from Caspian waters, Russia participated in the original developement of the Bern Convention, but has not since become a member country.

Committee for the Conservation and Use of Biological Resources in the Caspian Sea

Since 1992, there has been an effort to forge an international agreement governing Caspian sturgeon catch between Russia, Kazakhstan, Turkmenistan, Azerbaijan, and Iran. According to the Russian press, Azerbaijan's opposition to the proposed terms of the agreement has so far impeded consensus: dialogue between Azerbaijan and Russia is difficult because of a long history of conflict. Azerbaijan permits catches of sturgeons in the open sea and wishes the proposed agreement to allow a fishing zone extending 30 miles from the shore, which would allow their fishers to continue this practice. Until now, however, delegations from the five Caspian countries invölved have failed to agree on the size of their economic zones.

Nonetheless, recognizing the need for a conservation regime, they have so far set up a *Committee for the Conservation and Use of Biological Resources in the Caspian Sea* and, with the aid and backing of scientists from a body called the Russian Ecological Academy, discussions of the proposed agreement to govern Caspian sturgeon catches have been heard in the Russian Parliament. The United Nations and the World Bank have pledged financial help to the five countries in their attempt to reach an accord (Zaitsev, 1996).

CONCLUSIONS AND DISCUSSION

Since the mid-seventies, reported Caspian sturgeon catch has shown an overall decline, from around 30 000t to a reported quota of 719t for Russia in 1996 and an unknown quantity for the other major sturgeon fishery in the Caspian basin, that of Iran. Based on the official projection for Iranian caviar production for 1996 (120t), 1996 sturgeon catches will not exceed 1715t, which approximate to reported catches for 1994 in Iran. It is known, however, that the Shilat has declared that caviar production from Iran in 1996 will be 60% of that in 1995, suggesting a diminished sturgeon harvest since 1994, which in itself was half the amount of that reported in 1991. The findings of research trawls corroborate a theory of decline in Caspian sturgeon stocks. Furthermore, in the face of reduced supply, fishing effort has increased, rather than diminished, notably from the beginning of the 1990s, and the decline in catches is clearly therefore attributable to a decrease in numbers of sturgeons, rather than to reduced fishing. Until 1991, the management of the Caspian sturgeon fisheries was seemingly well controlled, but illegal sturgeon fishing has proliferated since, leading to overfishing, destructive fishing methods, inexpert and wasteful caviar processing and exacerbation of threats from habitat degradation. Although scientists, caviar suppliers, legal fishermen, and many others are very concerned about the future conservation prospects for Caspian sturgeon species, they are genuinely afraid to take action against illegal fishing and caviar processing and trade.

Caspian caviar exports from Iran and CIS countries have not always reflected the decline in sturgeon catches, owing to the change in the balance of caviar exports and domestic consumption inside the producer countries. At the beginning of the 1990s, both Iran and CIS countries increased their exports of caviar, according to statistics of the main importing countries (Tables 8 and 9), but import prices for caviar from the CIS fell at the same time for all types of caviar, as they did for Iranian beluga. This was a result of the large quantities of illegal, and often lesser quality, caviar flooding the export market. A reduction in quantities of caviar exported has been discernable in both Iran and CIS countries since 1994 and it appears that caviar exports may now also be mirroring the depletion of sturgeon stocks in the Caspian basin. Although the quantity of caviar which has so far appeared on the market from 1996 catches has surpassed the expections of one knowledgeable importer, this may only indicate that in most source countries with wild sturgeon populations, economic strife is driving fishers to catch every sturgeon possible.

In the view of some scientists, there are only a few possible outcomes for Caspian sturgeons and the caviar trade based on them. Firstly, if the situation remains as it is, natural reproduction of sturgeons in the Caspian Sea and its tributaries will cease - it is already considered to be "completely destroyed" - (Birstein, 1996) and survival in their native habitat of at least the three Caspian sturgeon species mainly fished for caviar would then depend wholly on hatchery production. Already, Russian scientists claim that all Belugas and more than 30% of Stellate Sturgeons caught, were originally released by hatcheries. Hatcheries have closed down or suffered underfunding since the collapse of the USSR, however, and are no longer able to operate at the potential realised under the previous political regime. Indeed, they have ceased to

provide any stock enhancement of Belugas and this species may therefore be said to have stopped reproducing altogether for the time being in the Caspian basin, except in Iranian hatcheries (Birstein, 1996; H. Dumont, *in litt.*, 21 May 1996).

Although recognizing the need for a structure for the conservation of their sturgeons, as witnessed by the establishment of the *Committee for the Conservation and Use of Biological Resources in the Caspian Sea*, the states surrounding the Caspian Sea have not come to an agreement on a common fisheries policy. The main point of discussion remains the size of the exclusive economic zone of each state. Postponing negotiations leading to such agreement will cause serious delays to any potential recovery of Caspian sturgeon stocks. Even now, if poaching were successfully curbed, recovery of wild stocks to a stable level is expected to take a minimum of 25 to 30 years (Malutin, 1995; Artyukhin, 1995).

At the national level, although enforcement of sturgeon fishing and caviar processing and trade regulations appears strong in Iran, it is ineffective in Russia, while in Azerbaijan, Kazakhstan and Turkmenistan, fishing regulations are said to be unpublished, rendering enforcement of laws governing caviar trade, from fisheries management to exported control, at best erratic. Importing countries could do more to reduce illegal caviar trade. Even though their grounds for obstructing trade at present are largely restricted to improper packaging, handling and labelling, these are faults typically associated with illegal production. Detection of fraud may soon become easier for importers, if the means for identification of the species of origin of caviar is standardized.

Catching a sturgeon in the past may not have been easy – legend recounts that Hiawatha was swallowed by the sturgeon he baited, while Russian fishermen earlier this century endured life in huts among frozen marshes. The Caspian sturgeons which supply the world caviar market today are becoming harder to catch for different reasons. Humankind has become all too adept at harvesting them, now more than ever, so that at present levels of overfishing, the legal commercial catch quotas for Caspian Belugas, Russian and Stellate Sturgeons will logically be set at zero in just a few years.

Ironically, the indiscriminate nature of sturgeon fishing and subsequent illegal caviar production may be the very redemption of sturgeons by a "killing" of world demand for caviar, as a result of growing dissatisfaction with the very poor quality of caviar now reaching the markets *via* illegal traders.

RECOMMENDATIONS

Management of fisheries in the Caspian basin

Fisheries management

- All countries using the fisheries resources of the Caspian Sea basin should endeavour to agree on co-ordinated management of their fisheries. Efforts to secure signature of an international agreement on a common fisheries policy by all Caspian states concerned, as initiated by the *Committee for the Conservation and Use of Biological Resources in the Caspian Sea*, should be pursued. Co-operative fisheries management could in turn lead to the stimulation of integrated conservation activities in the region.

- All countries fishing sturgeons from the Caspian Sea basin should develop clear legislative frameworks to govern the management of their sturgeon stocks and communicate the major points of these to each other and their trading partners.

- The government of each state bordering the Caspian Sea needs to consider enforcing a ban on open-sea fishing and trawling for sturgeons.

- Where not already in place, limits on size of sturgeons which may be legally caught, the establishment of annual quotas for numbers of sturgeons which may be taken, and annual setting of sturgeon fishing seasons, should be instituted by the governments of those countries fishing sturgeons from the Caspian Sea basin. Once established, these limits should be revised in accordance with contemporary conservation needs of Caspian sturgeons.

- In order to control the volume and type of sturgeon catches, observers would need to be stationed aboard fishing vessels and at processing plants.

Habitat protection

- Immediate legislative action for the protection of the remaining natural spawning sites for sturgeons in rivers flowing to the Caspian Sea and of the sturgeons' feeding grounds is recommended. Further action should then address the prevention of any further damage to sturgeon habitat through damming and irrigation schemes.

- Equally, legislation should be enacted for the improvement of water quality in the Caspian basin, by

  - promoting the use of cleaner industrial technologies,
  - addressing waste disposal practices,
  - reducing amounts of noxious fertilizers and pesticides used in agriculture,
  - limiting amounts of water permitted for offtake for irrigation purposes,
  - and minimizing oil pollution.

  Implementation of such measures would need to be agreed within a regional context in view of the number of countries sharing access to Caspian waters. Moreover, substantial financial commitment would be necessary to effect these measures, which would be costly to industry and agriculture.

Scientific research

- Baseline data from catch records need to be used in conjunction with knowledge of sturgeon biology and migration habits, and the impact on sturgeon populations caused by pollution-induced tumours and other biological anomalies, to determine appropriate fishing seasons, quotas, fish size limits, key habitats and priorities for water purification treatments.

- Current practice for breeding and releasing juveniles from hatcheries should be evaluated, to assess possibilities for improvement. In particular, the effect of hatchery releases on wild stocks; their wider effect on the environment (including the possibility of overstocking); and the survival rate and reproductive capacity of released sturgeon should be examined.

- Research should continue into the means of providing appropriate passageways for sturgeons to pass dams, to allow travel to and from spawning areas on dammed rivers.

- Opportunities for employing the most effective and modern techniques for sturgeon conservation and conservation research in the Caspian basin, for example, of measuring pollutant levels, should be maximized. To encourage the exchange of information, including research data and scientific

discussion, wider international access and usage of information networks should be promoted, for example, through means such as World Wide Web and the Internet electronic mail group set up for sturgeon specialists and other interested parties ("sturgeon@ucdavis.edu").

- Current research into the biological and conservation status of Caspian sturgeon species, for example, by the IUCN SSC Sturgeon Specialist Group, needs to be updated frequently, as the nature and pace of change in exploitation of stocks of these species has been so marked in recent years.

Enhancement of supply of sturgeons from captive sources

The role of hatcheries in restocking Caspian waters with sturgeons should be enhanced in Russia, where the production capacity of existing hatcheries has recently diminished.

- Taking into account the possible economic and ecological impacts of hatcheries on the Caspian basin ecosystem, (see ***Scientific research***), a review of the current distribution and number of hatcheries producing sturgeons for release in Russia is recommended. Once the number of hatcheries currently in operation is known, it should be assessed whether or not more are needed, or whether some could advantageously be re-located.

- Priority should be given to supporting existing hatchery programmes. Where necessary, facilities need to be renovated, modernized and re-equipped. In particular, the provision of boats would allow transport of hatchery juveniles down river to the Caspian Sea, where their chances of survival are greater. To this end, means of meeting the deficit of US$100 000, needed to complete construction of the ship for conveying young sturgeons to the sea from the Volga River should be considered.

- Since wild spawning stock is now scarce, possibilities for keeping and re-using captive spawners, the housing and feeding of which are particular problems at present, should be investigated.

- Exchange of information between sturgeon hatcheries around the world, should be promoted.

- Research into the production of caviar from captive-bred sturgeons which is closer to the taste of that from wild sturgeons should continue. If successful, the production of caviar, which is acceptable to consumers, from live, captive, Bester hybrids may follow.

- The construction of a bank for frozen sturgeon gametes in Russia should be brought to fruition and adequately stocked once built. Cryogenics may prove a valuable source of supply for sturgeon stock enhancement in the future.

- The establishment of live specimens of each of the Caspian species of sturgeon in captivity is recommended. Indeed, owing to the possibility of other sturgeons being threatened, captive specimens of all species and subspecies and/or populations within the family Acipenseridae should be collected, in order to maintain the full range of genetic diversity of sturgeons in safe quarters. This will require a co-ordinated international programme, involving scientific institutions, zoos and aquaria, worldwide.

Trade regulation

Production controls

- It is important to clarify legislation in Russia, Azerbaijan, Kazachstan, Turkmenistan and Iran governing the production of caviar. Where absent, provisions for the control of volumes and quality of caviar in Caspian processing plants should be instituted, in order to regulate the trade in accordance with levels sustainable by wild sturgeon stocks and standards required by importing countries.

- Technical missions from significant importers (chiefly, the EU, USA and Japan) should continue to visit Caspian caviar processing plants regularly to engender mutually beneficial trading standards. The growth of such collaborative practice, could lead to an increasing number of processing plants adhering to accurate labelling of caviar and appropriate control of sanitary conditions for preparation and packaging.

Trade controls

CITES

CITES offers the possibility to develop an international legal framework whereby legally and sustainably harvested sturgeon products can be distinguished from others. Sturgeons and sturgeon products that have not been obtained in compliance with the provisions of the Convention may be seized, and penalties provided for offenders. Given the diminishing faith of the informed consumer in caviar as an authentic and carefully produced product, certification of legality and country of origin, as required under the terms of the Convention may eventually restore the image of the product, and thereby bring monetary, as well as conservation benefits.

It is recognized that problems relate to the enforcement of CITES, with respect to any eventual listing of Caspian sturgeons in its Appendices and considerable research work would be required to ensure that export of sturgeon products complied with the requirements of Article IV of the Convention, in order that the impact of such trade will be non-detrimental to wild stocks. These obstacles notwithstanding,

- it is recommended that a comprehensive evaluation be carried out to ascertain whether additional sturgeon species meet the CITES listing criteria. It would appear that some sturgeon species that are now classified as Critically Endangered (according to IUCN threat categories) comply with the biological criteria for listing under CITES Appendix I, while a number of other sturgeon species could meet the criteria for CITES Appendix II-listing, either because current levels of harvest are suspected to be detrimental (CITES Article II, 2a), or on look-alike grounds (CITES Article II, 2b). If this is the case, all sturgeon species should be listed under CITES, thereby solving the problem of discriminating between CITES- and non-CITES-listed sturgeon products in trade. Furthermore, pressure on species currently relatively numerous, such as the species commercially exploited in the Caspian, is likely to increase. This is owing to the projected constant level of demand for caviar, but of dwindling sources of the product, because of economic hardship causing overfishing, pollution problems, difficulties in organizing effective fisheries management, lax enforcement, and other factors, which may be expected to persist for some time.

- It is also recommended, if Caspian sturgeon species are included in the Appendices of the Convention, that Kazakhstan, Azerbaijan, and Turkmenistan, take steps to join CITES as soon as possible, and adopt appropriate implementing legislation. This will be important, if such listings are not seriously to be limited in terms of regulating the regional caviar trade, as presently only two territories bordering the Caspian Sea are CITES Parties. In addition, improved CITES-implementing legislation should be adopted in Russia.

Other trade controls

While stronger legislation in supply countries is of paramount importance, improved control of the legality of caviar trade upon entry to recipient nations should not be ignored. Therefore,

- it is recommended that Customs authorities in all countries importing Caspian caviar should observe the separate tariff category (for sturgeon roe as distinct from roe from other species of fish), which is

designated within the Harmonized Commodity Description and Coding System, to which most are party. Until such common listing between trading nations is achieved, data relating to sturgeon trade in general remain unclear. Consequently, monitoring of amounts of caviar in international trade, and the roles played in the trade by separate countries, is obstructed.

- It is also recommended that training of Customs officers in recognizing inappropriate caviar packaging, forged accompanying documents (as far as possible), and inaccurate product labelling should be undertaken.

- It is recommended further to develop techniques to distinguish between caviars in trade from different sturgeon species, in order that control of species in regulated trade may be effective. Roes from different species may be mixed, which complicates such regulation, but although the means for identification of different caviars are expensive, time consuming, and not yet widely available, they should be accessible to all Customs authorities of main caviar-importing countries. As it cannot be expected that random sampling and analysis of all Caspian caviar imports will be practicable at ports of entry, it is recommended that a few regional forensic centres be established to carry out testing of caviar imports for several countries, or indeed independent importers (see **Industry action** below).

- It is recommended that the role of countries which serve as entrepôts, from where caviar of dubious or obvious illegal origins is re-exported, be investigated and exposed. Concerted efforts should be developed to eliminate the links which make this illegal trade possible.

Industry action and market influence

Measures to conserve Caspian sturgeon stocks taken at government level, nationally and internationally, may be complemented by responsible action by independent caviar-importing companies and caviar consumers. With this aim in mind,

- it is recommended that Caspian fisheries using relatively non-detrimental fishing methods (e.g. those avoiding trawling and nets obstructing access to river beds and sides; releasing undersized, male and immature sturgeons; refraining from fishing at sea) be identified.

- It is also recommended that fisheries agencies and experts identify standards for sustainable sturgeon fisheries, which take into account the conservation status of the species, the management of the sturgeon stocks, and the legality as well as the general quality of the likely resultant products.

- Fisheries meeting the standards identified by surveys as described in the two recommendations above should be certified accordingly and a label for caviar produced from these sources could then be created and promoted among importers and consumers.

- It is further recommended that such a certification and labelling scheme would only be likely to succeed if supported by a pool of traders agreeing to accept and market only caviar produced according to the terms of the scheme. An earlier attempt to create such a pool in Europe failed a few years ago, but consumer faith in caviar may have been shaken sufficiently since to render a "mark of quality" more financially rewarding to traders now than previously.

- As the ultimate destination of caviar in trade, the consumer is recommended to support any eventual labelling scheme which certifies legally and sustainably produced caviar, but which has also been subject to controls throughout its production (in order to guarantee the terms of its certification), thus resulting in direct benefits for the consumer.

- The existing International Standards Organization (ISO) and ISO 9002 certification, specifically relating to caviar, may provide the basis for certification as described above, as it already has the advantage of being an accreditation recognized worldwide as a guarantee of certain standards of quality. Although at present there is no facility for guaranteeing the authenticity and quality of caviar itself, within this organization, it is recommended that certification by ISO be promoted among consumers as a baseline standard for caviar producers.

Awareness

- Awareness of the danger of over-fishing sturgeon stocks should be promoted among Caspian fishing communties, in parallel with government-led plans for alternative sources of employment for fishers to compensate for any reduction in income from sturgeon fishing.
- In order to convince consumers that their choice may make a difference to the conservation prospects for Caspian sturgeon populations, the caviar industry should inform customers about the significance of purchasing caviar from sustainable and legal sources, in order that associated higher prices will be tolerated by the market.

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NOTES

[1] Russia, known as the Russian Federation, comprises 21 autonomous republics, including Kalmykia and Dagestan, which border the Caspian Sea.

[2] For the purposes of this report, references to caviar in trade from the USSR/CIS and Iran is considered to be approximately synonymous with Caspian caviar. One CIS non-Caspian state, Ukraine, is recorded as catching sturgeons (see Table 2), but only countries of the CIS bordering the Caspian Sea (which Ukraine does not) show up in the import statistics of the EU and USA and the other main importer of caviar, Japan, groups imports from the CIS. Moreover, roughly 90% of caviar in world trade is estimated to be of Caspian origin (see **Volumes of caviar produced**), which means that the percentage of world trade in non-Caspian caviar sourced from CIS States must necessarily be very small.

Other possible sources of caviar from the CIS are the Black Sea, Sea of Azov and the Amur River. The Black Sea has only a remnant population of sturgeons, and caviar from this sea and from the Sea of Azov is in any case invariably sold under a Russian label, rendering distinction between the two sources presumably difficult (S. Taylor, *in litt.*, 1 August 1996). The Sea of Azov is very polluted and reportedly held only 3000t of anadramous fish species (sturgeons, herrings, etc.) by 1992. There are no longer considered to be any sturgeon stocks of commercial value in that sea (Zaitsev, 1995). Finally, Russia harvests relatively minute quantities of sturgeon (and caviar) from the Amur River (see Table 4).

[3] The Commonwealth of Independent States (CIS), was created in December 1991, upon the disbanding of the USSR. It is made up of 12 of the 15 former Soviet constituent republics, namely, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. The Commonwealth is an alliance of fully independent States.

[4] Beluga, Russian Sturgeon and Stellate Sturgeon are *beluga*, *osetr* and *sevruga*, respectively, in Russian, hence the derivation of the names for their caviar.

[5] Currently, the USA and Japan forbid the importation of caviar preserved with borax. The use of borax has recently been allowed, once again, in caviar imported to the European Union, since June 1994.

[6] Alternatively, calculations of an official caviar producer and of a long-standing caviar importer result in an general estimate of 7.5% of a given tonnage of sturgeon catch equating to usable caviar produced (S. Taylor, *in litt.*, 1 August 1996).

[7] R = roubles: the conversion rate used in this report is R4500 to US$1.