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by

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MINISTRY OF FISHERIES

PROVINCE OF QUÉBEC

The Hon. Camille-E. Pouliot, M.D.
Minister

Arthur Labrie, D.Sc.
Deputy Minister

STUDIES OF AQUATIC MAMMALS

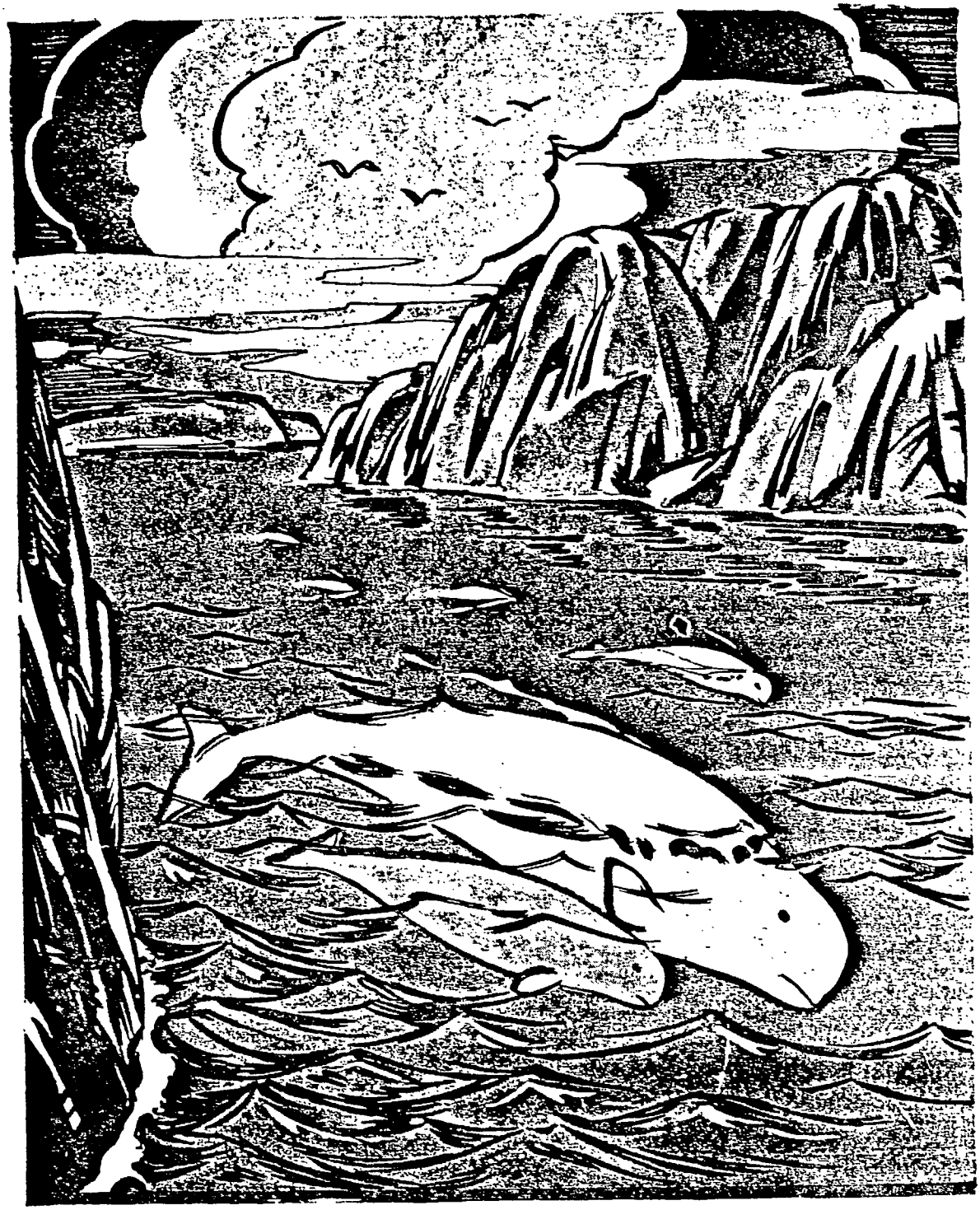
III. - Hunting, Biology and Economic Value of the White Whale or Beluga (Delphinapterus leucas) of the St. Lawrence River and Gulf

by

Vadim-D VLADYKOV, Ph.D.,
Biologist

QUÉBEC CITY

1944



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PREFACE

In 1938, the Ministry of Fisheries of the Province of Québec sponsored a scientific investigation of aquatic mammals of the St. Lawrence River and Gulf. The specific purpose of this investigation was to determine what influence the Beluga or White Whale had on the fluctuations in commercial fishing. Dr. V.-D. Vladykov, formerly a professor at the University of Montreal and now a biologist with the Provincial Ministry of Fisheries, was commissioned to conduct this research.

This study of the biology of the Beluga is a continuation of a series of publications on the aquatic mammals of the St. Lawrence River, the first two of which appeared in "Le Naturaliste Canadien" (The Canadian Naturalist). It will be followed by another study by the same author, on the food of the Beluga.

The many maps and photographs that illustrate this work will enable the reader to gain a better understanding of this interesting mammal. Local expressions such as "bleuvet" (blue calf), "blanchon" (greyish white calf), "mouvée" (school) and a host of others, equally colourful, used in the original French version of the text, enliven it and make it captivating reading.

It is hoped that this work will be helpful in the teaching of natural science and of considerable use to whalers and merchants, who will find in it a great deal of information with regard to the commercial utilization of the White Whale.

ARTHUR LABRIE, D.Sc.,
Deputy Minister of Fisheries

Quebec City, November 14, 1944.

INTRODUCTION

The White Whale (Marsouin Blanc), or Beluga, is the most distinctive animal of the St. Lawrence region. The first explorers who came to Canada noted its presence in our waters. The number of Beluga in these parts has no doubt varied a great deal from one period to another. In this century, it was not until about 1928 that the fishermen of Québec seemed to consider the Beluga as a dangerous ravager of salmon, cod and other commercially valuable fish. The Government of the Province of Québec took several steps to reduce their numbers; a summary of which appears in another report (Vladykov, 1938). In addition, the Ministry of Ocean Fisheries decided to subsidize a scientific investigation of the White Whale in order to improve our knowledge of the Beluga with respect to our commercial fish.

In 1938, the Québec Ministry of Fisheries appointed the Institute of Biology of the University of Montréal to supervise this investigation. The Institute assigned this work to the author, who was assisted by Dr. Guy Prévost, then a medical student at the university. The study was conducted during 1938 and 1939, then resumed towards the end of 1942.

In addition to the Ministry of Ocean Fisheries, several people took part in this study.

Dr. R. Kellogg of the Washington National Museum and Dr. A.B. Howell of Johns Hopkins University of Baltimore had lengthy discussions with the author about the manner in which this research

should be conducted.

Dr. Georges Préfontaine, Director of the Institute of Biology, University of Montréal, showed a keen interest in this research; he came up with numerous suggestions and was kind enough to offer to me the use of one of the Institute's laboratories. Through his energy and tact, Dr. Guy Prévost was highly successful in the laborious task of collecting data.

Numerous whalers on the St. Lawrence River, particularly whalers from Les Escoumains, Pointe-Lebel and Rivière-Ouelle, contributed greatly to the success of the study through the enthusiastic cooperation and valuable information they provided.

To all of the above-mentioned, the author wishes to express his sincere appreciation and deep gratitude.

Most of the illustrations in this study are original photos taken by the author; a few (Nos. 9, 19, 23, 24, 32, 39 and 53) were taken by Dr. Guy Prévost. A few plates are from a study by Bonin & Vladykov (1940) and Nos. 21, 22 and 30 from an article by the author (Vladykov, 1943).

BIBLIOGRAPHICAL NOTES

Although the White Whale or Beluga was already known to the first explorers of Canada, among them Jacques Cartier (Chambers, 1912) and De Charlevoix (1744), this Cetacean was not given a scientific name until 1776, by Pallas (1776).

The problem of the taxonomic classification of the White Whale (Delphinapterus leucas) was discussed by several authors: Lacépède (1844), Cope (1865), Scammon (1869) and True (1889 and 1908). In recent years, Russian authors such as Barabash & Klumov (1935), Barabash (1937) and others have come back to the view that several species of Belugas live in the Arctic seas. In this study it will be assumed, at least for the time being, that the White Whale or Beluga of the St. Lawrence River belongs to the species known to science as Delphinapterus leucas (Pallas).

The anatomy of the Beluga has been described mainly by the following authors: Barclay & Neill (1821), Wyman (1863), Watson & Young (1880) and Struthers (1896). A report on the changes in shape of the pectoral fin was published by Vladykov (1943). Geiling & Robbins (1936) made a detailed study of the structure and properties of the pituitary gland. Bonin & Bélanger (1939) and Bélanger (1940) discussed the histology of the Beluga's lung, Bonin and Vladykov (1940), the histology of its skin.

Certain aspects of the Greenland Beluga's biology were mentioned by Degerboel & Nielsen (1930). Many Russian authors have studied the Belugas of Northern Europe and Asia. Their names can be found in a

work by Heptner (1930) and particularly in the one by Arsenyev (1939).

Most of the information on the distribution of the Beluga in the Canadian Arctic is attributable to the following authors: Low (1889, 1897 and 1906), Bernier (1909), Soper (1928), Binney (1929), Sutton & Hamilton (1932) and Anderson (1935).

There is very little bibliographical data for the St. Lawrence region. A few comments made by Fortin (1863, p. 115) and Schmitt (1904, pp. 316-317) might be mentioned, plus a short paper on Beluga fishing at Rivière-Ouelle by Abbé Casgrain (1873) and a report by Forbin (1930), also with regard to Rivière-Ouelle. Andrews (1925, pp. 267-277) published remarks on the Beluga hunt near Ile-aux-Pommes, in the vicinity of Trois-Pistoles. Howell (1935) commented on these animals while on a Saguenay trip.

All things considered, one might say that information on the Canadian Beluga is very limited. Thus, there is a need for as much information as possible about the natural history, taxonomic classification, methods of hunting and economic value of these animals.

DATA COLLECTED

In 1938, Pointe-Lebel, a small village in Saguenay County about 7 miles west of Baie-Comeau, was selected as our research station. The considerable concentration of Beluga on the Manicouagan Bank (1), in the vicinity of Pointe-Lebel, makes this location the whale-hunting centre of the St. Lawrence (Fig.1).

Dr. Prévost arrived there on May 18 and remained until September 10. The author of this paper went there occasionally to organize and supervise the work. That particular year, the Beluga congregated near Pointe-Lebel later than usual and thus the first animal was not killed until June 10. We were nevertheless able to study 143 Beluga in all during the hunting season.

In 1939 we established our research centre at Les Escoumains, a village situated 30 miles east of the mouth of the Saguenay, where the Beluga has been hunted for a long time. We arrived there on June 16, and Dr. Prévost stayed on until September 13.

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(1) The whalers identify certain sections of the Manicouagan Bank according to the type of bottom: sand, clay or vegetation; hence, "White Bank" (Banc Blanc), "Clay Bank" (Banc de Glaise) and "Green Bank" (Banc Vert). Data on the Beluga captured in these locations are given in the tables included in the Appendix.

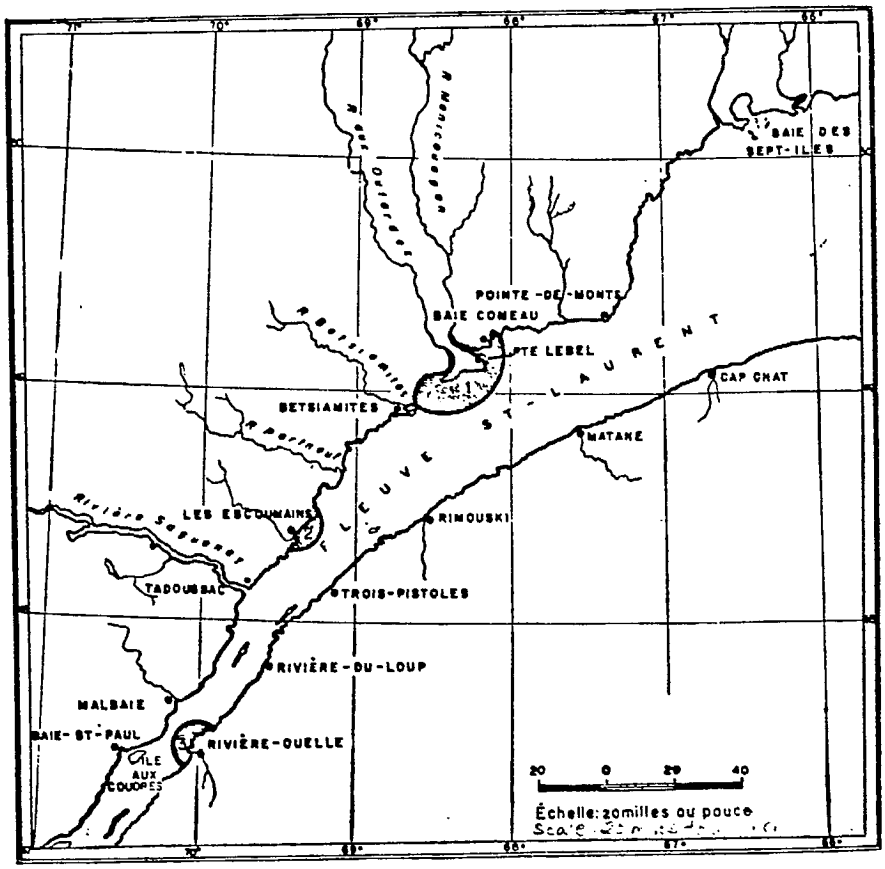

FIG.1.- Schematic map of the St. Lawrence River, indicating places where the Beluga specimens were obtained. 1- Manicouagan Bank, in the vicinity of Pointe-Lebel; 2- Les Escoumains; 3- Rivière-Ouelle.

TABLE I.- Distribution, by length, of Beluga caught in the St. Lawrence River in 1938 and 1939.

NO. OF SPECIMENS MEASURED

GROUPS

Groupes	Nombre de spécimens mesurés				
	1938		1939		Total
po.	♂♂ (1)	♀♀ (1)	♂♂ (1)	♀♀ (1)	
60-69	3	4	1	—	8
70-79	1	2	1	—	4
80-89	1	4	—	1	6
90-99	2	4	1	—	7
100-09	3	2	1	1	7
110-19	3	3	1	1	8
120-29	5	9	1	1	16
130-39	7	18	1	7	33
140-49	6	14	—	3	23
150-59	10	2	1	—	13
160-69	27	1	—	—	28
170-79	9	—	—	—	9
?	2	1	—	—	3
Total	79	64	8	14	165

(1) The symbol ♂ indicates males and ♀ , females.

Unfortunately, 1939 was the year the Québec Ministry of Ocean Fisheries withdrew the bounty it had granted the five previous years for destroying the White Whale (Vladykov, 1939). This is why whale-hunting in our province was practically non-existent. Our budget did not permit us to buy more than twenty Beluga; seventeen were studied at Les Escoumains and two at Pointe-Lebel. We measured three others at Rivière-Ouelle, on the South Shore. During these two years we examined a total of 165 Beluga caught in the St. Lawrence River (Table I).

Most of the Beluga were measured by Dr. Prévost. However, the ones captured between September 10 and 24, 1938, near Pointe-Lebel, were measured by Edmond Chouinard, a local whaler; the three specimens (Nos. 331-333) caught at the mouth of the Ouelle River in the fall of 1939 were measured by the author.

The purpose of this study was to determine what effect the Beluga had on our commercial fish supplies. Thus we paid particular attention to this animal's food habits. The stomachs of all the specimens were opened and their contents preserved in formalin.

The problems inherent in a study such as this prevented us from examining the specimens as thoroughly as we would have liked. We neverthless determined, for each specimen (1):

(1) The length and circumference of the body and width of the tail were measured with a tape, but calipers were used for the other measurements. The highly curved flippers of the old males were also measured with a tape (Figs. 19 and 32).

1. Length of the specimen (adult or embryo) measured in a straight line from the end of the snout to the notch in the tail;
2. Maximum circumference, measured just behind the pectoral fins;
3. Distance from snout to eye;
4. Distance from snout to nostrils (blowhole);
5. Length of the left pectoral fin;
6. Maximum width of the tail, measured between its two tips;
7. Thickness of the blubber (hypodermis) measured on the back, along the medial line, about one foot behind the blowhole;
8. Sex.

In the case of females, in addition to the above measurements, the following observations were made:

9. Report on the condition of the mammary glands;
10. Opening of the uterus to remove the foetus;
11. Examination of the ovaries to determine the presence of corpora lutea.

In addition to these routine observations, details of which appear in the Appendix tables, we made several others associated with the anatomy. These will be the subject of a special paper. Seventy-five skulls and two complete skeletons have been kept for study at a later date.

HYDROLOGY OF THE ST. LAWRENCE

In order to better understand some aspects of the biology of the Beluga, one must be familiar with the hydrological conditions in the St. Lawrence. That is precisely the purpose of this chapter.

General Remarks

The St. Lawrence is generally subdivided into two main parts: the river and the gulf. The estuary is the most important part of the river as regards the distribution of the Beluga. It is described as the section extending from the eastern end of Ile d'Orléans up to Pointe-de-Monts on the North Shore and Cap-Chat on the South Shore. The actual gulf lies east of these two sites.

In addition to the St. Lawrence and several other large rivers, the waters of Labrador also empty into the Gulf of St. Lawrence through the Strait of Belle Isle. The Gulf connects with the Atlantic Ocean through Cabot Strait and the Strait of Canso. However, according to Le Danois (1936, p. 190), the Canso channel is by far the more important:

> The basic phenomenon that distinguishes the hydrological conditions of this area is that the waters of the St. Lawrence do not empty into the Atlantic through its estuary or through the Lawrentian channel, which is its underwater continuation, but rather through the small channel that separates Cape Breton Island from Nova Scotia. The real course of the St. Lawrence on its way to the sea is, in actual fact, around Prince Edward Island, while its large estuary is merely a marine gulf.

There are two reasons for this phenomenon: firstly, the abyssal waters influenced by the turbulent branches of the Gulf Stream form a salt water transgression which, in accordance with the rule, follows the abyssal line and sinks down onto the steep slope of the Laurentian channel; secondly, there is the entry, through the Strait of Belle Isle, of a branch of the Labrador current, which is extremely cold and has a salt content higher than that of St. Lawrence water. These two movements force the water of the River to mix with the sea water.

Currents

Information on the currents in our region may be found in a work entitled The St. Lawrence Pilot (1943, p.7):

> Throughout the Gulf of St. Lawrence, the currents are the resultant of progressive movements of the waters on which are imposed the tidal influences, the effects of wind, and the effects of varying barometric pressures... Broadly speaking, a general circulation exists in the gulf area, the rotation being anti-clockwise.
>
> There is a constant outgoing current in the middle of the St. Lawrence estuary, which continues along the southern shore, as far as, and beyond, Cape Gaspé. This constant out-going tendency, as distinguished from the usual tidal behaviour of the Lower St. Lawrence, is first felt below Red inlet, near the mouth of the Saguenay river. It is met by a cross current, from the vicinity of Pointe de Monts, which sets towards Cap-Chat. Below this, the out-going current is more pronounced, and is known as the Gaspé current.
>
> The out-run of the Gaspé current turns southward round Cape Gaspé, and finds its way south-eastward, between the Magdalen Islands and Prince Edward Island.(1)

In the same work (p. 94), the currents between the St. Lawrence River estuary and Gulf are described as follows:

> Between Pointe de Monts and Cap-Chat, the currents, which were generally south-easterly, were more continuous and definite in direction than elsewhere; the average rate with rising tides was 0.7 knots (2) and, with falling tides, one knot; a maximum rate of 2 knots was observed, but the direction then was only slightly southerly.

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(1) The information contained in The St. Lawrence Pilot (1943) is based mainly on the observations of Dawson (1913, 1913a and 1917) and Anderson (1934). Other hydrological data about the St. Lawrence region can be found in works by Sandstrom (1919) and Bjerkan (1919). Schmitt (1904, pp. 46-49) gives a little information on water temperatures in the St. Lawrence, particularly near Anticosti Island.

(2) A knot is a unit of speed equal to a nautical mile, or about 6,080 feet, per hour.

Depth and Cold Water Layer

A glance at a nautical chart clearly shows that slightly east of the Saguenay (well offshore from Les Escoumains) there is the beginning of a channel that is at least 100 fathoms deep. It continues across the Gulf under the name of "Laurentian Channel" and connects with Cabot Strait. This channel follows the Gaspé Peninsula quite closely, so that it veers away from the North Shore. This configuration of the St. Lawrence riverbed is very significant as regards the distribution of Belugas because these animals prefer shallow places. This is probably one of the reasons they are more numerous along the North Shore than near the South Shore.

In all of the St. Lawrence region, the salinity of the water is very low (less than 30°/oo) near the surface; the water becomes 100% freshwater upstream from L'Islet (1). Another far more significant characteristic is the presence, in the vicinity of the Saguenay and everywhere in the Laurentian channel, of a layer of cold water (2) at a temperature of about 32°F., which is always found sandwiched between two layers of warmer water.

According to Gaudry (1938, p. 6):

> This is a cold undersea current which moves towards the estuary at a depth of 50 to 100 meters. Its temperature varies between 0° and -1°C. This current is completely stopped by the Ile Rouge shallows, at the mouth of the Saguenay River. The water in this current...is of Arctic origin and has a major influence on the temperature of the water near the mouth of the Saguenay River.

(1) Detailed information on the salinity of the water in the St. Lawrence estuary can be found in a work by Nadeau (1938).

(2) The origin of this cold water layer is discussed by several writers, such as Sandstrom (1919, p. 25), LeDanois (1936, p. 191), Hachey (1938) and Tremblay & Lauzier (1940).

This cold layer, about 25 fathoms deep, rises close to the surface a short distance east of Ile Rouge, at the mouth of the Saguenay. It was probably for this reason that in the summer of 1938 Gaudry found close to the surface a temperature of 38°F, which is even colder than in the Strait of Belle Isle (Cap-Saint-Charles). According to this author, in the St. Lawrence estuary the summer temperature variations near the surface are as follows: immediately west of the Saguenay River, water temperatures vary from 41°F to 46°F; at the centre of the estuary, water temperatures are generally between 43 and 46°F; between Ile-du-Bic and Pointe-de-Monts they are slightly higher and they rise as the distance to the Saguenay area increases.

During the summer, along the South Shore there is a clear demarcation between the warmer water of the St. Lawrence and the colder water of its estuary in the vicinity of the dock at Rivière-Ouelle, which is about four miles east of the mouth of the river by the same name. In fact, in July 1944, at high tide, we observed the following temperatures taken near the surface at the end of the docks:

LOCATION	DATE	TIME (1)	WATER TEMPERATURE °F
Saint-Roch-des-Aulnets	July 19	5:00 p.m.	71.6
Sainte-Anne-de-la-Pocatière	July 19	6:00 p.m.	73.4
Rivière-Ouelle	July 20	4:30 p.m.	55.4

(1) In the table above and elsewhere in this publication, the time is Daylight Saving Time.

The temperature reading near Rivière-Ouelle was in sharp contrast with temperature readings taken further west. This difference is a very significant factor in the distribution of Beluga here during the summer: they congregate regularly east of the Rivière-Ouelle dock but do not advance west of that dock.

Saguenay River

Because the Saguenay figures prominently in the distribution of the Beluga, the hydrological conditions in this great river deserve scrutiny. First of all, it should be remembered that this fjord-river is extremely deep: between its mouth and 50 miles upstream, depths can reach 100 fathoms even a few feet from shore, while near Cap-Eternité there are places where the river is 145 fathoms deep. The following description is based on data provided by Gaudry (1938, pp. 12-13), who notes that in August 1936 the temperature of the Saguenay, from Baie-Trinité to the estuary, was approximately 59° near the surface. At 5 fathoms, however, the water temperature dropped to 36°F, and at 13 fathoms to only 33°F.

The water of the Saguenay has a lower salinity than water at the same depth in the St. Lawrence estuary. Therefore, due to its lower density, it creates a surface current in the St. Lawrence. The current crosses the estuary and follows the South Shore, from Ile aux Basques to Ile du Bic, where it appears to flow through the middle of the estuary.

> However, it continues on to the very spot where the cold current finds its way to the surface layers. It is therefore likely that the "Saguenay River current" acts as a return path for the waters of the cold current that wells up over the shallows at Ile Rouge. This could explain why the water along the South Shore, in the path of the current from the Saguenay, is colder than the North Shore waters.

At the end of his work, Gaudry (p. 13) summarizes the importance of the cold Saguenay current as follows:

"The discovery of this cold current which affects the water of the estuary, even at the surface, fully explains the reason for the relative harshness of the climate in the neighbouring areas, and the formation of fogbanks which one so often encounters on approaching the Saguenay River.

This arm of the cold Labrador current is not identified merely by its temperature; the low temperature of this current goes hand in hand with a high pH, a high dissolved oxygen content and a low phosphate and silicate concentration."

Another interesting point is that the cold water of the St. Lawrence estuary is the habitat of invertebrates and especially fish of Arctic origin (Vladykov & Tremblay, 1935 and 1936), like the ones in Hudson Bay, whereas mainly Atlantic species are to be found in the Gulf of St. Lawrence.

Water Temperature Distribution

In order to provide a better understanding of the seasonal distribution of the Beluga in the St. Lawrence, it was the author's intention to correlate this with monthly temperature variations. Unfortunately, there are no complete data on the subject; data pertaining to different months and collected over several years therefore had to be used. Although this arrangement was somewhat heterogeneous and incomplete, it nevertheless provided certain interesting pieces of information. An example of this is provided in Fig. 2, which shows the summer temperature distribution, from June to September, at a depth of 5 fathoms (10 metres). This depth was felt to be the most appropriate as it corresponds approximately to the depth of water at which Beluga generally find their food. Moreover, temperatures at that depth are less influenced by the daily action of solar heat, wind, tides, etc., than they are near the surface.

These temperatures were taken, first of all, from a publication by Gaudry (1938) and then from works by Bjerkan (1919) and LeDanois (1936). The most complete information, however, was graciously provided by Dr. Jean-Louis Tremblay, Director of the St. Lawrence Biological Station. Some data was also obtained from the manuscript of Captain L. Beaugé (1), a professor at the École Supérieure des Pêcheries in Ste-Anne-de-la-Pocatière, Qué., on the results of cruises made in 1939 and 1942.

In Fig. 3, temperatures at 5 fathoms are divided into three groups, namely:

GROUP	TEMPERATURES	
	°C.	°F.
I	0 to 5	32 to 41
II	5.1 to 10	41.2 to 50
III	10.1 to 20	50.2 to 68

Although there are cold temperatures to be found in several spots in the River and Gulf, the water was always coldest out beyond the estuary of the Saguenay, with temperatures ranging between 32°F and 38°F.

It is unfortunate that no information whatever is available on water temperatures for most of the Gulf of St. Lawrence. It is known, however, that during the summer the temperature of the water from the surface to a depth of 5 fathoms is at least 54°F. throughout the Baie

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(1) The title of the manuscript is: "Recherches océanographiques", 1942, École Supérieure des Pêcheries, Ste-Anne-de-la-Pocatière.

des Chaleurs, along southern Gaspé and around the Magdalen Islands. In fact, our own water temperature readings taken near the surface at Carleton, on the south side of the Gaspé Peninsula, between September 27 and October 4, 1943, showed that the water was still warm in the fall, with temperatures ranging from 48 to 52°F, and averaging 50°F.

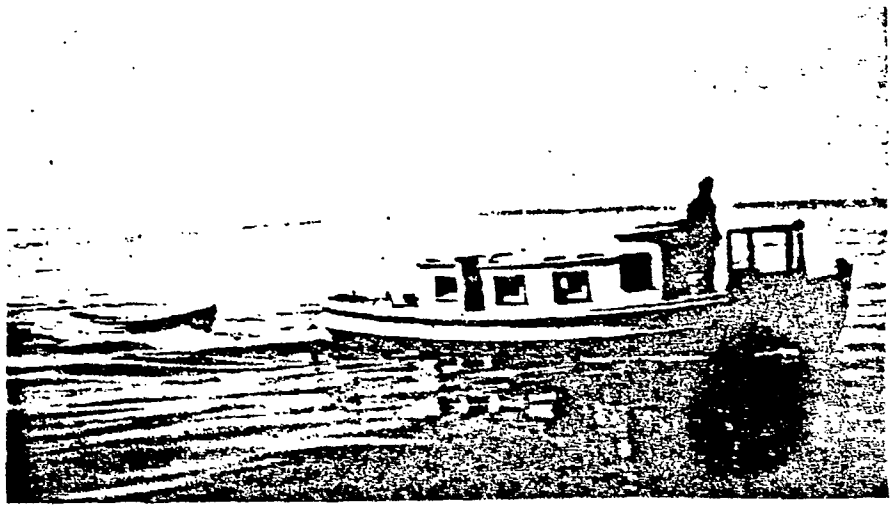

Fig. 2 Type of motorboat used on the Manicouagan Bank for hunting Belugas

In order to illustrate the water temperature distribution along the North Shore, reference will be made to our 1943 observations. During that trip, we were only able to measure water temperatures near the surface. The table below gives the details:

DISTRICT	DATE	TEMPERATURE °F.			
		N°. OF READINGS	MIN.	MAX.	AV.
Lourdes-de-Blanc-Sablon...	Jul.30 - Aug. 5	14	43.7	56.3	50.2
Bonne-Espérance to Romaine	Aug. 6 - 19	26	50.0	59.9	54.3
Natashquan to Sept-Iles...	Aug. 20 - 31	18	53.6	63.5	58.1
Godbout and Baie-Comeau...	Sept. 1 - 5	9	50.0	60.8	55.6

As shown in the preceding table, in the summer, temperatures at a depth of 5 fathoms were slightly lower than those near the surface of the water.

Water temperature readings from the South Shore of the St. Lawrence River between May 21 and June 2, 1944 complete the above hydrological data. Six readings between Montmagny and Saint-Antoine-de-Tilly, indicated that the temperatures near the surface ranged between 61°F and 66°F, and averaged 63°F.

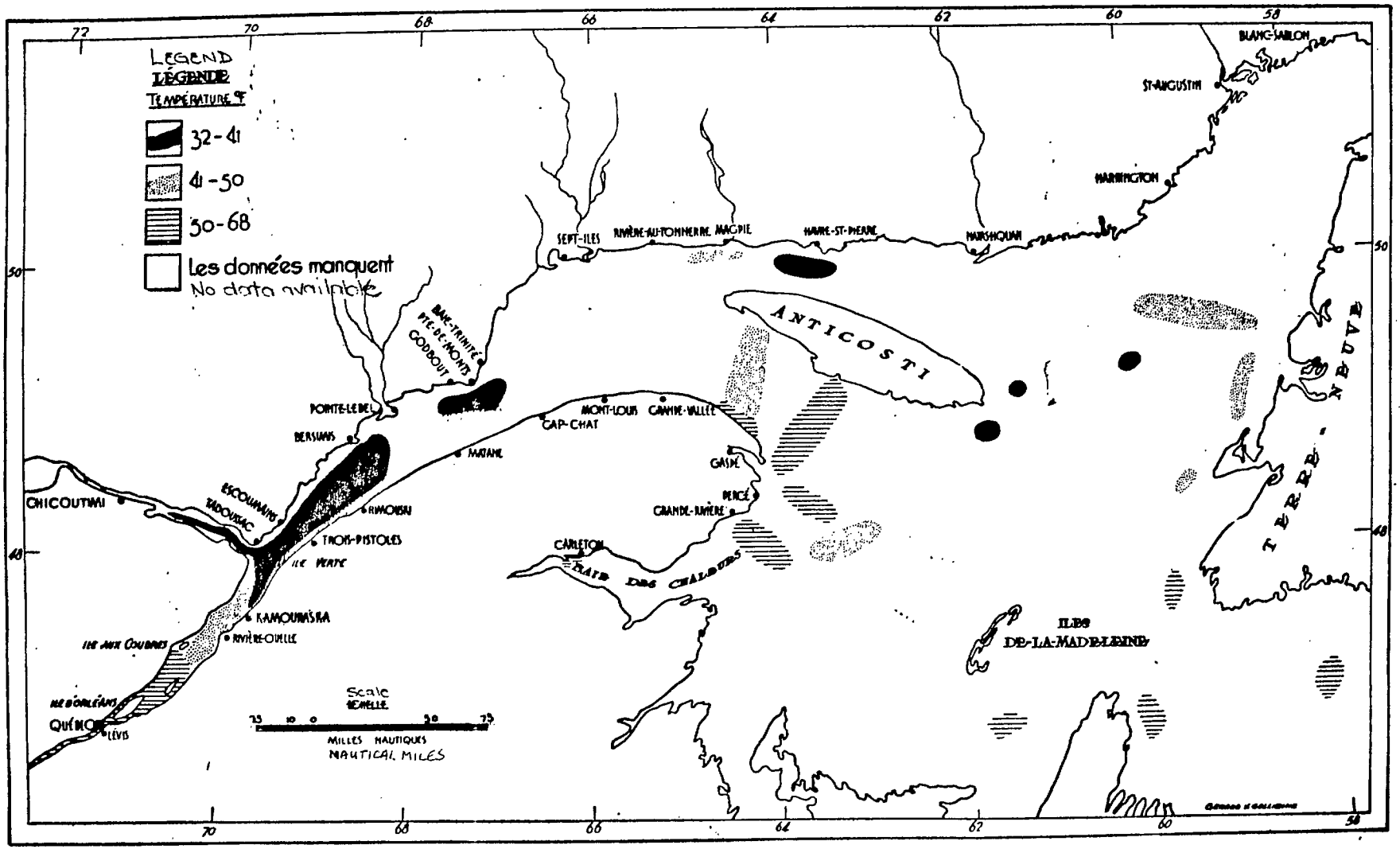

FIG. 3. Distribution of summer water temperatures at 5 fathoms, in the St. Lawrence River and Gulf.

HUNTING METHODS USED IN THE PROVINCE OF QUÉBEC

Three methods of capture were used for the Beluga studied in 1938 and 1939. A knowledge of these methods will aid in the understanding of certain biological facts. Furthermore, if the commercial applications of this sea mammal are to be developed, the effectiveness of the hunting methods used in our province should be known.

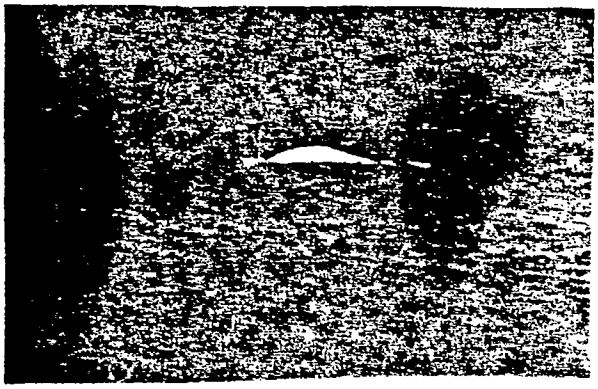

Fig. 4.- From a distance, a Beluga resembles the white foam of a wave crest.

Motorboat

Beluga caught on the Manicouagan Bank are hunted by motorboat. This very recent method has been used in the province for only the past eighteen years.

It is said that one day in July, 1926 near Pointe-Lebel, the people there noticed that a herd (pod) of Beluga, caught unawares by the falling tide, were trapped in the shallow water. This gave Mr. Honoré Chouinard, who lived in the village, the idea of hunting the White Whale by chasing it by motorboat (Fig. 2).

Any kind of motorboat can be used for the hunt (1). The type generally used are 25 to 40 feet long. The hunters post a man at the bow to act as a lookout. Usually, the navigator and hunter are the only ones in the boat. Although some prefer rifles, the hunters use 10, 12 and even 16 gauge shotguns.

The hunt begins in the morning at high tide when the White Whales are approaching the shore. When the tide changes, the whales must be prevented from returning to deep water. They are driven back into the shallows where swimming is difficult and where, because they are more visible, the kill is easier.

The marksman, stationed at the bow, points the way. The jets of vapour emitted with each exhalation make it possible to spot the Beluga from a distance (Figs. 4 and 5). When the boat approaches the pod, the frightened animals dive and disappear for a few moments, resurfacing in small groups. The hunters pursue a group or, as is more often the case, a solitary individual. A fifteen-minute race is enough to tire a large male. The female, particularly a pregnant one, can hold out longer (2).

Not being a fast swimmer, the Beluga is winded faster when chased by a powerful boat. The Beluga's usual speed is about 6 miles per hour (Degerboel & Nielsen, 1930, p. 144).

When the animal resurfaces to breathe, the whalers fire (Fig. 6). The most vulnerable part of the Beluga is behind the blowhole. Because this part has a very small surface which is exposed for only

(1) The lack of power and noise of the motors used by the hunters hinder the hunt.
(2) This difference in stamina explains why more males than females were caught in 1938.

a moment during respiration, the marksman must be very good to hit the mark. Because the animal is protected by a thick layer of blubber, a wound in the back is not dangerous; however, a bullet to the brain or heart will kill the animal outright. Usually several bullets are required to finish off this powerful catch. To ensure that he will not lose a dead or seriously injured Beluga, the hunter spears it with a harpoon attached by a rope to a buoy (Fig. 7). Unless it is exceptionally fat, a dead Beluga will sink if it is not thus secured.

When the weather is calm, water that reflects light, somewhat like a mirror is said to be "white". Under these conditions, the bright reflection makes it difficult to spot and chase a Beluga. A clear day when the sun is quite high (about 10:00 a.m.) and a light breeze is stirring the surface of the water is a good time for the hunt because the water is perfectly transparent.

Because the water is shallow and the bottom generally sandy, the Manicouagan Bank is an excellent place for this type of hunting. During the season which lasts from the end of May until mid-October, each whaling boat kills an average of two or three Beluga per day, with ten being the maximum (Fig. 8). If several boats were to join forces in the hunt for Beluga and divide up the catch later, the hunters' profits could be even higher that they are now. In 1938, not only did the men set out separately, but quite often competed with one another.

The main disadvantage to this type of hunting is that in the taking of one animal, the whole pod is frightened. Since these are intelligent animals, individuals that have been chased before will become increasingly timid and, in time, will avoid places frequented by hunters.

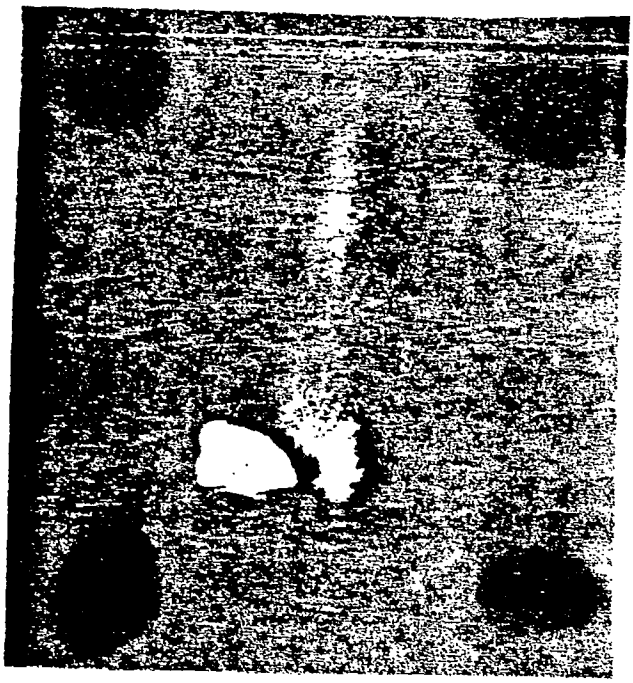

Fig. 5.- Jet of steam from a Beluga as it exhales.

Fig. 6.- Turbulence indicates to the whaler the place where the pursued Beluga will resurface.

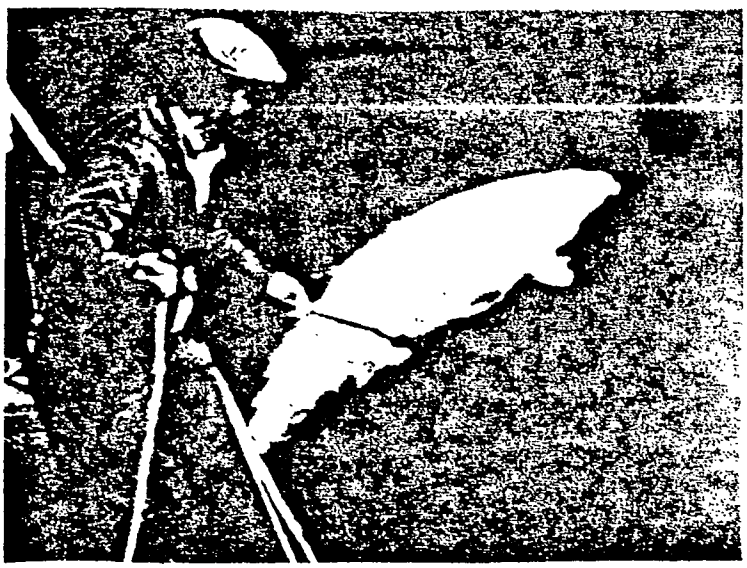

Fig. 7.- The whaler harpoons a mortally wounded Beluga..

Sail-driven Canoe

The Beluga caught in the vicinity of Les Escoumains in 1939 were hunted in sail-driven canoes, a method characteristic of that region (1). The description which follows is based on information from Ernest Boulianne, a strong advocate and user of this method for the past thirty-six years (Fig. 9)

Fig. 8.- Once the Beluga has been killed, a rope is attached to its lower jaw and it is towed behind the boat.

The wooden canoe, known in the area as a "barge", is about 16 feet long and is equipped with a sail 6 feet by 6 feet at the base, and 4 feet wide at the top. Two oars, a 12 gauge shotgun and harpoons (2) attached to 7- to 20-fathom lines and buoys are the required equipment.

(1) Andrews (1925, pp. 267-277), a participant, gives a vivid description of a hunt of this type on the St. Lawrence in June, 1909.
(2) The harpoon is made of special steel called lance-tip iron.

The barge carrying two men follows the school of Beluga. The marksman is at the bow while his companion, known as the "aft-man", steers and works the sail. The feeding animals do not notice the approaching canoe and thus the hunter can spear his prey when the boat is only 20 to 30 feet from the school (1). The man in the stern throws the line and buoy into the water. The hit is the critical moment because the Beluga reacts instantly and violently: it could overturn the canoe if the harpoon line gets caught. The buoy helps in tracing the wounded Beluga's movements and tires the escaping whale as the whaler follows it and, at the right moment, finishes it off with his shotgun.

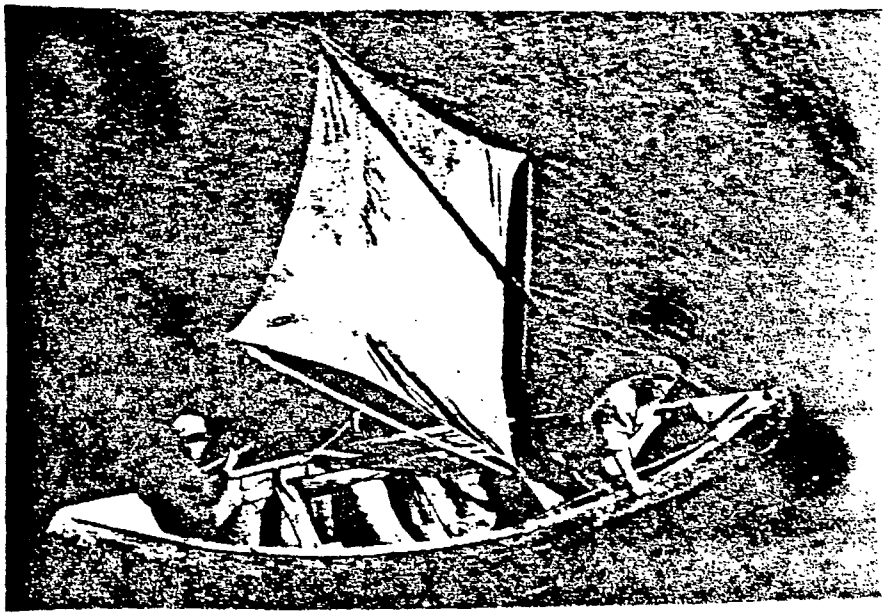

Fig. 9.- Type of sail-driven canoe used for hunting Beluga in the vicinity of Les Escoumains.

(1) Some hunters prefer to shoot the animal with a gun before shooting it with a harpoon. The conventional and more hazardous method is to throw the harpoon first.

Spring is the best season for sail-canoe hunting. At the end of April and in May, the Beluga congregate near l'Île Verte, Île-aux-Coudres, etc., or in the coves near Les Escoumains where food is plentiful this time of year. In the fall (September and October), when there are killer whale (Orcinus orca), the dreaded enemy of the Beluga, the frightened whales keep to the shorelines where they are easy prey for whalers in sailing canoes.

The most favourable conditions for this type of hunt are an overcast sky, a northeast wind and choppy water, which make it impossible for the animal to see the canoe's shadow.

A whaler catches an average of one Beluga a day, three at the most. According to E. Boulianne, the biggest catch of whales by sail-driven canoe was in 1918, when 57 whales were killed. In subsequent years the season's catch was only 15 Beluga.

This method is not very popular because it entails considerable risk and the catch is less than when hunting with motorboats. Sail-canoe hunting is an old custom that is bound to fall into disuse. Its main advantage is that it is possible to chase the Beluga in deep water.

This account of the Beluga hunt would be incomplete without a few words about the hunters themselves. On the North Shore of the St. Lawrence, between the Saguenay River and Godbout, there is, in fact, a population of skilled White Whale hunters experienced in the hardships of this hazardous occupation.

Weirs

The Beluga studied in the fall of 1939 were caught near the mouth of the Ouelle River, Kamouraska County in a weir, a type of trap generally known in Quebec as a "pêche". At the beginning of the 18th century there were several White Whale weirs along the St. Lawrence River (Chambers, 1912, pp. 58-59), but now there are only two places where this type of trap is used regularly for catching Beluga. Since the weirs in these two places differ somewhat, they should be described separately.

Rivière-Ouelle.- Quite probably this is where the first "pêche à Marsouin" or White Whale weir was used. According to Chambers (1912, pp. 58-60), around 1720, Sieur Peire had a weir constructed of poles rather than netting in order to avoid the high cost of rope. This type of construction seems to have persisted, without any major changes, up to the present day. In fact, seventy years ago the Abbé Casgrain (1873, pp. 9-14) published an interesting little report on the Beluga weir near Rivière-Ouelle. He also gave a quite detailed description of its construction, summarized below:

The Rivière-Ouelle weir consists of approximately 7,000 poles, 18 to 20 feet long, planted a foot and a half apart on the bank. The shore at this location drains to about a mile and a half from the high-tide mark. The semi-circular weir is about 38 arpents long, and has an opening. Beluga that enter at high tide are stranded in the weir in the deeper spots specially chosen for this purpose. The Beluga run aground during the season of big tides and are very easy to kill, but in the small tide season, the water level drops far less

and they can thus swim over a large area.

The boats then follow the outside perimeter of the weir, enter the cordon of poles on the seaward side and chase the trapped whales. When the Beluga are numerous, they must be killed quickly before the tide rises.

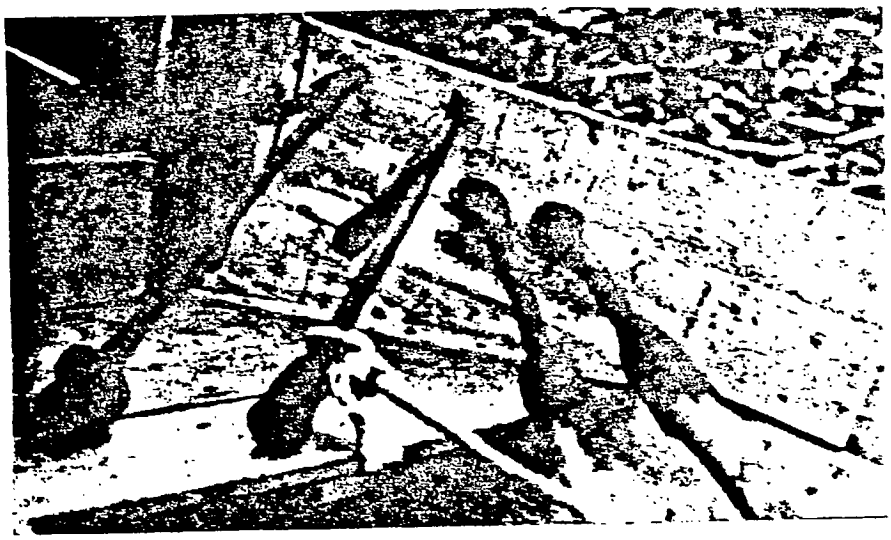

Fig. 10.- Harpoons (the two on the left) and "espontons" (lances) used at Rivière-Ouelle to kill Beluga caught in a weir.

The whale hunters are armed with harpoons and "espontons". The harpoon is a lance with barbs that open when one tries to remove it; it is approximately two feet long and is attached to a line. A detachable wooden handle fits into the socket at its base. The "espanton" is an ordinary lance fitted to a seven- or eight-foot handle (Fig. 10). Vivid details about capturing White Whales in a weir are given by the Abbé Casgrain (1873, pp. 9-14). Joseph and Émile Lizotte, two brothers who own the only weir at Rivière-Ouelle, still use this method for catching Beluga.

In the Abbé Casgrain's time, between 300 and 500 Beluga were caught in one tide. Over the past thirty years far fewer have been caught.

Indeed, the most extraordinary catch in a single tide was 107 Beluga on May 21, 1929 (Fig. 11). No more than 15 a year have been caught since. Generally speaking, the hunting seasons at Rivière-Ouelle are, in spring, the end of April to the beginning of June, and in fall, October to December.

Fig. 11. - A Beluga graveyard at Rivière-Ouelle, a souvenir of the exceptionally good catch in 1929.

Ile-aux Coudres- A White Whale weir was used here for well over a hundred years, by the Indians and then by white men. It was located about a mile and a half from the western end of the island. Although, smaller than the one at Rivière-Ouelle, it was constructed of 3500 poles (known as "harts" [withes]) 18 to 20 feet long. Each of the 32 people who had a share in this weir had to cut and haul 110 poles of fir, spruce or birch, averaging 3 inches in diameter at the base.

Over a period of four tides, three men can drive all these stakes in by hand. The completed weir consists of a yard approximately 20 arpents long and 15 wide. Its longest side, on the south, is called the "pan du sud", or south section. On the north side, leading into the yard there is a wide entrance about 8 arpents across with wings on either side. The smaller wing on the Ile-aux-Coudres side is called the "petite aile" (small wing) while the other is the "raccroc". The small wing is connected to a leader, about 2,000 feet long, which guides the White Whales into the weir (Fig. 12).

The stakes around the yard of the weir (i.e. the small wing, south section and "raccroc") are driven in at 2- or 3-foot intervals, while the leader-stakes are 9 feet apart.

At high tide, the water in the weir is 7 to 8 feet deep. At low tide, the yard is almost completely drained except for a sandy spot about 5 arpents in area in the "raccroc" where, even at low tide, about 2 feet of water always remain. When the water level drops, the White Whales that have come into the yard of the weir take refuge in the "raccroc".

The wind and current vibrate the poles of the weir which emit a sound that can be heard from as far away as five or six arpents. The White Whales are so frightened by this vibration that they do not go near the poles and thus rarely swim out between them.

The weir is built about the end of April and lasts the whole season until the poles are uprooted by the ice. Thus, each year, a new weir has to be constructed.

The best seasons for catching Beluga in weirs are: spring (May and early June) when herring and caplin abundant, and late autumn when eel swim down to the ocean(1). According to Louis-Abraham Tremblay, one of

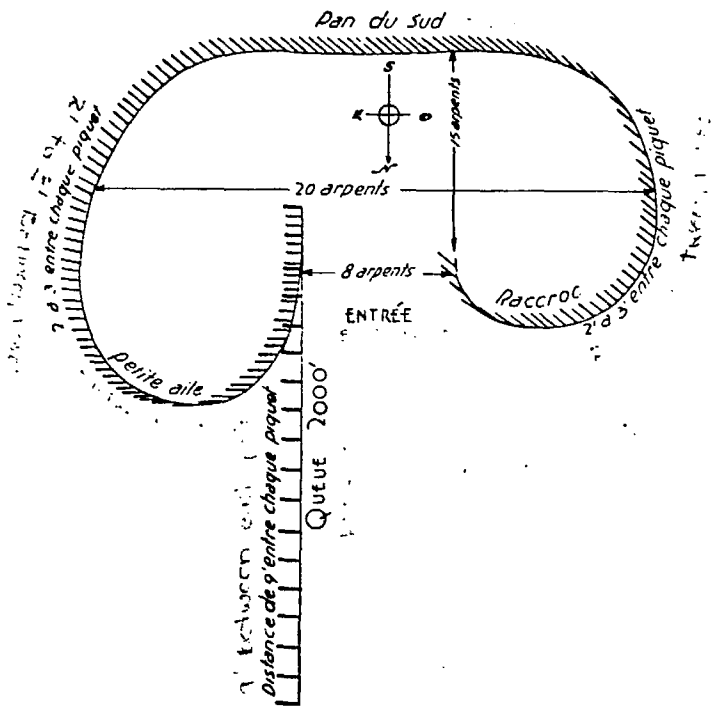

Fig. 12.- Sketch of the White Whale weir at Ile-aux-Coudres

(1) The question of the importance of eel in the diet of White Whales will be discussed in detail in a later publication.

the people in charge of the Ile-aux-Coudres weir, 1923 was the best season in recent years. In May of that year, 125 Beluga were caught, most of them large specimens: 2 Beluga were taken on May 17, 36 on May 22, and 87 on May 28.

The main advantage of a weir is that, in a good season, large numbers of White Whales can be taken easily. On the other hand, the weir is a passive device that is useless unless the Beluga enter it. There are, in fact, years when these animals congregate some distance from shore; however, this problem can always be overcome by driving them towards the weir, with nets or by frightening them with boats.

Other Methods of Capture

Around 1927 in the vicinity of Les Escoumains, Beluga were caught with gill nets. Hector Morneau used a "rets" (gill net) 800 feet long, 12 feet high with 12-inch point mesh of 2- to 3-ply hemp rope. Cedar floats at ten-foot intervals held the net in position while the lower strengthening rope was weighted with a 500-pound anchor attached to a wire. In one autumn month, 15 Beluga and 24 shark were caught in this net. There are accounts of other people catching up to 95 White Whales a season using similar nets.

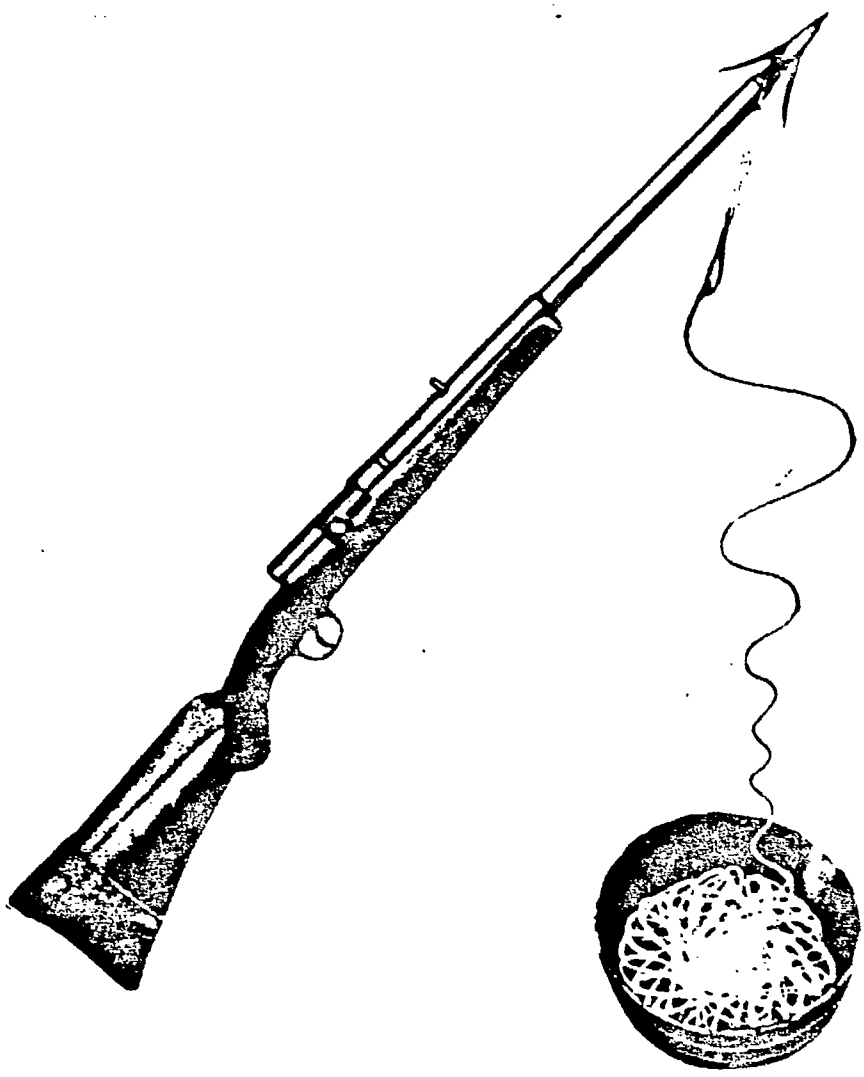

Fig. 13.- Harpoon gun.

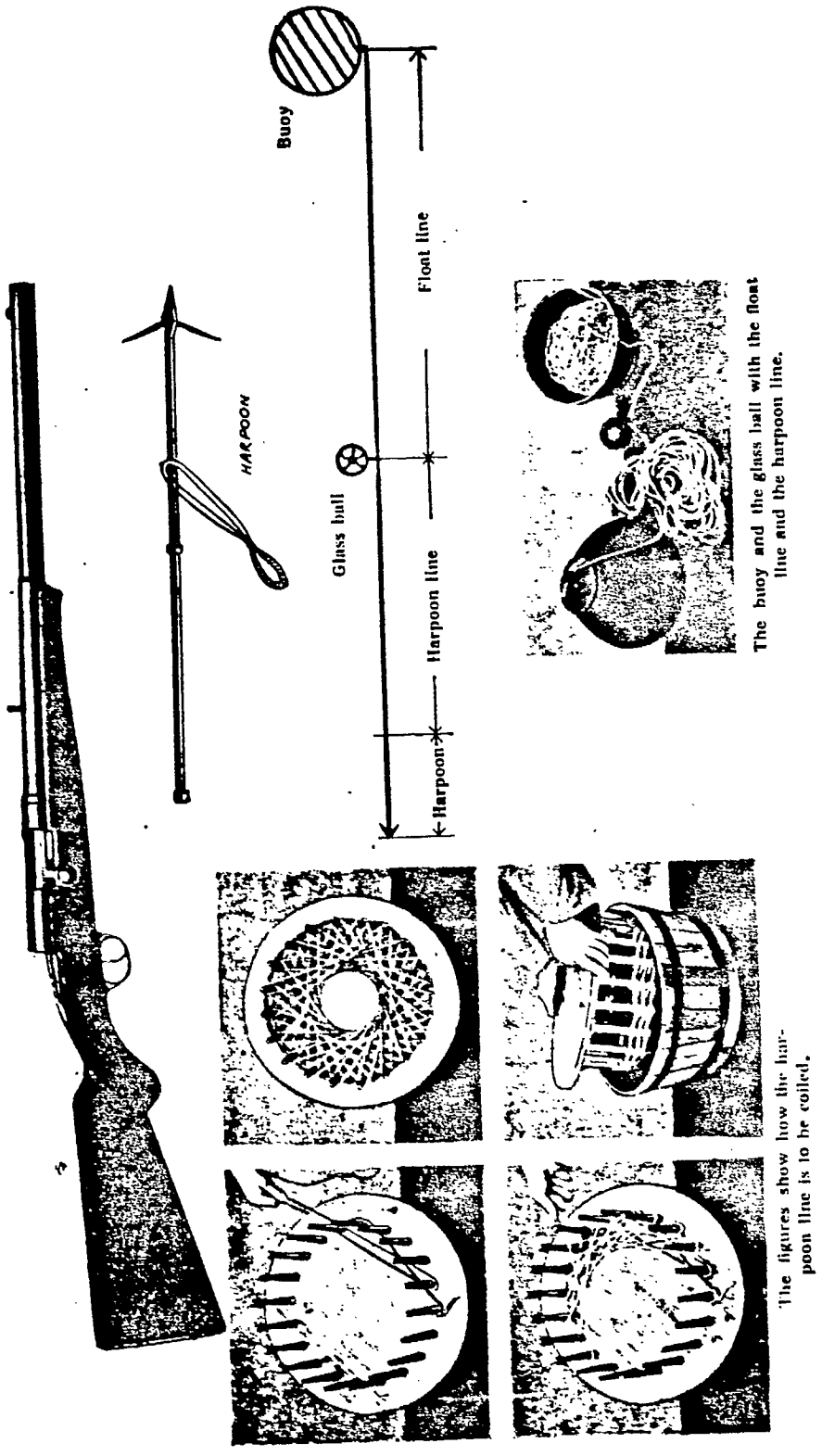

Figure 14.- Harpoon gun with accessories.

In 1930, Elzéar Gagnon of Tadoussac was the first to try to catch Beluga in the Saguenay using bait as a lure. A live salmon was tied by the tail to the end of a rope and trolled behind the boat. When a White Whale drew near, it was either harpooned or shot with a gun. Although it was good sport, the results of this method were not exactly encouraging: Elzéar Gagnon never caught more than one or two whales per season (1). This type of whale-hunting was tried in the autumn, in the belief that the White Whales gathered at the mouth of the Saguenay to feed on the salmon coming downriver after spawning. In early June of 1939, a few Les Escoumains hunters tried using shad as bait to catch Beluga in the Saguenay; their experiment was unsuccessful.

We also tried hunting whales with a harpoon gun, using the No. 47 Norwegian gun, manufactured by Husqvarna Vapenfabriks Aktielolag, in Husqvarna, Sweden (Figs. 13 and 14). White Whale hunters have not found it very practical. Considerable care must be exercised when using this gun: the piece of rope attached to the leather loop connecting the harpoon to the float line must be replaced often (Fig. 14). In order to use this gun effectively, it is advisable to have on hand several harpoons already tied to lines. This precaution naturally involves equipment outlay. In addition, because the Beluga is such a powerful animal, there is little likelihood that it would be killed by only one harpoon shot from this gun. If several harpoons are shot at the same animal their lines become hopelessly entangled.

(1) He probably killed several that he lost because, in autumn, Beluga are so thin that they sink immediately.

HUNTING METHODS USED ELSEWHERE

Outside of the St. Lawrence region, there are two main methods of hunting Beluga. A knowledge of these might be helpful to our whalers.

Primitive Method

The Beluga hunting method currently used in the Arctic may be called "encirclement by a fjord". Andersen (1934, p. 74) gives a good description of this method as it is practised in Baffin Island.

"During recent years the Hudson's Bay Company at Pangnirtung has been conducting an extensive White Whale fishery when the animals enter the upper fiords of Cumberland sound in July. When the Whales come in, they are frightened to the heads of the fiords by motor boats, firing of rifles, and beating of pans. When the tide drops, the Whales are stranded, and are shot and skinned, the skin and blubber being saved".

This same method is used on the west coast of Greenland, north of Sukkertroppe (Degerboel & Nielsen, 1930).

Modern Method

In Norway and Russia, nets are used to capture Beluga. Gill nets with 17-inch mesh are not as effective as the "Norwegian seine". According to Chapsky (1937), the dimensions of this type of seine

used in the Gulf of Ob are as follows: 300 fathoms long, 18 feet high, 7-inch point mesh of very stout rope.

Due to the initiative of two Russians skilled in Beluga fishing, S.A. Yulyncev and particularly I.K. Nepomniachtchy, the most effective methods were adopted in the Far East. Arsenyev (1940) gives the following description:

The seine for catching Beluga at sea is approximately 450 fathoms long (1) and has a Manila hemp cable 335 fathoms long at each end. The seine, without the purse, has a 9-fathom drop over its full length, and its wings are squared off at the end. It is made of 180-ply cotton, and each framing line (2) is one inch in diameter. The net is held in position by wooden floats weighing 13 ounces each (total weight: 570 lbs.) and is held down by 14-ounce sandstone weights (total weight: 170 pounds). The seine consists of three parts: the short wing, which is 50 fathoms long with 8-inch point mesh; the middle section, 135 fathoms long with 7-inch point mesh, and the long wing, 245 fathoms long with _____-inch point mesh.

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(1)In Arsenyev's article (1940), the dimensions of this net and of the purse seine are given in metric units, which the author has converted in whole numbers to British units.

(2)The line to which the net is attached is called the "maître (master line) by St. Lawrence fishermen; hence the upper one is the "maître du haut" (float line) and the lower one is the "maître du bas" (footrope).

This fishing operation is carried out by a team of 25 to 30 men in two barges, equipped with a quiet, 72-h.p. motor; a scrow of about 15 tons and 5 rowboats. The movements of the Beluga are observed from a tower on the riverbank. When the school of whales approaches, a flag gives the signal and the whalers take off in pursuit.

In no time the powerful motorboats have enclosed the Beluga in the seine. Figure 15 illustrates clearly the order of operations. If the school is fairly large, or if the whales are too scattered, the seine will not be long enough to encircle them all. In these situations, the cables are let out to their full length in order to enlarge the "yard". The cables are hit with sticks to prevent the Beluga from escaping from the seine: the vibration of the taut ropes frightens the animals and discourages them from escaping under the cables.

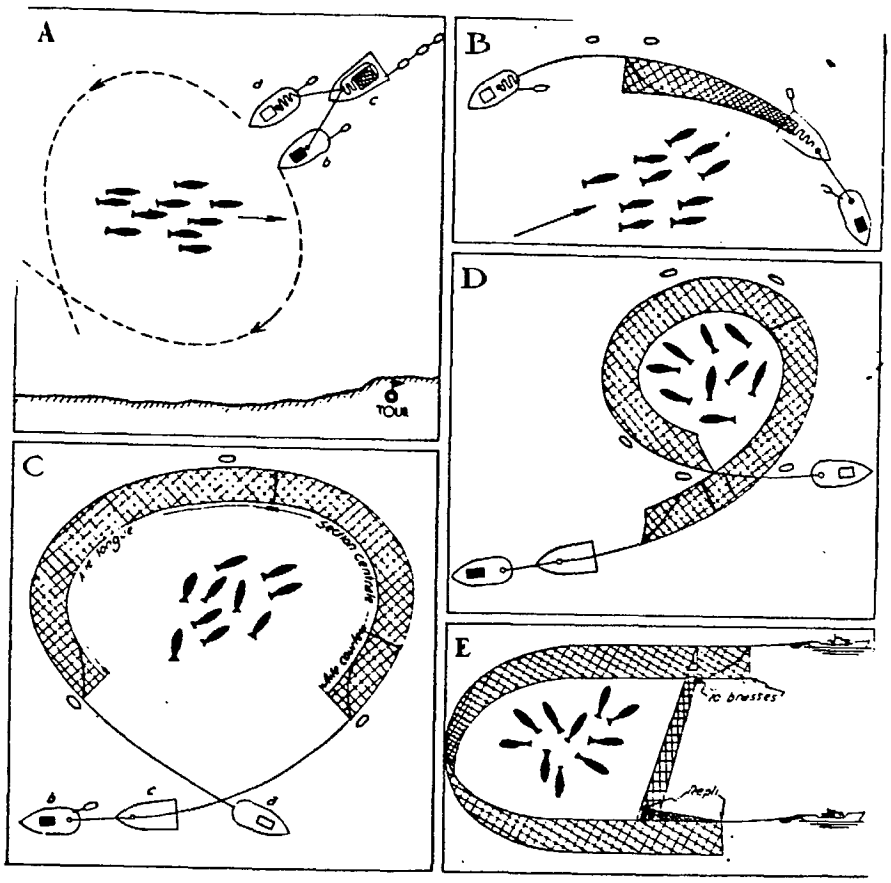

Fig. 15.- Encirclement of Beluga, step by step, with a special seine (Arsenyev, 1940)

During the spring tides, the Beluga are enclosed by the seine some distance offshore where the hunters wait for the tide to drop before killing the animals. During low tides, however, the hunters have to tow the seine towards shore. To do this, the entire short wing and most (125 fathoms) of the middle section are untied and the ends of the net that remain (the long wing) are joined, reducing the circumference of the yard to 255 fathoms.

In order to prevent the net from rising from the bottom when it is being towed and to keep the Beluga from finding an escape route underneath, the ends of the long section are not tied together directly but, rather, one end of the seine is attached about 10 fathoms from the other end. Then, about 25 to 30 fathoms further along from this connection a 20-fathom-long fold is made in the net. All of these manipulations reduce the size of the yard to approximately 200 fathoms in circumference. Hence the seine consists of a 10-fathom-long middle section, plus the long section, minus the fold that takes in 40 fathoms in all. The seine is now ready to be towed by the upper framing line. One of the barges hooks its cable to the 10-fathom section of seine and the other barge is hooked to the leading edge of the fold. Two 72 h.p. barges can tow the seine at a speed of about one mile per hour. There are times when the seine has to be towed for periods of up to seven hours (Fig. 15).

When the Beluga, enclosed in the big net, reach shore, they are hauled to land with a smaller seine which is about 100 fathoms long and 18 feet high. A rope with a slipknot is attached to the tail and

the animal is pulled from the water. It is then finished off with a long lance thrust into the left side under the flipper where the heart is located.

The disadvantage of the Beluga seine, which has only a 9-fathom drop, is that it cannot be used for fishing in depths greater than 7 fathoms. Also, considerable time is lost towing it to shore. Nevertheless, up to 250 Beluga at a time have been caught using this type of seine and it has been used successfully up to 10 miles from shore where the depth of the water and the type of bottom have been favourable.

The Beluga purse seine is probably the most effective fishing device. The following table gives more information about this cotton yarn net:

SECTION	LENGTH (fathoms)	HEIGHT (fathoms)	NUMBER OF STRANDS OF ROPE	SIZE OF MESH (INCHES)
Short wing	70	9	140	9
Yard.....	440	13	540	11
Long wing	490	10	540	14-18

The seine's footrope and headline are of Manila hemp 1¼ to 1½ inches in diameter. The cables, of the same size and material, are attached to each end of the seine; the one attached to the short wing is 200 fathoms long and the one tied to the long wing is 300 fathoms long. The floats, by fathom-length of line, are attached as follows: 8 on the line around the yard, and 4 or 6 on the line around the wings. Each footrope has a sandstone weight.

The wings are joined to the yard section by a rope, and the points at which they meet are marked with buoys (small barrels). To facilitate handling of the central part of the seine or yard, it is divided into 30-fathom-long sections which are tied together with a rope and marked with buoys. Iron rings, 3 inches in diameter, are placed on both lines, at one fathom intervals. If one wanted to close the purse of this seine at the bottom, a steel cable could be threaded through these rings. However, if this seine is not meant to be closed, there is no need to install this cable. In practice, according to Arsenyev (1940, p. 146), steel cables have so far not been used to close the seine at the bottom.

The following describes how a seine without a closing cable is used for this operation, 26 men board the following craft: a large barge equipped with a 150 h.p. motor, another smaller one with a 72 h.p. motor and three rowboats, one of which is slightly larger than the other two. The seine is transported by the two barges: the short wing and its cable are placed on the smaller one and the rest of the net is on the large one.

As they put out to sea, the large barge tows the small barge and the rowboats. Beluga sightings are made directly from the boats. As soon as a pod is spotted, the fleet of boats heads for the Beluga. As the boats approach, the short wing is joined to the rest of the seine, and the two barges then advance, side by side, full speed ahead.

At the leader's command, the net is drawn around the pod of Beluga (Fig. 16). The big rowboat remains close to where the long wing is attached to the yard section; the other two proceed around

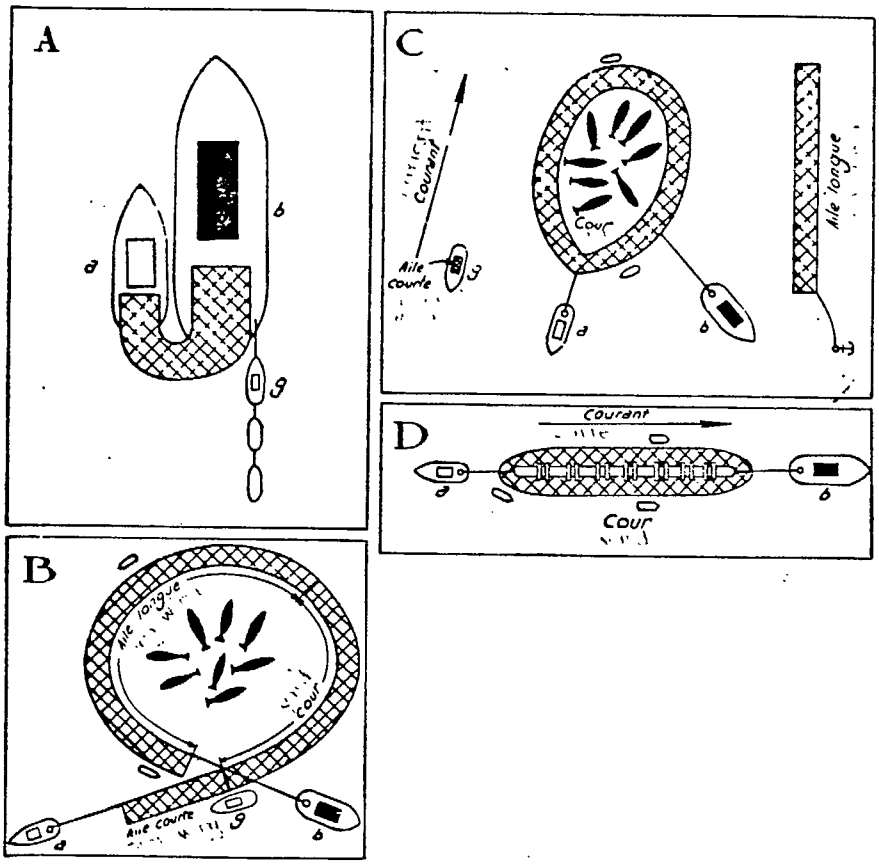

Fig. 16.- Surrounding the Beluga, step by step, with a purse seine (Arsenyev, 1940).

the outside perimeter of the seine where the men can watch the position of the net. The size of the pod will determine whether it is to be enclosed using a net only, or a net and cables. If cables are used, the circumference can be extended to a maximum of 1300 fathoms.

When the pod is encircled, the 300-fathom-long cable is hauled back on board the big barge. The small barge pulls the short wing to the point where its connection with the yard section (Fig. 16B) is in line with the outside edge of the long section. The short section is then untied and hauled onto the large rowboat. The small barge tows the end of the yard section, previously attached to the short wing, into the seine, towards the spot where the other end of the yard section is joined to the long section. The two ends of the yard are fastened together and the long wing removed. If the sea is calm, the long section is immediately hauled onto the big barge; in places where the current is strong, the long section is left to ride at anchor for a time. The yard with the two wings detached, now has a circumference of 440 fathoms; it can be made even smaller by removing 30-fathom-long sections.

The most critical moment in this fishing operation is the closing of the seine. The small barge tows the yard section against the current to prevent the current from tangling the net. If the current is too strong, both barges are used to keep the seine in its proper position (Fig. 16). The force of the current narrows the yard making it oblong in shape. The upper edges of the two sides of the yard are then drawn together. The large and small barges, attached to the opposite ends of the yard, hold the seine in position. Since this

type of seine is used for fishing in places where the depth of the water is less than the height of the net, the captured Beluga are unable to escape under the lower edge. When the seine is closed at the top the animals are prevented from surfacing to breathe. After a very short while, most of the frightened and agitated Beluga remain caught in the folds of the net and die of asphyxiation. The animals that are still alive are taken out of the net and killed with a thrust of a lance.

In his observations of Beluga hunting with a purse seine, Arsenyev (1940) mentioned the following disadvantages: first, because there is no cable, the yard of the seine cannot be closed at the bottom, and thus, the seine cannot be used for fishing in depths greater than the height of the net. In addition, when a seine containing dead Beluga is raised, several of the animals become disentangled from the net, sink to the bottom and are lost. This type of seine fishing is often done at a considerable distance from the base of operations. For this reason, it is an advantage to have a third barge for transporting the whales, thus saving the whole fleet the trouble of transporting the catch back to the base.

The long nets used in the Far East and the powerful but quiet motorboats are real advances in the technique of catching Beluga. Perhaps, with certain modifications these methods could be applied to Canadian conditions. The Beluga seine might be used, for example, in conjunction with a standard design weir built with poles. The seine could be used to drive the Beluga into this trap.

Purse seines without closing cables would probably be very useful in shallow waters where Beluga congregate during the summer. The Manicouagan Bank, in the vicinity of Pointe-Lebel, and several sandy locations on the North Shore between Godbout and Natashquan, would be suitable locations. A purse seine with a bottom closing cable could be used to advantage in much deeper waters, such as in the vicinity of Les Escoumains. These methods could also be used in the Canadian Arctic.

TABLE II.- Number of Beluga, by district, caught in the St. Lawrence between 1932 and 1937 when a bounty was paid.

Year / Année	Rivière Saguenay	Les Escoumains — Pte Manicouagan	Baie-Trinité — Sept-Iles	Iles de Mingan — Natashquan	Rivière-du-Loup — Barachois	Baie des Chaleurs	Total
1932	0	171	2	3	1	0	177
1933	0	202	0	3	3	0	208
1934	3	418	2	6	1	3	433
1935	0	552	0	6	0	0	558
1936	No bounty paid that year						
1937	4	483	0	2	32	0	521
Total	7	1,826	4	20	37	3	1.897

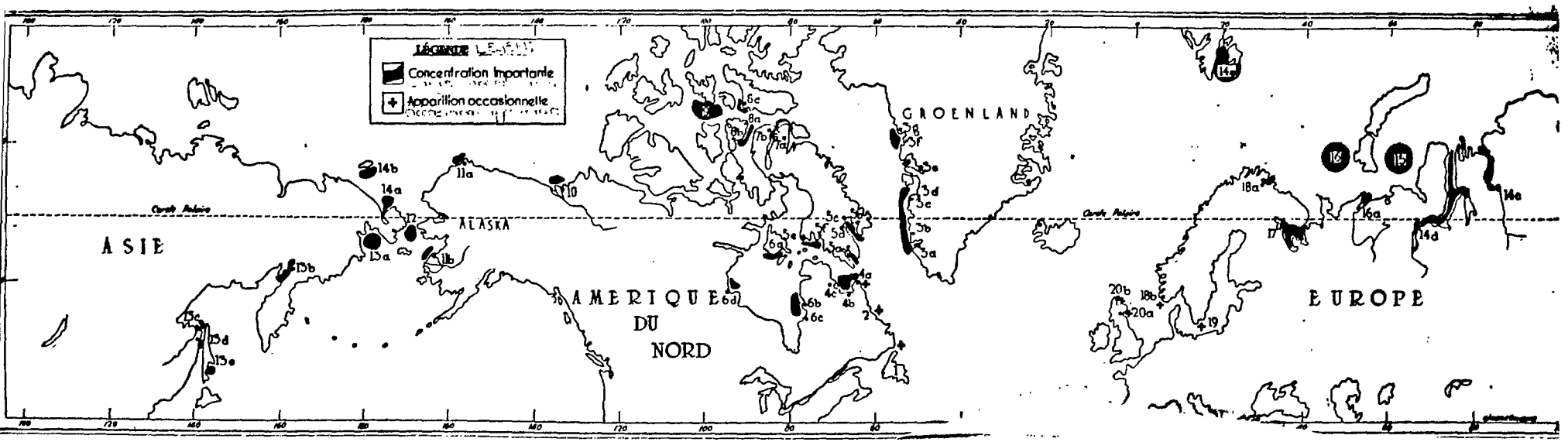

Fig. 17.- Map of the Northern Hemisphere showing the geographical distribution of the Beluga. Additional data is given in the chapter entitled "Distribution".

FIGURE 18.- Head of an adult Beluga, probably a female, about 11 feet long. The teeth seen on the upper jaw are still quite sharp; the arrow indicates the ear opening.

TAXONOMY

It was Pallas (1776, pp. 84-87) who first suggested in 1776 (1), the name Delphinus leucas for a White Dolphin (Beluga) he had observed in the Gulf of Ob in Siberia. In 1804, Lacépède (2) made it part of a new genus, Delphinapterus, which means dolphin without a dorsal fin (3). Thus Delphinapterus leucas (Pallas) became the scientific name for the Beluga, the more usual name today.

The Delphinapterus leucas belongs to the Odontoceti suborder, i.e., toothed Cetaceans, such as the sperm whale, dolphins, etc.. The Beluga and the narwhal (Monodon monoceros) constitute a special family, the Delphinapterids (4). They have no dorsal fin; in its place there is a low ridge. The cervical vertebrae are free and not joined like those of the Delphinidae (5). The eight upper ribs have two processes (Beddard, 1900, p. 242).

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(1)The French translation of Pallas' works was published after the German text, i.e., in "Year II of the Republic" (1794?).

(2)In this present study, the author was able to consult the new edition of Lacépède's work, published in 1844.

(3)In 1815, Rafinesque (True, 1889, p. 146) proposed that the White Dolphin be classified as genus Beluga, probably without knowing that Lacépède had already created the genus Delphinapterus.

(4)Several authors are of the opinion that the Beluga and the narwhal are only a subfamily. The author is inclined to accept the opinion of others such as Lönnberg (1911), who classified these genera as belonging to an entirely separate family.

(5)Howell (1930), p. 149) gives a good illustration of the cervical vertebrae of the Delphinapterus and the Grampus.

The structure of the teeth of the D. leucas is quite unusual (Lönnberg, 1911): the enamel layer, which is very thin, is quickly worn down; the cementum, on the other hand, is very thick. In the adult animal, therefore, the root of the tooth functions as the crown. This is not the case with the Delphinidae, whose tooth enamel is very thick.

The derma or true skin of the Delphinapterids is very thick (Harmer, 1930; Bonin & Vladykov, 1940), whereas the derma of other Cetaceans it is either minimal or does not exist (1). The Beluga's skin is completely hairfree, even in the case of a 4-inch embryo, as the author himself observed. These animals therefore lack one of the most important characteristics of mammals: body hair. (2).

Another anatomical characteristic peculiar to the Beluga that deserves mention is that it has only one pair of nasal sacs (Watson & Young, 1880, pp. 412-413) rather than seven, as is the case with the Delphinidae.

Although a few of the early writers (Cope, 1865; Scammon, 1869) distinguished several species of Beluga (3), latter-day authors (Miller, 1924; Fraser, 1938) generally acknowledge only one, the Delphinapterus leucas (Pallas), 1776. However, Russian authors such

(1) According to Gray (1930), however, the derma of the Bowhead Whale (Balaena mysticetus) is also very thick.

(2) Other species of Cetaceans have always been found to have a few hairs. (See, for example, Japha, 1911; Harmer, 1927; Mackintosh & Wheeler, 1929).

(3) These authors name the following species: Beluga angustata, B. catodon, B. concreta, B. declivis and B. rhinodon. True (1889), after careful study, did not consider all these species as being distinct from D. leucas (Pallas).

such as Klumov (1935), Barabash (1937) and others recognize three species of Beluga. According to them, the D. freimani Klumov lives in the White Sea; the D. dorofeevi Barabash & Klumov is found in the Okhotsk Sea and the D. leucas frequents the North Atlantic and Arctic oceans. The conclusions of these authors are nevertheless based on somewhat limited information and require additional observations if they are to be confirmed.

With a view to providing a more accurate taxonomic classification of the St. Lawrence Beluga, the author hopes in the near future to publish the results of a study made of 75 skulls.

COMMON NAMES

The Cetacean known by the scientific name Delphinapterus leucas, is commonly called the "Marsouin" (porpoise) in the Province of Quebec. Although this name has been used for at least 200 years (De Charlevoix, 1774, pp. 216-217), it is incorrect. It should be used for other smaller Cetaceans (6 feet long, at the most) belonging to the genus Phocaena (1). In order to avoid this type of confusion, Forbin (1930) suggested replacing the name "Marsouin" (i.e., porpoise) in the case of Delphinapterus leucas, by the more appropriate French word "Bélouga" or "Béluga" (Beluga). (2).

(1) The common porpoise, or Phocaena phocaena, which has a black back and white belly, mainly inhabits the warmer regions. In summer, however, it makes regular forays into the Gulf and along the South Shore of the St. Lawrence. This species is presently known in Quebec as the "Pourcil" (herring hog) Préfontaine, 1930, p. 60); De Charlevoix (1744, p. 217), however, called it the "Pourcelle".

(2) In France, however, the name "Béluga" is wrongly used to denote another Delphinidean, the Grampus griseus (Brunelli, 1931). This gives rise to confusion between the G. griseus and the D. leucas (Harmer, 1927, pp. 11 and 39).

In current literature, the Delphinapterus leucas described by Pallas in 1776 and originating in the Gulf of Ob in Siberia, is known by the name Beluga. The word Beluga is Russian in origin (1) and means "white". The spelling of this word with a "g" is phonetically incorrect, because in Russian the "Beluga" is a type of sturgeon (Huso), whereas another word, "Belukha" (2) or "Bieluga" is used to designate our mammal (D. leucas).

The whalers of the Lower St. Lawrence call the adult Beluga a "Marsouin" (porpoise) or "Marsouin blanc" (white porpoise) because it is completely white. The young animals at different ages are called by several different names: at Rivière-Ouelle they are called the "Veau" (newborn calf), "Gris" (grey calf) and "Blafard" (light-coloured calf); along the North Shore (Les Escoumains, Pointe-Lebel), "Veau", "Bleuvet" and "Blanchon" are the corresponding names which mean newborn calf, blue calf and greyish-white calf, respectively. An explanation for these terms will be given in the chapter on the age of the Beluga. The reader is invited to pause here

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(1) Sutton & Hamilton (1932, p. 92) believe that the name Beluga is from the Eskimo word "Kellilughak", used by the inhabitants if Hudson Bay. The author feels that this is unsubstantiated.

(2) Confusion between the word Beluga for the fish (sturgeon) and the Russian word "Bĕlukha (Bieluga), the mammal, appears in even such a reputable publication as the Larousse. In fact, in "Larousse Gastronomique" (Montagné, 1938, p. 167), under the heading "Béluga" (no doubt Delphinapterus leucas) one reads the following: "The flesh of the Beluga is excellent and makes choice dishes; it is rather dark in colour, but flavourful, not unlike veal. Its skin provides a type of high quality leather used in England. The oil is also a source of profit" (this must be a mammal, V.D.V.) Then it continues: "Caviar of a very high quality is made from Beluga roe" (this must be a fish, V.D.V.).

and examine the words "Bleuvet" and "Blanchon", which are probably old French words. They are very nice-sounding and expressive words: the "Bleuvet" is a young Beluga of a bluish colour and the "Blanchon" is almost white.

In his account of his first voyage to Canada in 1534, Jacques Cartier speaks of the wealth of fish and sea animals in the St. Lawrence, one of which he refers to as the "Adhothuys" which is, according to him,

> "a kind of fish I have never seen or heard of. It is as white as snow and as large as a Porpoise, and has a body and a head like a Hound; it keeps to an area between the sea and fresh water that begins between the Saguenay River and Canada". (Chambers, 1912, pp. 20-21).

The "Adhothuys" can only be the Beluga.

In this paper the words "Bêluga", "Marsouin" and "Marsouin Blanc" will be used interchangeably as synonyms for Delphinapterus leucas (in the French original). The corresponding English terms are Beluga, White Whale or White Dolphin. The Eskimos call it "Killeluak" or "Kellelugak" (Soper, 1928, p. 74).

DISTRIBUTION

It is probably because of its anatomical peculiarities such as the complete absence of hair and pores, the very thick epidermis, etc., that the Beluga prefers cold habitats, so much so that it is only found in regions with harsh climates. The white colour of the adult

blends in well with surroundings of floating ice and snow. The Beluga does not avoid these regions, even in winter. It is thought that the ridge that replaces its dorsal fin helps it to break the ice so that it can surface to breathe.

The Beluga lives only in arctic and subarctic seas and oceans of the Northern Hemisphere where it keeps to the coastal zone, rarely venturing out to sea. Its presence has been noted in the Arctic Ocean as far north as 81°35'N (True, 1889, p. 188); it has been seen occasionally in the vicinity of Cape Cod and even near Atlantic City (39°22'N), New Jersey (True, 1909, p. 325) (1).

The Beluga appears to prefer brackish water, although it is quite at home in salt water and does not hesitate to venture into fresh water. According to Tschirkowa & Folitarek (1930), the Beluga of northern Russia often swims several miles up the Petchora River. One was even killed in 1863 in Nulato, in the Yukon River, about 700 miles from the Bering Sea (Fraser, 1938, p. 287).

(1) From fossil remains of the Beluga, found in North America in marine deposits of the Pleistocene period, it can be assumed that its range in earlier times was more extensive that it is today. In fact, Whiteaves (1907) cites the following places where skeletons were unearthed: Montreal; the Ottawa River Valley and Cornwall in Ontario; and also near Lake Champlain, in the State of Vermont.

General Distribution

The distribution of the Beluga in the Northern Hemisphere is illustrated by a map that has been included in this paper (Fig. 17). In the text below, each of the place names bears a number that corresponds to one on the map, and which indicates where the largest concentrations of Beluga were noted by various authors. Needless to say, this data is rather incomplete as these vast arctic regions have not as yet been sufficiently investigated.

(a) Newfoundland (No. 1) and Labrador (No. 2).- The author has not found any specific information on the numbers of Beluga to be found in these two regions. Certain authors, however, without providing any proof whatsoever, note, as does Forbin (1930, p. 546), that "enormous herds of Beluga come down from the polar seas into the waters off Newfoundland".

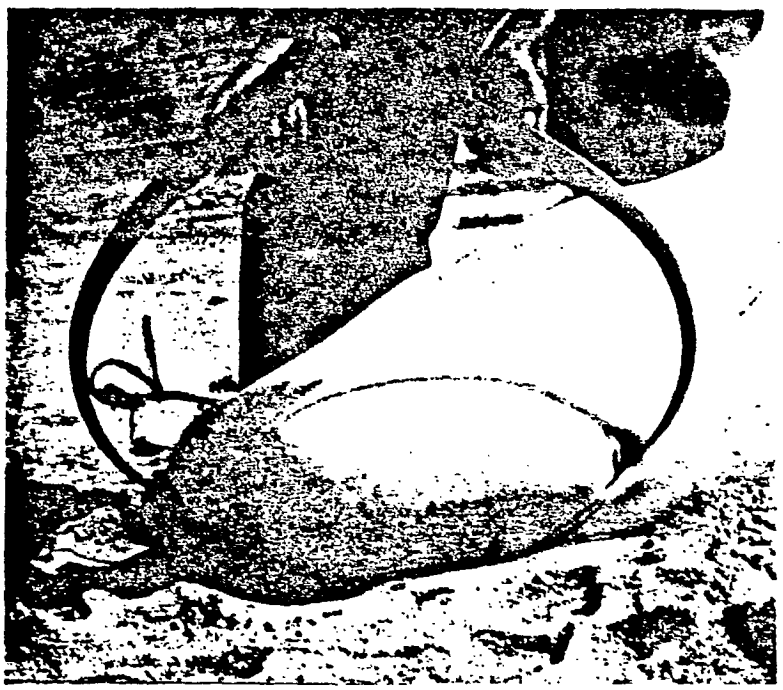


Fig. 19.- Callipers show the distance between snout and blowhole.

In the case of Labrador, Packard (1891, p. 442) in his list of mammals noted that "the White Whale is not uncommonly seen passing in schools along the coast in the summer-time".

It is impossible, unfortunately, to know exactly where this author saw the Beluga, since he covered the entire coast of Labrador from the Gulf of St. Lawrence to Ungava Bay (1).

As for the northeastern extremity of Labrador, north of latitude 59°30'N, Hantzsch (1909, pp. 245-247) reported seeing Beluga near Hudson Strait on several occasions.

Although there is not a great deal of information available on Newfoundland and Labrador, it can be assumed that there are not a great many Beluga there.

(b) Greenland (No. 3).- According to Degerboel & Nielsen (1930), Beluga are very plentiful in the Davis Strait, along the west coast of Greenland. Dr. Magnus Degerboel, in his letter of June 21, 1939, added some interesting statistical data on Beluga caught in this region between 1925 and 1936.

From this information it would appear that more Beluga were caught between 1925 and 1927 than in subsequent years (2), namely:

PERIOD	NO. OF YEARS	BELUGA CAUGHT	
		TOTAL	YEARLY AVERAGE
1925-27	3	4,768	1,590
1928-31	4	1,807	452
1932-36 (2)	5	1,912	383

(1) Low (1897, p. 362L), in referring to the distribution of Beluga along the coast of Labrador, does not mention specific spots; he merely says that he "found them all along the coast of the Labrador Peninsula, from the St. Lawrence to the southern end of Hudson Bay".
(2) The reason for this variation is explained on page of this text.

According to Dr. Degerboel's information, the main locations for hunting Beluga along the west coast of Greenland, from south to north, are as follows:

NO. ON THE MAP	NAME OF THE PLACE
3a	Godthaab
3b	Sukkertoppen
3c	Egedesmindes
3d	Christianshaab
3e	Umanak
3f	Pröven
3g	Upernivik.

(c) The Canadian Arctic (Nos. 4 to 10).- The Beluga is no doubt widely distributed throughout the Canadian Arctic. According to Low (1906, p. 274), these animals were caught in large numbers in Hudson Strait (No. 4), particularly in Ungava Bay (2), near the mouth of the Koksoak River (No. 4b) and in Leaf Bay (No. 4c).

Fig. 20.- Head of an old 14-foot 8-inch male, The teeth shown on the lower jaw are very worn.

(1) Statistical data for the 1932-36 period are incomplete.
(2) Bernier (1910, p. 313) mentioned Port Burwell (No. 4a) as a place where large numbers of Beluga could be found.

The best-known spots for hunting Beluga, however, are farther north, along the east coast of Baffin Island (No. 5), especially in Frobisher Bay (No. 5a) and Cumberland Sound. According to several authors (Low, 1906, p. 274; Soper, 1928, pp. 74-75; Anderson, 1934, p. 74), the largest concentrations of White Whales are to be found in the fjords at the lower end of Cumberland Sound: Pangnirtung (No. 5b), Issortukdjuak (No. 5c) and Nettilling (No. 5d).

According to Soper (1928, p. 75), Beluga are also found off the west coast of Baffin Island, a bit south of Foxe Peninsula, near Gordon Bay (No. 5e) and Amadjuak Bay (No. 5f).

According to data provided by authors such as Low (1906), Binney (1929), Sutton & Hamilton (1932) and Bagby (1940), the main concentrations of Beluga in Hudson Bay are around Southampton Island

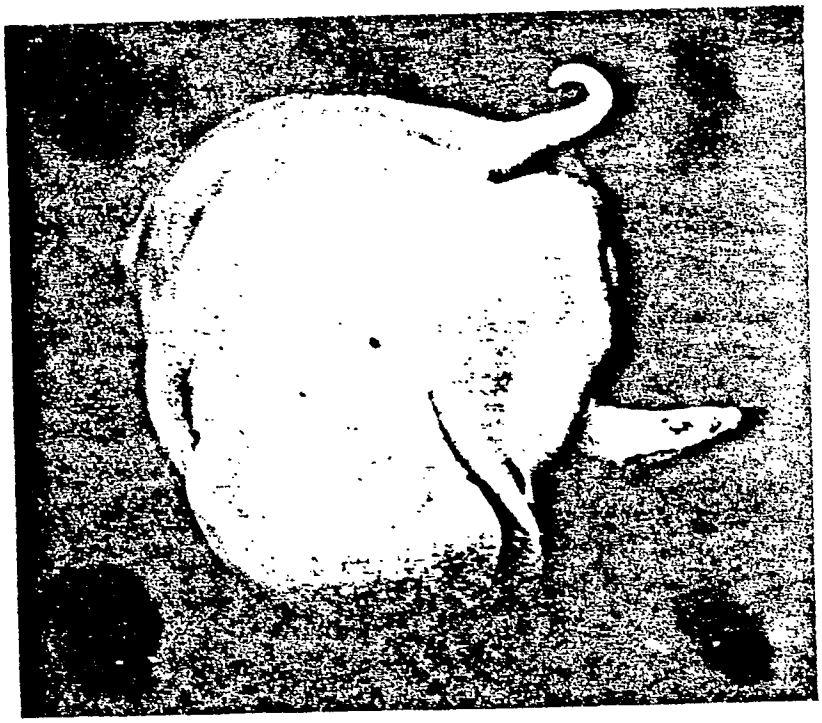


Fig. 21.- Anterior view of the male Beluga shown in Fig. 20. The flippers are sharply bent back.

(No. 6a) and near the estuaries of the Little Whale (No. 6b), Great Whale (No. 6c) and Churchill Rivers (No. 6d).

Bernier (1909, p. 71), during his voyage of discovery on the C.G.S. Arctic in 1906-07, saw numerous Beluga in Lancaster Strait (No. 7), namely: in Navy Board (No. 7a) and Admiralty (No. 7b) Inlets. The same author, as well as Soper (1928, p. 74) and Anderson (1934, p. 74), also ran across a great many White Whales in several locations in Prince Regent Inlet (No. 8), Port Leopold (No. 8a), Batty Bay (No. 8b) and Erebus Bay (No. 8c), near Beechy Island.

Low (1906, p. 274) noted considerable concentrations of Beluga in Barrow Strait (No. 9). According to Anderson (1934, p. 73), the Mackenzie River Delta (No. 10) is an important whaling centre where Beluga are hunted by the Eskimos.

(d) Alaska (No. 11).- Beluga frequent many locations in this territory (Nelson, 1918, p. 468). They are not hunted, however, on a regular basis there. According to Kellogg (1931), over a period of three years, from 1919 to 1921, only 327 Beluga were caught in this region. According to Anderson (1934, p. 73), there are large numbers of these animals in the vicinity of Point Barrow (No. 11a). They are especially plentiful in the Yukon River (No. 11b) where they can swim upstream a considerable distance (Nelson, 1918, p. 468); Fraser, 1938, p. 287).

(e) Bering Sea (No. 12) and the Sea of Okhotsk (No. 13).- Not only does the Beluga frequent the west coast of the Bering Sea (Nelson, 1918, p. 468), but a great many are caught along the east coast, particularly in the Gulf of Anadyr (No. 13a).

Arsenyev (1939, p. 109) mentions the following areas as Beluga (1) whaling centres in the Sea of Okhotsk: the Gulf of Penzhin (No. 13b), the estuary of the Amour River (No. 13c), the Strait of Tartary (No. 13d) and south of Sakhalin Island (No. 13e). The Beluga apparently does not go down into the Sea of Japan itself.

(f) Arctic Ocean (no. 14).- Along the coast of Siberia, Beluga are caught on a commercial scale, (Arsenyev, 1939) in Kolutchinsky Bay (No. 14a) and also, south of Wrangel Island (No. 14b). It is entirely possible that they are to be found at the mouths of all the rivers draining into the Arctic Ocean. Detailed information on commercial whaling, however, is only available for two rivers: Ostroumov (1929) and Arsenyev (1936) mention whaling on the Yenisey (No. 14c), whereas Pallas (1776) had already mentioned the presence of Beluga in the Ob (No. 14d), as have more recent authors (Douhovny, 1933; Chapsky, 1937).

By the middle of the seventeenth century, Spitzberg (No. 14e) was an important Beluga-whaling centre (Jenkins, 1921, pp. 21-22). The Beluga were either caught with a net or killed on shore at low tide.

(g) The Kara (No. 15), Barentz (No. 16) and White (No. 17) Seas.- Destroumov (1935) among others, gives information on the Beluga in the Kara Sea. According to Tschirkowa & Folitarek (1930), Beluga were caught regularly in the estuary of the Pechora River (No. 16a).

(1) According to Barabash & Klumov (1935), the Beluga that live in the Sea of Okhotsk belong to a particular species (D. dorofeevi) that is distinct from the typical Beluga (D. leucas) which is distributed widely throughout the North Atlantic and the Arctic Oceans. Additional information on the subject is given on page of this paper.

Heptner (1930), Birula (1934) and Barabash (1937) describe in detail several important Beluga-hunting centres (1) in the White Sea.

(h) Scandinavia (No. 18) and the Baltic Sea (No. 19).- Along the coast of Norway, regular sightings of a few scattered Beluga only occur some distance out from the Varanger Fjord (Harmer, 1927; Forbin, 1930; Freund, 1932; Birula, 1934). During very cold winters, however, the Beluga may go as far south as Christiania (No. 18b). They have even been sighted occasionally in the Baltic Sea (Japha, 1909, p. 171).

(i) British Isles (No. 20).- Beluga have been seen from time to time in the waters off Great Britain, particularly along the northeast coast of Scotland, near the Firth of Forth (No. 20a) and Dunbeath (No. 20b) in Caithness County. Barclay & Neill (1821) examined the anatomy of a 13½-foot male Beluga caught near the Firth of Forth, and Struthers (1896) examined a female about one foot shorter that was caught in a salmon net at the second location. Additional information about the Beluga scattered around the British Isles can be found in publications by such authors as Millais (1906), Harmer (1927) and Fraser (1938).

(1) According to Klumov (1935) and Barabash (1937) the Beluga found in the White Sea are members of a special species (D. freimani).

Distribution in the St. Lawrence

Although the presence of Beluga has been noted in various districts of the St. Lawrence, concentrations vary greatly from one place to another and depend on the season. Figures 48 and 49 illustrate this point. Generally speaking, the region can be divided into three zones, according to the number of animals that inhabit each, and according to the different age groups of the herds.

1. Area of largest annual concentration (Figs. 48 and 49).- The estuary of the St. Lawrence River, particularly the mouth and the vicinity of the Saguenay, may be considered the area where the largest concentration of Beluga is to be found. It was here that Jacques Cartier, on his first voyage to Canada in 1534, saw White Whales (Chambers, 1912, pp. 20-21). Beluga are as numerous there today as they were in earlier times.

Along the North Shore, Ile-aux-Coudres and Pointe-de-Monts (1) mark the boundaries of this area, which on the South Shore extends from the Rivière-Ouelle pier (2) to Cap-Chat.

Several years ago, the Abbé Casgrain (1873, pp. 3) noted that there was a great abundance of Beluga in these waters. He writes: "The explorers travelling along the St. Lawrence between the St-Roch short-cut (3) and the Gulf, see a sight as curious as it is interesting, and

(1) The author has taken the spelling of Pointe-de-Monts used by Magnan (1925, p. 156), as authoritative.

(2) According to Luc Bélanger and his son, Adalbert, who own an eel trap located about two miles east of the Rivière-Ouelle pier,

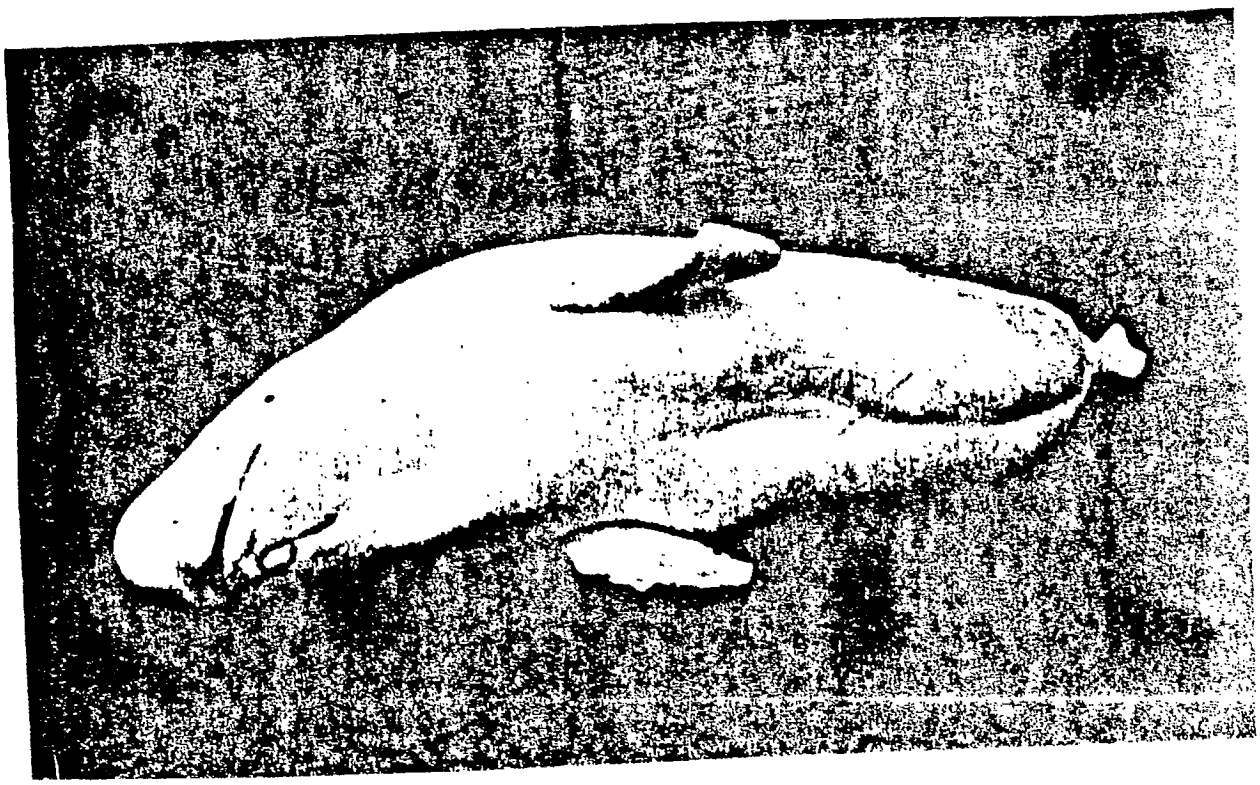


Fig. 22.- Frontal view of the male Beluga shown in Fig. 21.

Fig. 23.- Frontal view of a large male Beluga. The bent-back flippers are clearly visible.

very peculiar to our river and its waters: it is the sight of herds of White Whales surfacing to breathe and frolic about... The sparkling whiteness of their skin contrasts with the dark green of the waves and makes them look like snow-covered ice floes".

From June to November, in addition to adult males, herds of females with their young can be seen around Ile-aux-Coudres, in the waters of the Saguenay, in the many coves near Les Bergeronnes and Les Escoumains, and on the Manicouagan Bank, offshore from Pointe-Lebel.

2. Seasonal area of concentration (Figs. 48 and 49).- There are several localities east and west of the area of heaviest Beluga concentration where one can find either small herds or a few scattered animals during certain months of the year. In most cases, white adults rather than young animals are usually seen in this area. Furthermore, even during the best season, there are never as many Beluga here as in the waters of the Saguenay.

This area includes Baie des Chaleurs, the Gaspé Peninsula, the district between Natashquan and Baie-Trinité, along the North Shore, and also the section of the St. Lawrence from west of Ile-aux-Coudres to 30 miles above Quebec City.

3. Area where there are no Beluga (Figs. 48 and 49). According to a number of people, no Beluga have been seen in the Gulf of St. Lawrence for at least the past thirty years (1). For example, John Willcott, a fisheries inspector who has been travelling the North Shore for 25 years, has never seen any between Kégashka and Blanc-Sablon. However, James Kennedy, a former fishery protection

(1) Earlier authors mention the Beluga in the Gulf of St. Lawrence, but do not specify where: for example, DeCharlevoix (1744, p. 211) states that they can be caught "everywhere in the St. Lawrence Gulf and even well before then, in the river itself", and Pennant (1784, p. 182) adds that "they are numerous in the Gulf of Saint-Lawrence, and go with the tide as far as Québec".

officer, saw Beluga in this district only once, notably around Vieux-Fort, in 1931 or 1932 (he does not recall exactly which).

Many of the people from Rivière-au-Tonnerre who fish for herring in the spring and cod in the summer along the north shore of Anticosti Island, never see White Whales there (1).

Beluga have never been seen around the Iles-de-la-Madeleine, although this region is one of the richest in our Province in terms of cod and other varieties of fish.(2)

The author will conclude this chapter with the addition of Table II which is based on some interesting information found in the files of the Department of Maritime Fisheries. The table gives the names of places where Beluga have been caught during recent years when the Government paid a bounty. It is clear that 96 per cent were caught between Les Escoumains and Pointe Manicouagan.

(1) Schmitt (1904, p. 317), in referring to Anticosti, noted that the White Whale could be seen in pods, but only rarely. "On the other hand, downstream toward the Island or upstream toward Quebec, we often ran across them, between Baie St-Paul and Pointe-de-Monts".
(2) Information on the Iles-de-la-Madeleine was kindly provided by the following: Charles Boudreault, Mayor of Havre-Aubert; Maurice Chiasson, Mayor of Étang-du-Nord; and former fisheries inspector S. Arsenault, of Cap-aux-Meules.

Fig. 24.- Platform scale used at Pointe-Lebel to weigh Beluga.

The Manicouagan Bank always yields the greatest number. Although Beluga are numerous in the Saguenay estuary, they are very difficult to catch because of the very deep water and the strong current. Among the other North Shore locations, the largest number of Beluga have been caught mainly in the area between the Mingan Islands and Natashquan.

Few animals have been caught on along the South Shore between Rivière-du-Loup and Barachois. Spring of 1934 was the only occasion in Baie des Chaleurs when three Beluga were taken.

EXTERNAL CHARACTERISTICS

The Beluga has several striking external characteristics which distinguish it from other Odontoceteans.

General Shape

The Beluga's head is rather small, round and bulbous in front, and it is no more than one fifth of the animal's overall length. An almost imperceptible neck separates the head from the body. The snout is short and round. The upper anterior part of the head has a crescent-shaped protuberance, in the middle of which there is an orifice (blowhole) which is a modification of two airholes. The cavity of the blowhole tilts forward (Fig. 19). The eye is small and round. Slightly behind it, there is a small hole, hardly larger than a pinhead: this is the external opening of the ear (Fig. 18).

The lower jaw is round and protrudes almost as far as the upper one. The mouth opening, which seems small in comparison with the length of the animal, is at the end of the snout (Fig. 20). The mouth has a generous supply of teeth. The number of teeth in an adult animal varies between 8 and 10 on each side of the upper and the lower jaws, the maximum number thus being 40 teeth. Degerboel & Nielsen (1930) have published some interesting data on the number of teeth in Beluga of different sizes in the Greenland region.

The flippers are rather short and wide, with the ends bent back and upwards in the adult (Vladykov, 1943). As Lacépède (1844, p. 83) noted earlier, "The anterior part of the body is shaped like a cone with its base, which is located near the flippers, resting against the base of another much longer cone that consists of the rest of the body and the tail".

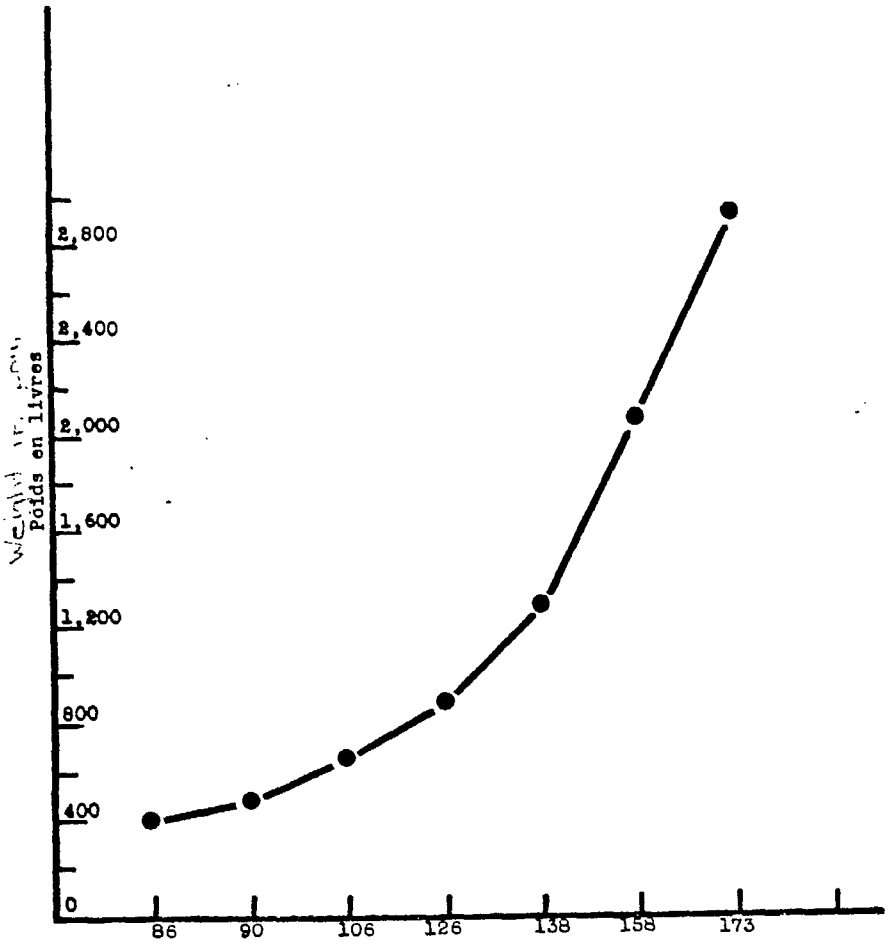


Fig. 25.- Correlation between weight and length of Beluga caught on the Manicouagan Bank in 1938.

The body of the young and the female Beluga is more aerodynamic in shape than that of the male. The animal's largest circumference is located slightly behind the flipper, after which it gradually decreases down to the base of that powerful means of propulsion, the tail (Figs. 21-23). Like that of all Cetaceans, the tail is divided into two flukes by a fairly deep notch (Figs. 32 and 33).

As Pallas (1794, p. 196) noted earlier, the Beluga's skin is completely devoid of hair. Along the medial line of the back there is an inflexible ridge which is a vestige of the dorsal fin of the other dolphins (Fig. 29). According to Barclay & Neill (1821, p. 374), this ridge which begins slightly back of the middle of the body, is 16 inches long in a 13-foot 4-inch male Beluga. The ventral surface can be slightly puffy, flat or hollow, depending on the fatness of the animal.

Colour

As explained earlier, "Beluga" means white-coloured animal; however, this colouration is a characteristic of the adult animal only. The young Beluga goes through four successive colour changes (Fig. 30) between birth and maturity: dark brown, bluish, greyish and lastly, white. The St. Lawrence Beluga are never mottled or yellow, contrary to what has been said about the species in general by Beddard (1900, p. 244), and reiterated by Millais (1906, p. 314), Harmer (1927, p. 15) and Fraser (1938, p. 287).

The Beluga's colour depends on the pigment (brown or black melanin particles) which is present only in the epidermis. With age, the amount of pigment in the melanic Malpighian cells decreases progressively and even disappears in adult animals, who then turn

white. These changes are visible even to the naked eye in a cross-section of skin (Fig. 31). Microscopic data is given in another publication (Bonin & Vladykov, 1940, pp. 257-269).

Size

Lacépède (1844, p. 83) determined the maximum length of the Beluga as being between 20 and 23 feet. Subsequent authors such as Beddard (1900), Millais (1906), Harmer (1927), Freund (1932), Fraser (1938), etc., did not contribute anything new on this subject.

The length of the Beluga no doubt varies from one region to another: Birula (1934, p. 12) gave 13 feet as the maximum length of White Sea specimens, 15 feet 2 inches for Kara Sea specimens and 17 feet 8 inches for specimens from the Pacific Ocean. Of the 190 Beluga measured in western Greenland, Degerboel & Nielsen (1930) gave 15 feet 7 inches as the maximum length for the female, and 18 feet 9 inches for the male.

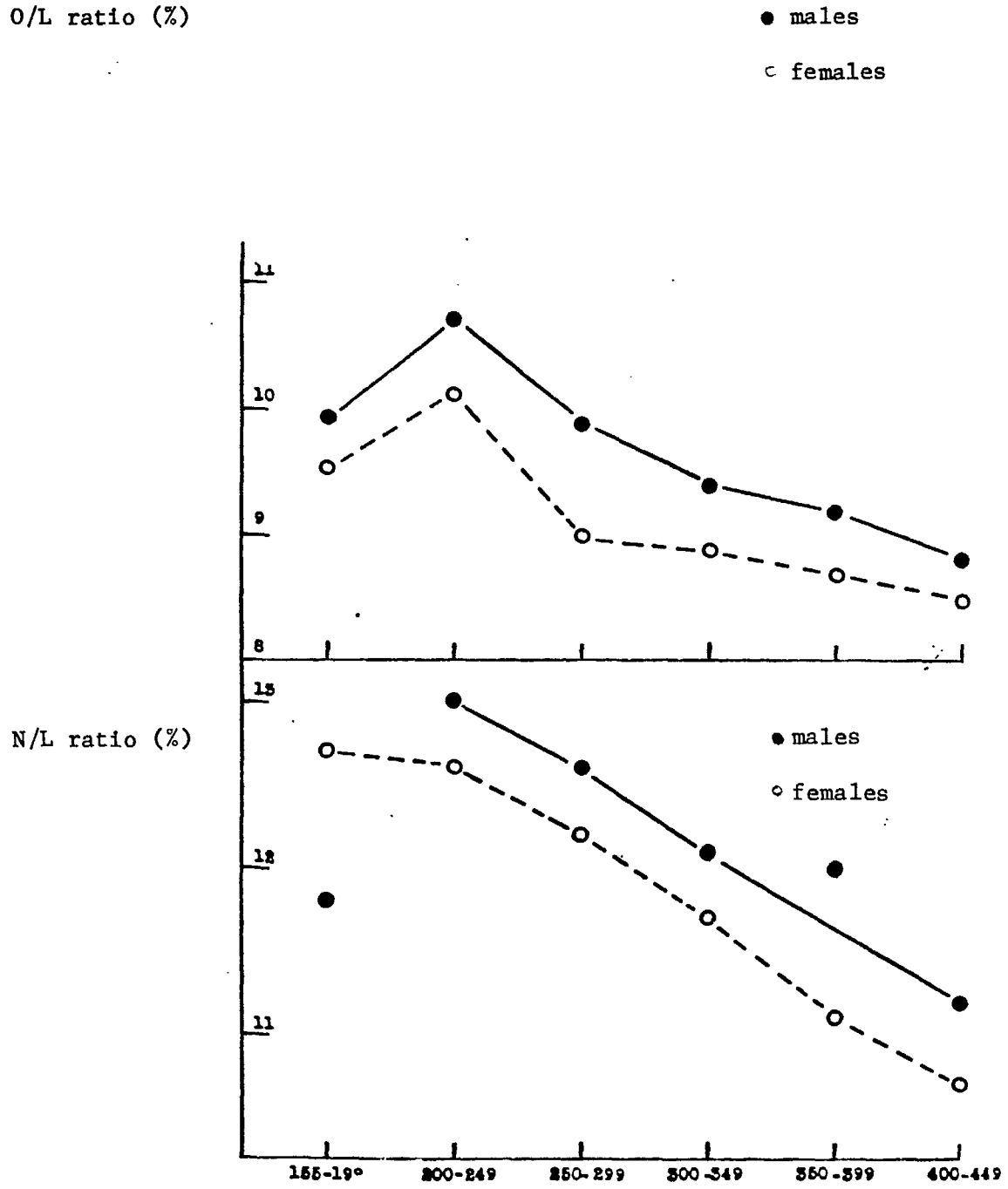


Fig. 26.- Ratio of the distance from the snout to the eye (O), and, from the snout to the blowhole (N), to the total length (L) of Beluga.

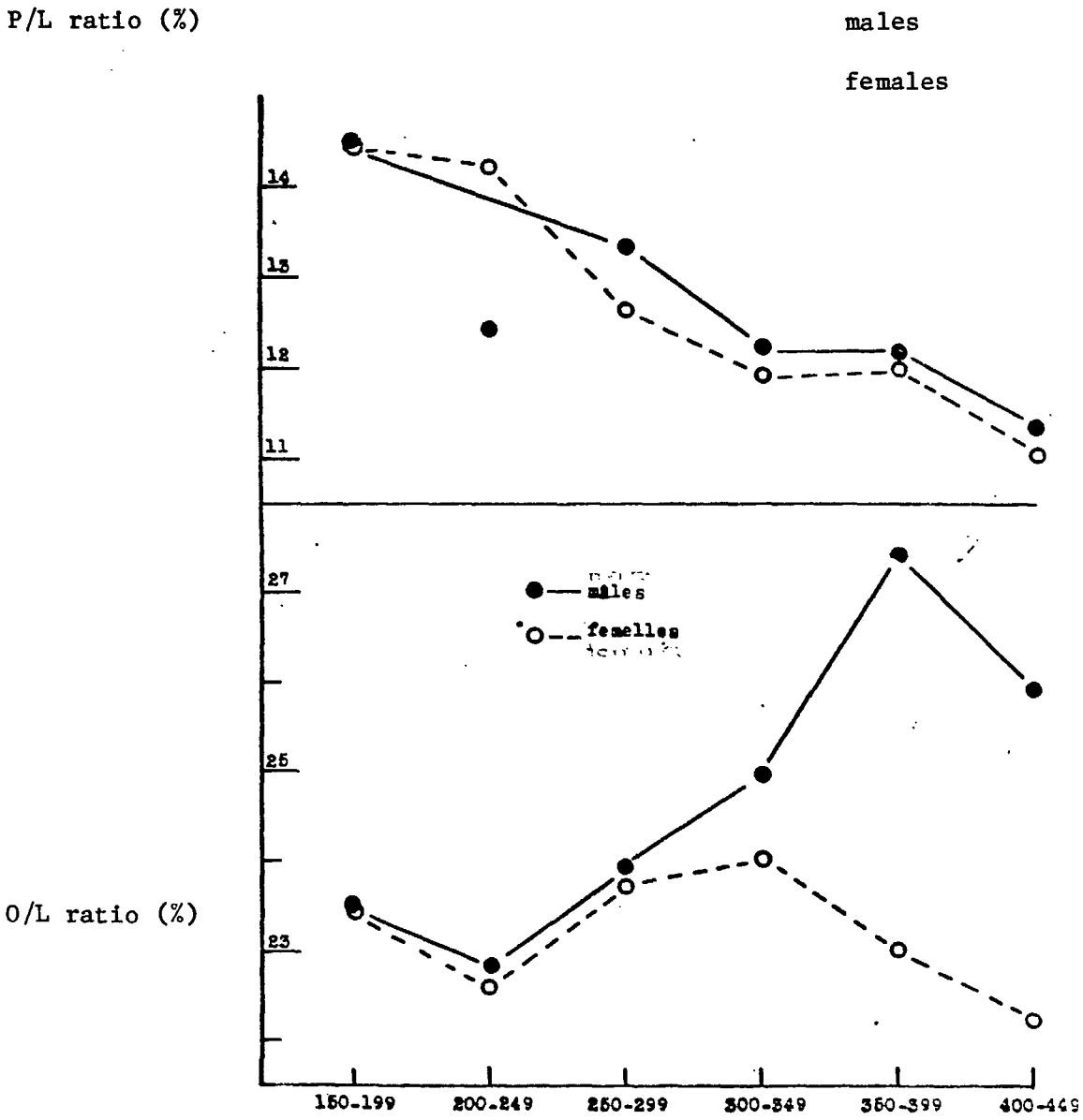


Fig. 27.- Ratio of the length of the Beluga (L) to the length of the flippers (P) and to the width of the tail (C). Specimens were caught on the Manicouagan Bank in 1938.

TABLE III.- Correlation between length and weight of Beluga caught in the St. Lawrence River in 1938 and 1939.

No.	Date	SEX	LENGTH in.	LENGTH cm.	BLUBBER THICHNESS cm.	WT. IN POUNDS SKIN & BLUBBER	WT. IN POUNDS REMAINDER	WT. IN POUNDS TOTAL	WEIGHT (lbs) / LENGTH (ins.)
317	3.VIII.39	♂	62½	159	8.3	-	-	185	2.9
97	30.VIII.38	♀	83	211	8.0	-	-	441	5.3
104	31.VIII.38	♀	88	224	12.0	-	-	415	4.8
98	30.VIII.38	♀	90	229	8.0	-	-	574	6.4
110	2. IX. 38	♀	105½	268	9.0	-	-	668	6.3
99	30.VIII.38	♀	126	320	10.1	415	486	901	7.2
100	30.VIII.38	♀	138	351	17.0	659	654	1,313	9.5
103	31.VIII.38	♀	158	401	12.5	916	1,192	2,108	13.4
114	2. IX.38	♂	170	432	20.0	1,561	1,420	2,981	17.5
94	27.VIII.38	♂	176	447	15.5	1,332	1,529	2,861	16.2

Now and then very large Beluga are seen in the Canadian Arctic. W.E. Swaffield of the Hudson's Bay Company in Montreal, who spent several years in the Arctic, provided us with extremely interesting data on this subject. According to him, every year, a few 19- to 20-foot Beluga are caught there. The largest, killed in June 1929, in Ungava Bay, measured 28 feet in length, the most ever reported for this species.

Among the specimens we studied in 1938 and 1939, the largest male Beluga was only 14 feet 8 inches long. Three animals of this size were killed in August and September 1938. The hunters say that sometimes larger Beluga are caught in the St. Lawrence River: in 1924, E. Boulianne measured one that was 17 feet 3 inches long and in 1926, H. Chouinard caught a 19-footer. On July 6, 1943, Walter Bond, a local fisherman, killed a 17-foot male near La Chaloupe, east of Rivière-aux-Graines (Saguenay County). The Abbé Casgrain (1873, p. 4) mentioned catching Beluga that were up to 25 feet in length; however,

he did not specify whether these animals were caught in the St. Lawrence or in Hudson Bay.

Weight

Current literature rarely gives specific data on the weight of Beluga. One exception is some information provided by Arsenyev (1939, pp. 31-36) on the Beluga of the Far East. He gives the weight of a 163-inch male as being 1,631 pounds; the average weight of a semi-adult Beluga, 1,100 to 1,300 pounds, and 4,400 pounds as the maximum weight for an adult.

For the present study, only 6 specimens could be weighed. A 500-pound capacity platform scale (Fig. 24) was used. The animals were cut up into large pieces that were weighed individually; however, a small amount of blood and other fluids was lost during this operation.

The weights of the Beluga examined ranged from 185 pounds for a suckling calf approximately one month old to 2,981 pounds for an old male (No. 114) 14 feet 2 inches long with 8-inch thick blubber. Another male (No. 94) which was 6 inches longer than the one above, weighed only 2,861 pounds because it was a bit thinner, with only 6-inch blubber.

Table III shows the correlation between length and weight. Although there are individual and seasonal variations, a definite relationship between length and weight can be readily seen.

For example, for a 62½-inch nursling, the ratio of weight (in pounds) to length (in inches) is approximately three; in 83- to 88-inch specimens, it is about 5; in a 138-inch specimen, it is 9½, etc.: the ratio thus increases proportionately with the size. One should always bear in mind, however, that the weight can vary with the season: at the beginning of summer, when food is abundant, the Beluga is fatter than in fall or winter (Cf. pp. 76-78). And thus, the ratio of weight to length can also vary from month to month. Nevertheless, with more complete data, the weight could be determined, by multiplying length in inches by the corresponding factor, without actually weighing the Beluga.

As shown graphically in Fig. 25, the ratio of Beluga length to weight yields a curve that closely approximates the trend shown in the one calculated by Schultz (1938) for large fish and aquatic mammals. There is, nevertheless, a difference between the data given by Schultz and that of this author. For example, according to Schultz, a 157-inch aquatic animal should weigh 1,100 pounds, whereas our 158-inch Beluga weighed 2,108 pounds.

TABLE IV.- Circumference and thickness of the blubber of the males caught in 1938.

Average Values							
GROUPS	No. OF BELUGA	LENGTH		CIRCUMFERENCE		BLUBBER	
in.		in.	cm.	in.	cm.	in.	cm.
60-69	3	63	160	38	96	2.0	5.0
70-79	1	76	193	53	135	2.8	7.0
80-89	1	89	226	66	167	3.2	8.2
90-99	2	96	244	66	167	4.3	10.8
100-09	3	102	259	72	183	4.8	12.1
110-19	3	114	290	77	196	4.0	10.2
120-29	5	124	315	76	193	4.1	10.4
130-39	6	136	345	93	237	5.8	14.7
140-49	6	147	373	90	229	6.0	15.2
150-59	10	153	389	92	234	6.0	15.2
160-69	27	165	419	105	267	6.8	17.3
170-79	9	173	439	106	269	6.7	17.0

Body proportions

In the present study, we have made a few observations about the body proportions. Details of these measurements appear in the Appendix tables.

By dividing the specimens gathered into groups according to length, it is apparent that different parts of the body of young Beluga are smaller than those of older ones (Tables IV - VII). If direct comparison of corresponding data is replaced by ratios of the various parts of the Beluga's body to its total length, the results are quite different. Take, for example, the ratio of body length to distance between snout and eye, or snout and blowhole. The resulting ratios for the youngest Beluga will be higher than those for the oldest animals (Table XII and Figs. 26 and 27). Similarly, the ratio of maximum circumference to body length in the young animal is on average 66%, in the adult, 62.3% (Tables VIII and IX).

In other words, the young Beluga's body is thickset, whereas the adult's is more elongated. As Arsenyev (1936) noted earlier, this indicates that growth in length occurs at a faster rate than does increase in volume. According to the same author, the ratio, expressed as a percentage, between the length of the head and the animal's total length varies from 16.3 to 20.0 in young Beluga (170-290 cm) and from 13.4 to 15.1 in older ones (304-410 cm).

In another work (Vladykov, 1943), the author has shown that in both sexes, the ratio of length of the flipper, expressed as a percentage, to the total length of the animal, decreases with the animal's size. With age, however, the increase in the breadth of the tail differs in

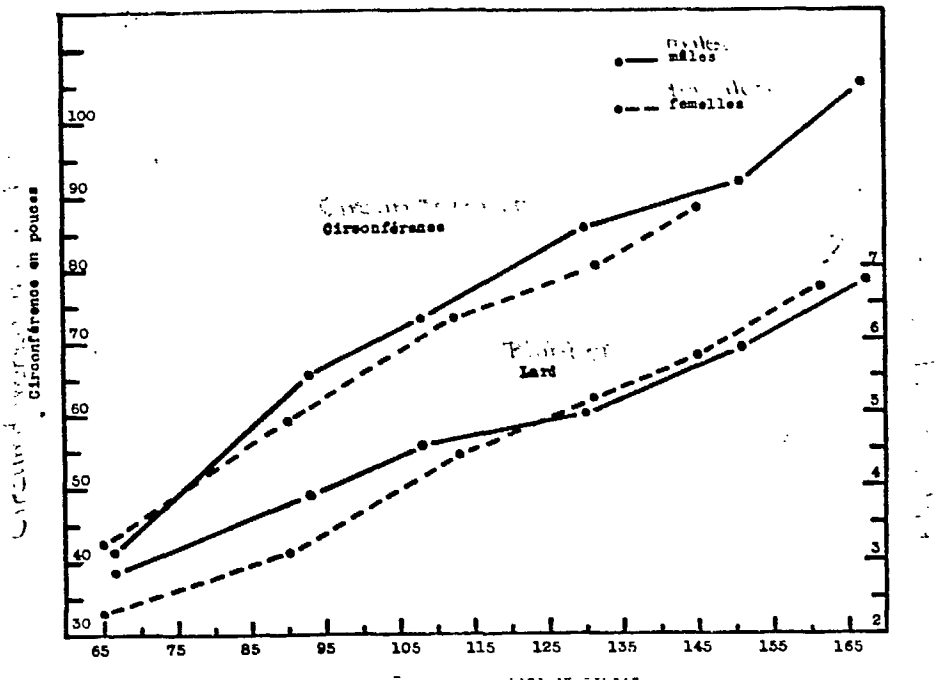
the two sexes: in the adult female, the rate of growth remains more or less the same as that of the young animal, whereas in the adult male, it increases (Table XIII and Fig. 27). Information on other body proportions of the Beluga can be found in an interesting work by Arsenyev (1936).

Blubber Thickness

Abundance of blubber is one of the reasons why Cetaceans are hunted so intensively. The thickness of the hypodermis or blubber varies not only from one species of whales to another but also from animal to animal. As an example of extreme variations in blubber thickness in members of the same species one could mention the observations by Risting (1928, p. 4) on the Balaenoptera musculus: the fattest specimen yielded 305 barrels of oil and the thinnest, less than half a barrel (75 kg.).

As a general rule, in the larger whales such as the Balaenoptera (Mackintosh & Wheeler, 1929, pp. 365-368); Matthews, 1938, pp 234-238) and Megaptera (Matthews, 1937, pp. 43-47), the blubber or hypodermis is not as thick as that of the Beluga. The thickness of the Beluga's blubber varies from 3 to 4 percent of total length (Tables VI and VII), while this figure is rarely higher than 1.5 for whales. Blubber thickness, in absolute values, is quite often greater in Beluga than in whales. It goes without saying, though, that because of its

smaller size, the Beluga yields a lot less oil than a large whale (1).



Average length in inches

Fig. 28.- Correlation between data on average length, circumference and blubber thickness in Beluga caught on the Manicouagan Bank in 1938. Specimens were divided into groups by 20-inch intervals: 60-79, 80-99, etc.

(1) This is probably why Capt. Bernier (1910, p. 313) said that Belugas are not lighly sought after, because they are "deficient in blubber".

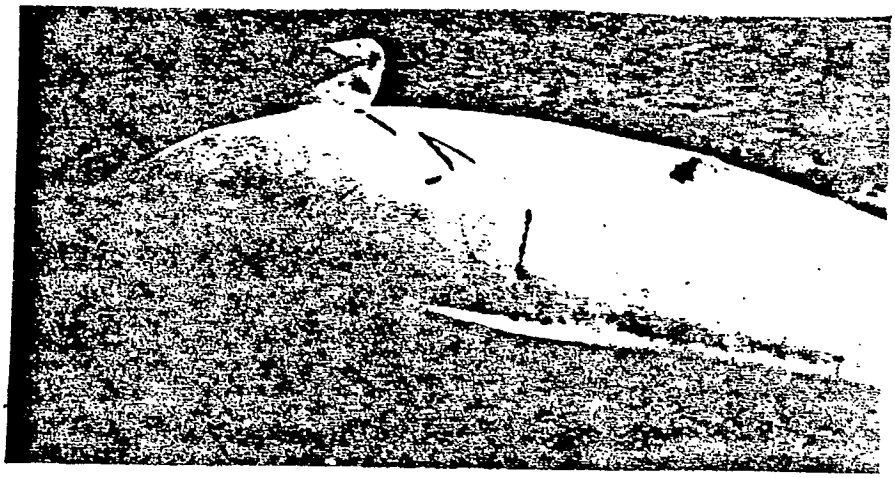


Fig. 29.- Dorsal view of an adult male Beluga. The dorsal ridge is clearly visible.

TABLE V.- Circumference and thickness of blubber in females caught in 1938.

Average Values							
GROUPS	No. OF BELUGA	LENGTH		CIRCUMFERENCE		BLUBBER THICKNESS	
in.		in.	cm.	in.	cm.	in.	cm.
60-69	4	63	160	42	106	2.1	5.4
70-79	1	73	185	46	117	2.5	6.5
80-89	4	87	221	55	140	3.0	7.6
90-99	4	94	238	65	165	3.3	8.5
100-09	3	105	265	70	178	4.5	11.3
110-19	3	118	300	75	190	4.5	11.2
120-29	9	125	318	77	196	4.6	11.7
130-39	18	134	340	84	209	5.3	13.3
140-49	13	144	366	89	226	5.6	14.3
150-59	2	155	394	88	224	5.9	15.0
160-69	1	161	409	-	-	6.7	17.0

TABLE VI.- Correlation between length, circumference and blubber thickness in males caught in 1938.

GROUPS in.	NUMBER OF BELUGA	CIRCUMFERENCE / LENGTH %	BLUBBER THICKNESS / LENGTH %	BLUBBER THICKNESS / CIRCUMFERENCE
60-69	3	60.0	4.64	5.20
70-79	1	69.5	3.62	5.21
80-89	1	74.5	3.63	4.90
90-99	2	68.4	4.43	6.45
100-09	3	70.5	4.65	6.60
110-19	3	66.3	3.55	5.35
120-29	5	61.2	3.28	5.36
130-39	6	68.9	4.30	6.25
140-49	6	61.5	4.10	5.55
150-59	10	60.3	3.85	6.38
160-69	27	63.4	4.16	6.65
170-79	9	61.5	3.88	6.33

Index of condition - In order to better describe the varying degrees of blubber thickness in Beluga, the "index of condition" was used (1). This index is the relationship between the blubber thickness and the animal's total length, expressed as a percentage: the higher the percentage the fatter the Beluga, and vice versa. In order to obtain a more accurate index, blubber thickness should be measured at different parts of the body.

The average index of condition for Beluga of different sizes caught in 1938 and 1939 varies between 2.12 and 5.26 (Tables X and XI). For 1938, the average index is 3.87 for all the young Beluga, (less than 10 feet long), 3.92 for adult females and 3.97 for adult males. For

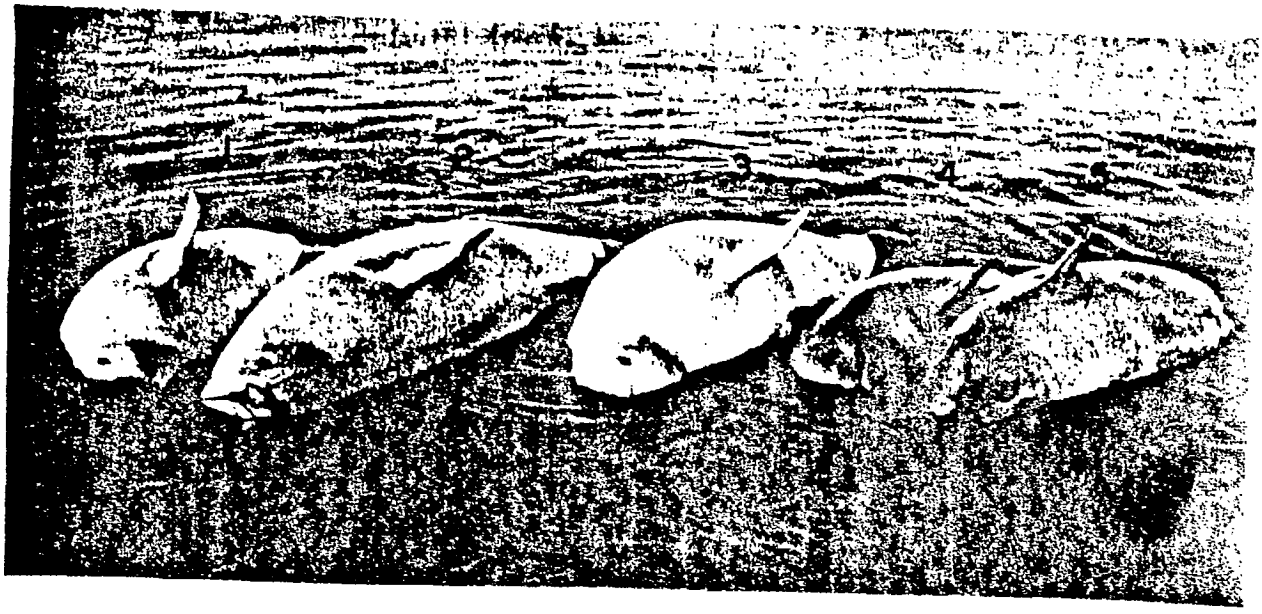
TABLE VII. - Correlation between length, circumference and blubber thickness in females caught in 1938.

GROUPS ins.	NUMBER OF BELUGA	CIRCUMFERENCE LENGTH %	BLUBBER THICKNESS LENGTH %	BLUBBER THICKNESS CIRCUMFERENCE
60-69	4	66.2	3.38	5.10
70-79	1	58.3	3.50	5.50
80-89	4	63.3	3.42	5.40
90-99	4	69.0	3.57	5.15
100-09	3	65.8	4.20	6.40
110-19	3	63.5	3.74	5.90
120-29	9	59.0	3.80	6.25
130-39	18	61.5	4.05	6.35
140-49	13	61.5	3.91	6.35
150-59	2	57.2	3.83	6.70
160-69	1	-	4.15	-

(1) Mackintosh & Wheller (1929) and Matthews (1937 and 1938) used the condition index to great advantage in their studies of the larger whales.

Fig. 30.- Female Belugas at three different colour stages:

1. Greyish-white (Blanchon), 10 feet 7 inches long;
2. Greyish-white (Blanchon), 10 feet 11 inches;
3. White (Blanc), 11 feet 11 inches;
4. Blue calf (Bleuvet), 6 feet 11 inches;
5. Blue calf (Bleuvet), 7 feet 4 inches.



the young caught in 1939, the indices were slightly higher (4.20) but remained more or less the same (3.94) for the adults. The combined data for the two seasons gave an average index of 3.93 for 31 young animals and 3.95 for 124 adults (Fig. 28).

When more Beluga caught in different months can be measured, it will be possible to establish more specific indices of condition by season and location. By multiplying this index by the length of the Beluga, the amount of fat (as well as oil) could be given a value without having to weigh the animal.

The index of condition for the Beluga can also be obtained by calculating the percentage ratio of blubber thickness to maximum circumference. In animals of different sizes caught in 1938, this index varied between 4.90 and 6.70 (Tables VI and VII). It is much more difficult, though, to measure the circumference than the overall length because for the former measurement, the heavy animal often has to be turned over in order to move the tape along underneath. Moreover, in summertime, if a dead Beluga lies on shore for more than a day, decomposition sets in and the animal becomes bloated with gas which alters its true circumference. This is why it is simpler to determine the index of condition from the ratio of blubber thickness to the animal's total length.

TABLE VIII. - Monthly variations in the ratio of circumference to body length of young Beluga of both sexes caught in 1938 and 1939:

MONTH	1938	1939	TOTAL
June	71.2 (4)	-	71.2 (4)
July	65.0 (8)	67.5 (3)	65.7 (11)
August	66.8 (6)	63.4 (2)	66.0 (8)
September	64.8 (7)	-	64.8 (7)
October	-	57.2 (1)	57.2 (1)
Total average	66.4 (25)	64.5 (6)	66.0 (31)

Note: The numbers in parentheses indicate the number of animals.

Blubber thickness of the Beluga depends on several factors: age, sex, food supply, etc. The extremes of these variations in the Beluga examined were 1½ to 10½ inches, or 4 to 27 cm. It is interesting to note that the Beluga with the least fat were caught towards the end of October, when the water was cold, whereas they were extremely fat during the summer. This indicates that the Beluga does not require a thick layer of blubber to protect it from the cold (Figs. 33 and 42).

Variations according to part of the body.- The blubber thickness of the St. Lawrence Beluga was measured on the back only. There is no doubt that, for this species, as for Cetaceans in general (Andrews, 1925, p. 153), blubber thickness varies in different parts of the same animal. For example, the blubber on the ventral side is approximately half as thick as the blubber on the dorsal side. A few such measurements of Beluga caught in the fall of 1939 follow:

NO.	SEX	LENGTH	BLUBBER THICKNESS			
			BACK		ABDOMEN	
		in.	cm.	in.	cm.	in.
331	female	103	8.5	3.4	5.0	2.0
332	female	140	11.5	4.5	5.0	2.0
333	male	129½	7.0	2.8	4.0	1.6

Variations according to size.- Blubber thickness increases with the size and age of the Beluga. In the newborn calf, it varies from 2 to 3 inches on average; in the blue calf it is approximately 4 inches thick and in the adult, 6 to 7 inches. Details for specimens grouped by 10-inch intervals, are given in Tables IV and V and Fig. 28. It should be added that there is practically no difference in blubber thickness between males and females of the same size.

Monthly variations.- Without a doubt, there are quite considerable variations in the condition of animals from one location to another, and from one year to another. For example, H. Chouinard noted that on the Manicouagan Bank in the summer of 1935, the Beluga were so fat that, after they had been killed they floated in the water, unlike in 1937 when they were quite thin and sank.

According to the hunters, the St. Lawrence Beluga are extremely thin in winter, that is, from November to March, and even in April. May and June are probably the months when they put on the most fat. In the Rivière-Ouelle region, the Abbé Casgrain (1873, pp. 9-10) observed that the Beluga, which appears near the estuary in April, "is thin and starved... and gorges itself with food so voraciously that in eight or ten days, it acquires five or six inches of fat, and sometimes as much as eight inches". The Beluga remain quite fat in summer, from July to September.

Earlier in this paper reference was made to a monthly variation in the blubber thickness of the Beluga. During the summer of 1938, the index of condition was higher in June and lower in July for the young animals and adults of both sexes caught on the Manicouagan Bank (Tables X and XI). In the following year, the adult Beluga caught in the vicinity of Les Escoumains had a higher index in July. The few young animals examined in 1939 showed a higher condition index in August (Table X).

TABLE IX.- Monthly variations in the ratio of circumference to length of adult Beluga (over 10 feet) caught in 1938 and 1939

MONTH	1938		1939	TOTAL
	♂ ♂	♀ ♀	♂♂ and ♀ ♀	
June	65.4 (12)	76.9 (2)	64.0 (5)	65.4(19)
July	61.0 (19)	68.6 (8)	63.0 (5)	63.3(32)
August	63.9 (21)	57.6 (18)	62.2 (2)	61.0(41)
September	61.8 (13)	60.7 (17)	-	61.4(30)
October	-	-	57.9 (1)	57.9 (1)
November	-	-	55.5 (1)	55.5 (1)
Total Average	62.9 (65)	61.6 (45)	62.4 (14)	62.3 (124)

Note: The figures in parentheses indicate the number of animals.

TABLE X.- Monthly variations in the "index of condition" in the young Beluga of both sexes caught in 1938 and 1939.

MONTH	1938	1939 and	TOTAL
June	4.91 (4)	-	4.91 (4)
July	3.13 (8)	4.18 (3)	3.48 (11)
August	4.35 (6)	4.71 (2)	4.44 (8)
September	3.52 (7)	-	3.52 (7)
October	-	3.25 (1)	3.25 (1)
Total Average	3.87 (25)	4.20 (6)	3.93 (31)

Note: The figures in parentheses indicate the number of animals.

TABLE XI.- Monthly variations in the "index of condition" in adult Beluga (over 10 feet) caught in 1938 and 1939

MONTH	1938		1939 ♂♂ and ♀♀	TOTAL
	♂♂	♀♀		
June	4.21 (12)	5.26 (2)	4.01 (5)	4.28 (19)
July	3.57 (18)	3.75 (8)	4.22 (4)	3.72 (30)
August	4.08 (21)	3.81 (19)	4.01 (2)	3.96 (42)
September	4.11 (14)	3.97 (17)	-	4.03 (31)
October	-	-	3.23 (1)	3.23 (1)
November	-	-	2.12 (1)	2.12 (1)
Total Average	3.97 (65)	3.92 (46)	3.94 (13)	3.95 (124)

Note: The figures in parentheses indicate the number of animals.

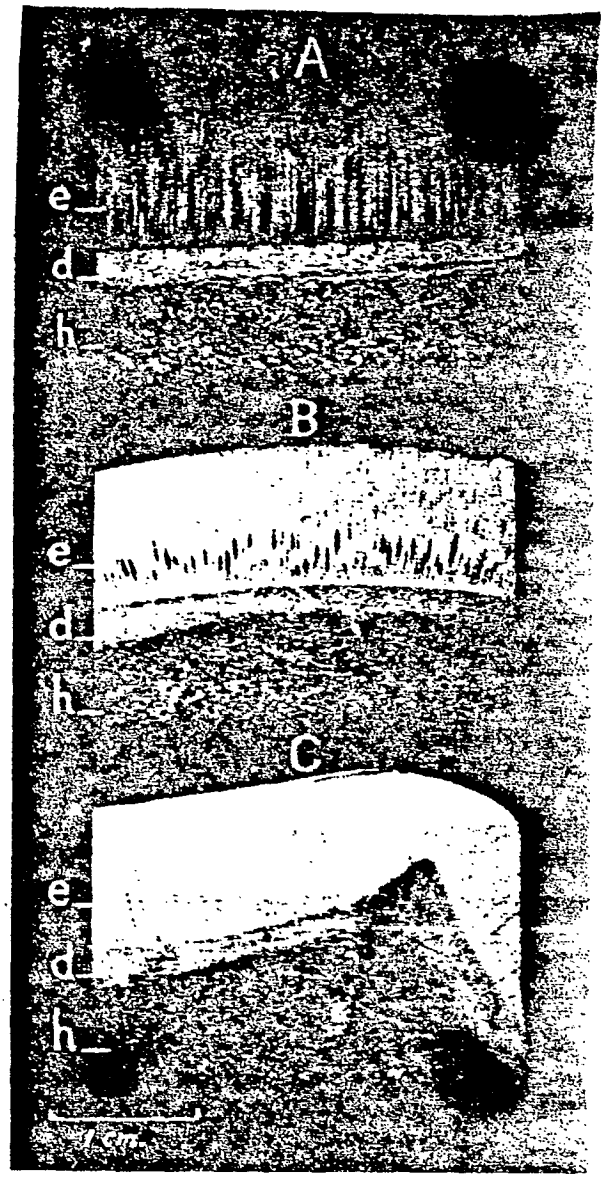


Fig. 31.- Skin of the St. Lawrence Beluga as seen under a microscope:

A. Blue calf, 7 feet 8 inches long.

B. Greyish white calf 10 feet 2 inches long.

C. White adult, 12 feet 7 inches long.

e - epidermis (scale); d - dermis (skin); h - hypodermis (section) or blubber.

Variations in females according to state of maturity.- It has been well established (Andrews 1925, p. 153; Mackintosh and Wheeler, 1929, p. 368, etc.) that, in the case of whales, gestating females are a great deal fatter than nursing females. Our hunters feel that this is so for the Beluga as well.

In 1938, probably because of insufficient specimens, it was difficult to separate the influence that the different stages of maturity of the females had on the condition index from the influence of the monthly variations or differences in size. The table below makes it possible to compare the indices of the females in the two categories. These animals, caught in 1938, were divided into groups by length; the number of animals in each group is shown in parentheses.

GROUPS in.	PREGNANT FEMALES INDEX OF CONDITION	NURSING FEMALES INDEX OF CONDITION
120-29	3.68 (4)	3.62 (1)
130-39	3.81 (7)	3.98 (11)
140-49	3.96 (3)	3.92 (10)
150-59	-	3.83 (2)
General Average	3.88 (14)	3.94 (24)

In some cases the condition index was higher with pregnant females. The following are a few examples:

No.	DATE	LENGTH (in.)	CONDITION OF INDEX
		Pregnant females	
308	4.VII. 39	138	4.18
311	15.VII. 39	131	5.40
		Nursing females	
306	30.VI. 39	136	3.68
312	22.VII. 39	134	3.74
314	24.VII. 39	131	3.66
316	2.VIII.39	135	4.28

AGE AND GROWTH

There are several ways of determining the age of Cetaceans. For Mystacocetes, Mackintosh & Wheeler (1929) and Wheeler (1930) in particular, felt that the best indices for determining age were: the number of atrophied corpora lutea, in the case of the female, or the condition of the vertebral epiphyses in both sexes.

Unfortunately, we do not have much information about the number of atrophied corpora lutea or the condition of the vertebral epiphyses in the specimens we had. The condition of the teeth will be carefully examined when we have finished studying the skulls. That is why, in this report, our determination of the ages of the St. Lawrence Beluga is only tentative, based solely on two characteristics: size and colour.

TABLE XII.- Ratio (percentage) of total length (L) to distance from snout to eye (O) and snout to blowhole (N) in the Beluga caught in 1938.

GROUPS cm.	MALES NUMBER	MALES O/L %	MALES N/L %	FEMALES NUMBER	FEMALES O/L %	FEMALES N/L %
155-199	3	9.9	11.8	6	9.5	12.7
200-249	2	10.7	13.0	8	10.1	12.6
250-299	7	9.9	12.6	3	9.0	12.2
300-349	9	9.4	12.1	26	8.9	11.7
350-399	17	9.2	12.0	17	8.7	11.1
400-449	37	8.8	11.2	2	8.5	10.7

During 1938 and 1939, we examined only 165 Beluga that were taken in the St. Lawrence River. Of these, 143 were caught in 1938 on the Manicouagan Bank. This many would have been sufficient for determining age if these animals had been caught randomly that year. This, however, was not the case: because the hunters prefer to chase the males, who tire faster than the females, more males than females were killed that year. We therefore do not have as much information on the young animals and the females as on the adult males (Fig. 34).

Several people, from Pallas (1794, p. 196) to recent authors such as Douhovny (1933), Arsenyev (1936) and others, have already noted that the Beluga's colour changes with age. According to these Russian authors, there are four different colour stages, each corresponding to a particular age. Their conclusions, for the most part, agree with the data that has been collected on the St. Lawrence Beluga.

Fig. 32.- The edge of the tail fluke of a greyish-white calf is very dark in colour. The measuring tape is stretched between the tip of the right lobe and the notch in the tail.

CALF

The term "calf" refers to a newborn or a young animal a few months old. The umbilical cord of the former is clearly visible: for example, on No. 43, a calf 61 inches long and caught July 20, 1938, there was a 2-inch cord.

The most characteristic colour of the skin is brown, shading from dark brown to bluish brown. The flippers and tail are very dark, with black tips. The older calves have an intermediate colouration between brown and blue.

TABLE XIII.- Mean ratio of the overall length (L) to the length of the fins (P) and the width of the tail (C) of Quebec Beluga.

GROUPS cm.	NUMBER	LENGTH cm.	P/L %	C/L %	C/P %
		Males			
150-199	5	167	14.4	23.4	1.6
200-249	3	232	12.4	22.8	1.8
250-299	9	271	13.3	23.9	1.8
300-349	9	326	12.3	24.9	2.0
350-399	16	379	12.1	27.4	2.3
400-449	36	425	11.3	25.9	2.3
		Females			
150-199	6	171	14.4	23.4	1.6
200-249	9	226	14.2	22.6	1.6
250-299	5	273	12.6	23.7	1.9
300-349	24	330	11.9	24.0	2.0
350-399	17	364	12.0	23.0	1.9
400-449	2	405	11.0	22.2	2.0

The length of the specimens examined varied from 61 to 83 inches; the latter measurement was rather unusual for an actual suckling. The stomach of this 83-inch calf contained various marine organisms rather than milk (Table XIV): it is quite likely that this specimen (No. 97) was already weaned. Another 80-inch calf (No. 319) that had already taken on almost a bluish shade typical of the blue calf, was apparently living on milk.

The calves had not yet cut teeth and were still accompanying their mothers who were nursing them. These, then, were sucklings, whose stomachs were free of parasites and contained no food other than milk. We do not know exactly how long the mother nurses her young, but it is quite possible that it is for a period of at least 6 months. It is also not known whether the calf begins to eat only after it has been weaned, or if it occasionally takes food other than milk during the suckling period.

TABLE XIV.- Data on Beluga calves caught in 1938 and 1939.

NO.	SEX	DATE	LENGTH		COLOUR	STOMACH CONTENTS	
			in.	cm.		TYPE OF FOOD	PARASITES
43	♀	20. VII.38	61	155	brown	milk	none
47	♂	22. VII.38	62	158	brown	milk	none
51	♂	28. VII.38	62	158	brown	milk	none
317	♂	3. VIII.39	62½	159	brown	milk	none
117	♀	2. IX.39	63	160	brown	milk	none
86	♀	20. VIII.38	64	163	brown	milk	none
131	♀	10. IX.38	64	163	brown	milk	none
122	♂	8. IX.38	66	168	brown	milk	none
142	♀	23. IX.38	73	185	brown	milk	none
130	♂	10. IX.38	76	193	brown	milk	none
301	♂	21. VI.39	78½	199	brown	other	present
73	♂	6. VIII.38	78½	199	brown	none	present
319	♀	27. VIII.39	80	203	bluish	milk	none
97	♀	30. VIII.38	83	211	bluish	other	present

We therefore consider to be a calf, any young Beluga that is 85 inches or less in length with the typical brown colour (Table XIV). Even though their diet consisted of food other than milk, specimens 97 and 301 will be classified as calves, as will 73 whose stomach was empty. It was observed that any Beluga that live on food other than milk become infested with parasitic worms: such was already the case with calves 73, 97 and 301 and all the older Beluga. Hence the absence of these worms in the stomach would certainly tend to indicate that the animal was a suckling.

TABLE XV.- Data on blue calves caught in 1938 and 1939.

NO.	DATE	LENGTH			
		ft.		in.	cm.
		Males			
32	13. VII.38	7	and	5	226
24	7. VII.38	7	"	8	234
313	24. VII.39	7	"	8½	235
61	1.VIII.38	8	"	3	252
10	24. VI.38	8	"	4	254
310	13. VII.39	8	"	4	254
13	27. VI.38	8	"	7	262
4	16. VI.38	8	"	7½	263
		Females			
31	13. VII.38	7	and	3	221
29	11. VII.38	7	"	4	224
104	31.VIII.38	7	"	4	224
98	30.VIII.38	7	"	6	229
124	9. IX.38	7	"	10	239
11	25. VI.38	7	"	10	239
34	14. VII.38	8	"	1	246
331	25. X.39	8	"	7	262
74	9.VIII.38	8	"	7½	263
110	2. IX.38	8	"	9½	268
309	8. VII.39	9	"	3	282

The calves studied in this paper were caught between June and September, although June and July are the peak months for calves in the St. Lawrence River. Six of the animals we examined were males and 8, females. In the first summer, the average length of the calves was 68 inches (173 cm.) for the males, and 71 (180 cm.) for the females.

Blue Calf

The blue calf is a young Beluga in its second year, in the stage after newborn calf. Although it feeds itself independently, it often accompanies its mother and is found in a herd of female adults.

The calf is bluish in colour: as Wyman (1863, p. 604) noted, at the back of the head and around the eyes, the blue is darker than the body itself (Fig. 30). The tips of the flippers are very dark, almost black.

The characteristic most typical of this stage, is the bluish tinge which is the origin of the calf's local name, "Bleuvet". In the Gulf of Ob in Siberia, they are known as also being blue (Douhovny, 1933). In certain places, however, this bluish colour is called "grise", or grey, by the local people, for example, at Rivière-Ouelle. (1).

The pectoral fins or flippers of the blue calf are not yet turned back (Vladykov, 1943). A very small number of teeth have begun to break through on both jaws: details are given by Degerboel & Nielsen (1930). We had at our disposal 8 male blue calf specimens averaging 97½ inches (248 cm) in length and 11 females averaging 96½ inches (245 cm.) Generally, the blue calf is 7 to 9 feet long (Table XV).

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(1) Arsenyev (1939, p. 23) states that the newborn Beluga of the Far East is first grey, then blue, the exact opposite of observations of the St. Lawrence animals. Our Beluga could thus belong to a taxonomical classification different from that of the animals that inhabit the North Pacific. This would confirm the view of Barabash-Nikiforoff (1938, pp. 1093-1096) that there are several species of Beluga.

Greyish White Calf

This is an animal of three, perhaps four years of age. The dark pigment of the earlier stages is beginning to disappear. Locally, it is called "Blanchon" or "Blafard" because of the pale grey or whitish colour. The flippers are still dark, particularly at the tips (Fig. 32).

The flippers recurve slightly at the tips (Valdykov, 1943). The observations of Degerboel & Nielsen (1930) would indicate that, at this age, the Beluga have almost all of their teeth. The greyish white stage marks the beginning of sexual maturity for the female, but it is doubtful that the male has reached maturity yet. The male and the female average 123½ inches (314 cm) and 126 inches (320 cm) in length, respectively. The usual length of animals of both sexes is 10 to 11 feet (Tables XVI and XVII).

The greyish white calves often form herds and remain apart from the older animals. Because they mill around close to the boat and are very watchful, they are called a "school of inquisitive observers".

TABLE XVI.- Data on the male greyish white calves caught in 1938 and 1939.

NO.	LENGTH				STATE OF SEXUAL MATURITY
	ft.		in.	cm.	
47a	9	and	3	282	young
113	9	"	5½	288	young
19	9	"	9	297	young
141	10	"	2	310	young
36	10	"	2	310	young
39	10	"	2½	311	young
21	10	"	3½	314	young
139	10	"	9	328	young
92	10	"	10	330	young
134	11	"	0	335	young
63	11	"	4	345	adult?

TABLE XVII.- Data on the female greyish white calves caught in 1938 and 1939.

NO.	LENGTH				STATE OF SEXUAL MATURITY
	ft.		in.	cm.	
146	9	and	6½	291	young
112	9	"	11	302	young
137	9	"	11½	304	young
105	10	"	1	307	virgin
143	10	"	1	307	virgin
71	10	"	2	310	virgin
305	10	"	3	312	nursing mother
49	10	"	4	315	virgin
145	10	"	5	318	nursing mother
99	10	"	6	320	pregnant
101	10	"	7	323	pregnant
106	10	"	8	325	pregnant
128	10	"	8	325	pregnant
93	10	"	10	330	pregnant
138	10	"	10	330	pregnant
84	10	"	11	333	pregnant
108	10	"	11	333	pregnant
311	10	"	11	333	pregnant
48	11	"	1	338	pregnant
87	11	"	3	343	nursing mother

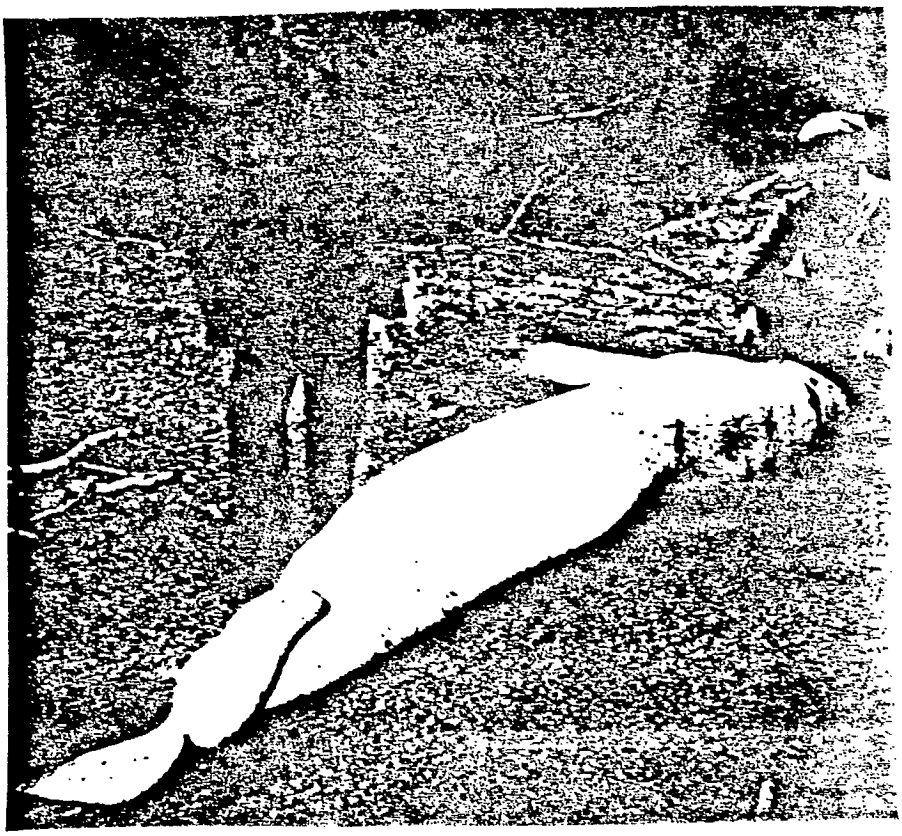


Fig. 33.- Dorsal view of an 11-foot 8-inch female Beluga caught on October 25th, 1939, at Rivière-Ouelle. This specimen is as thin as the one in Fig. 42.

White Adult

This is an adult Beluga at least four years old and completely milk white. The youngest animals in this category still have traces of dark grey pigmentation at the tips of the flippers.

This group comprises animals of different ages. For the time being, animals with dark-tipped flippers will be classified as a separate younger group, probably about 4 years old. On average, lengths of the male and female in this group are 11 feet 9 inches (358 cm.) and 11 feet 6 inches (351 cm.) respectively.

TABLE XVIII.- Estimated ages of the Beluga caught in 1938 and 1939.

AGE	NAME USED LOCALLY	Males, LENGTH				Females, LENGTH			
		NO.	MIN.-MAX.	AVERAGE		NO.	MIN.-MAX.	AVERAGE	
			in.	in.	cm.		in.	in.	cm.
I	Newborn calf ("Veau")	6	62-79	68	173	8	61-80	71	180
II	Blue calf ("Bleuvet")	8	89-104	97½	248	11	87-111	96½	245
III	Greyish white calf ("Blanchon")	11	111-136	123½	314	20	115-135	126	320
IV	White adult ("Blanc")	13	130-151	141	358	34	130-149	138	351
V	White adult ("Blanc")	46	150-176	164	417	3	151-161	157	399

Animals without the dark edges on the flippers and with badly worn teeth, will be considered to be five to seven years old (Table XVIII). In addition, the males in this age group have flippers that are sharply recurved at the top. The author does not have specific information on the lifespan of the Beluga; however, the much greater size that the male attains is an indication that it lives longer than the female.

Sleptzov (1940) believes that the Dolphin (Delphinus delphis) lives 18 or 20 years. This author gives some interesting details on the female Dolphin's age, based on the number of gestation scars of the corpora lutea on the ovaries. For example, if the ovary has only one scar, the female is 4 years old: 3 years to sexual maturity plus one year of gestation and nursing (1). Generally speaking, the relationship between the number of scars and the age of the female Dolphin is as follows:

Number of scars	1	2	3	4	5	6	7	8	9	10	11	12
Age (years).....	4	5	6	8	9	10	11	13	14	15	16	18

Growth

The graphical representation by groups of length (Fig. 34) of material collected in 1938, reveals some interesting points. Because there are so few young animals, the distinction between their various ages is not very clear. Among the adults, however, observations indicate there are more females than males approximately 4 years old in the 130-inch to 149-inch range. Males are more numerous in the 160- to 169-inch group which is

(1) Additional information on the sexual cycle of the Dolphin is given on page 108 of this work.

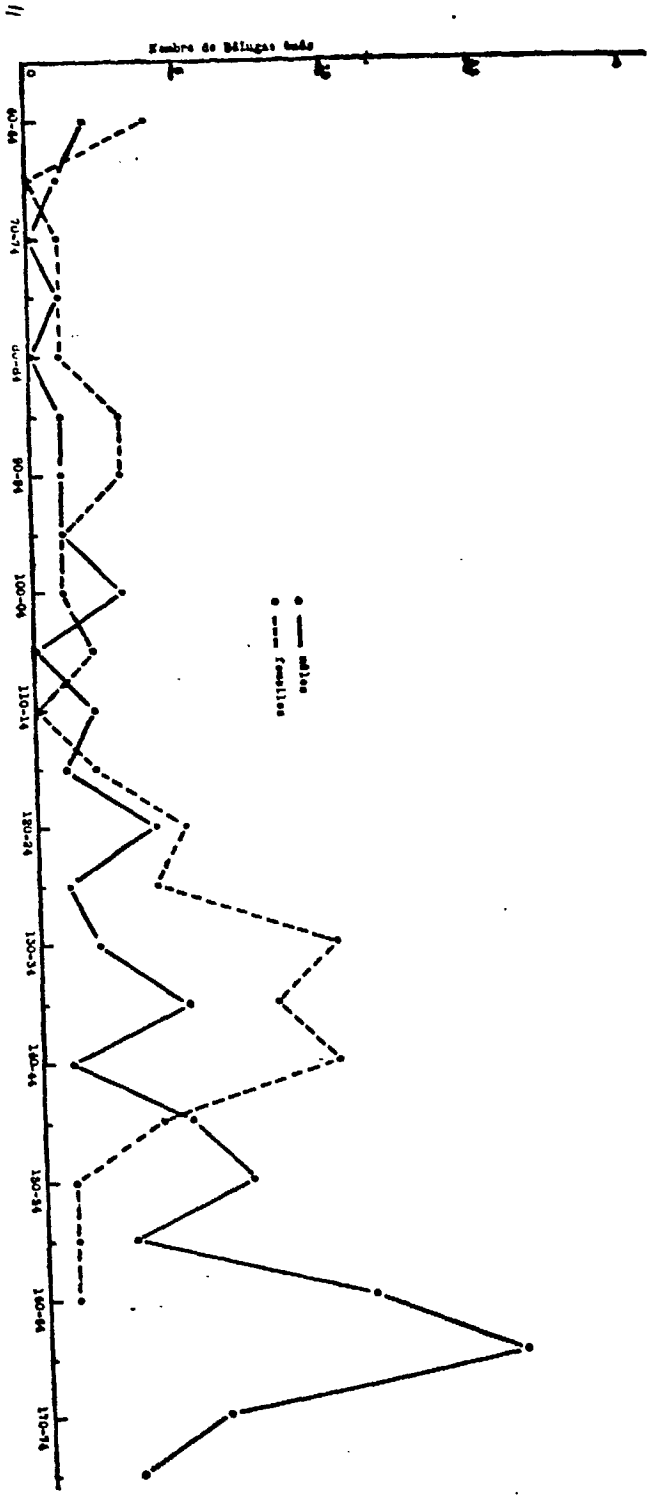
probably five or perhaps six years old.

Although the precise growth rate of the St. Lawrence Beluga is not yet known, we shall endeavour to provide some details on this subject. A graphical presentation (Figs. 35 and 37) of the average lengths of different categories of Beluga gives quite an accurate picture of the growth rate from one year to the next. The data can also be arranged differently by assigning 100 as the average length of calves of both sexes and using this base to calculate the size in the other groups (Fig. 36) as was done by Douhovny (1933).

The first method gives the direct relationship and the second, a ratio. It is interesting to note that the average size of Beluga in the different categories is almost the same for the Beluga of the Gulf of Ob (Douhovny, 1933) as for those of the St. Lawrence. For example, the relative lengths (length of the calf always equal to 100) of the male blue calves of the Gulf of Ob and the St. Lawrence River are 139% and 143% respectively, and the relative lengths of the greyish white calves are 185% and 182%, respectively.

For the St. Lawrence Beluga, the absolute average lengths and the relative lengths, expressed as a percentage, are as follows:

No. of Beluga killed



males

females

Fig. 34.- Beluga caught on the Manicouagan Bank in 1938, divided into groups according to length, at 5-inch intervals.

CATEGORY	LENGTH (Males)			LENGTH (Females)		
	Number	in.	%	Number	in.	%
Newborn calf	6	68	100	8	71	100
Blue calf	8	97½	143	11	96½	136
Greyish white calf	11	123½	182	20	126	178
White adult	13	141	205	34	138	195
White adult (older)	46	164	240	3	157	211

The average length of the newborn St. Lawrence calf is approximately 59 inches or 150 cm. The annual increase in average length for the various Beluga groups is as follows:

AGE (years)	CATEGORY	MALES (in.)	FEMALES (in.)
I	Newborn calf	9	12
II	Blue calf	29	25
III	Greyish white calf	26	30
IV	White adult	18	12

For the first three years, Beluga of both sexes are more or less the same size, the greyish white females being perhaps slightly larger than the males. After the fourth year, the female's growth slows down somewhat, whereas the male continues to grow (Table XVIII). Degerboel & Nielsen (1930) estimated the annual growth of the Greenland Beluga during the first two years to be approximately 40 inches, slowing down gradually in the later years.

DISTINCTION BETWEEN MALE AND FEMALE

The sex of a Beluga can already be determined from a four-inch or longer foetus. Differences in the structure of the genitals help to distinguish the sex of the embryo and the young animal, whereas several other characteristics distinguish the adult sexes.

Primary Sexual Dimorphism

Pallas (1794, p. 196) gives the following description of Beluga of both sexes:

"Clearly visible on the abdomen of the female is the opening of the reproductive organ which is adjacent to two teats similar to a cow's udder. They are filled with a white milk... The male has a penis three spans long; it is the size of a man's arm and is pointed at the apex, like a bull, and has no bone or cartilage".

Female.- The main distinction between the sexes is that in the female, the genital orifice and the anus are in the same cavity, opening to the exterior through a rather long groove. The different organs in this cavity converge in the following order: the vagina, with the clitoris, is at the front; the urethra opening is directly behind the clitoris and the anus behind that. There is a mammary gland on either side of the groove on the back third of the body (Figs. 40 and 41). The teats of the nursing female protrude, whereas inactive mammary glands are completely hidden in the mammary groove. Watson & Young (1880, pp. 429-433) have given detailed anatomical data on the reproductive organs of the female Beluga.

Male.- When the penis is drawn back into the genital groove, the best way to distinguish a male is to determine the position of the anus. It is always some distance behind the genital groove (Fig. 40). There are a pair of rudimentary mammary glands immediately in front of the anus (Figs. 38 and 41).

Barclay & Neill (1821, p. 384) describe the genitals of a 13-foot 4-inch male Beluga:

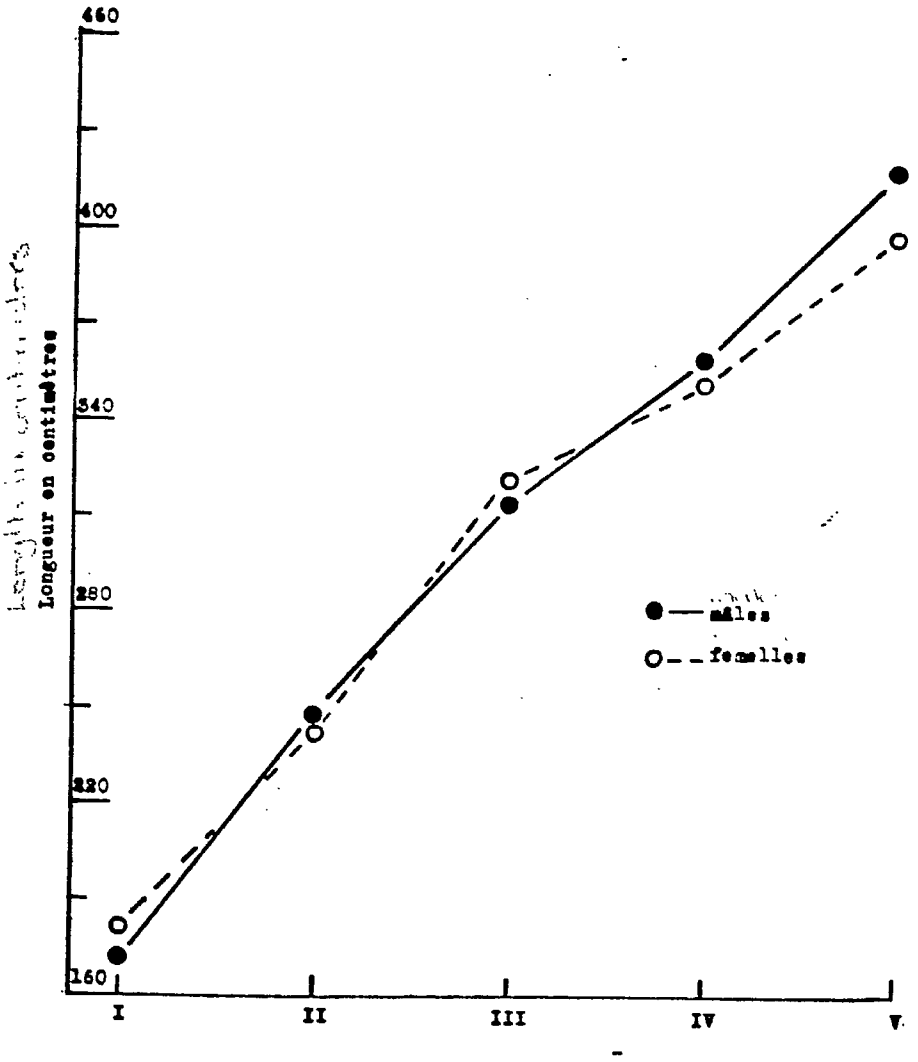
"The testicles we found within the abdomen, of an oblong shape, and lying close by the sides of the intestine, near its extremity. They were 4 inches in length, and the same in circumference. The penis was conical; at the apex 1½ inch in circumference, but 4 in circumference towards the base, near to which it exhibited a sigmoid flexure, owing to two very powerful muscles that seemed to have performed the office of retractors. Through its whole extent it was soft and flexible, without either a bone or a cartilage" (Fig. 40).

The distance between the anus and genital groove in the male Beluga, expressed as a percentage of the animal's total length, varies from 4.6 to 12.3 (Barclay & Neill, 1821, p. 375; Wyman, 1863, p. 605; Arsenyev, 1936, pp. 134-135).

Length in centimeters

males

females



Age in years

Fig. 35.- Estimates of the annual growth of Beluga caught in the St. Lawrence River in 1938 and 1939.

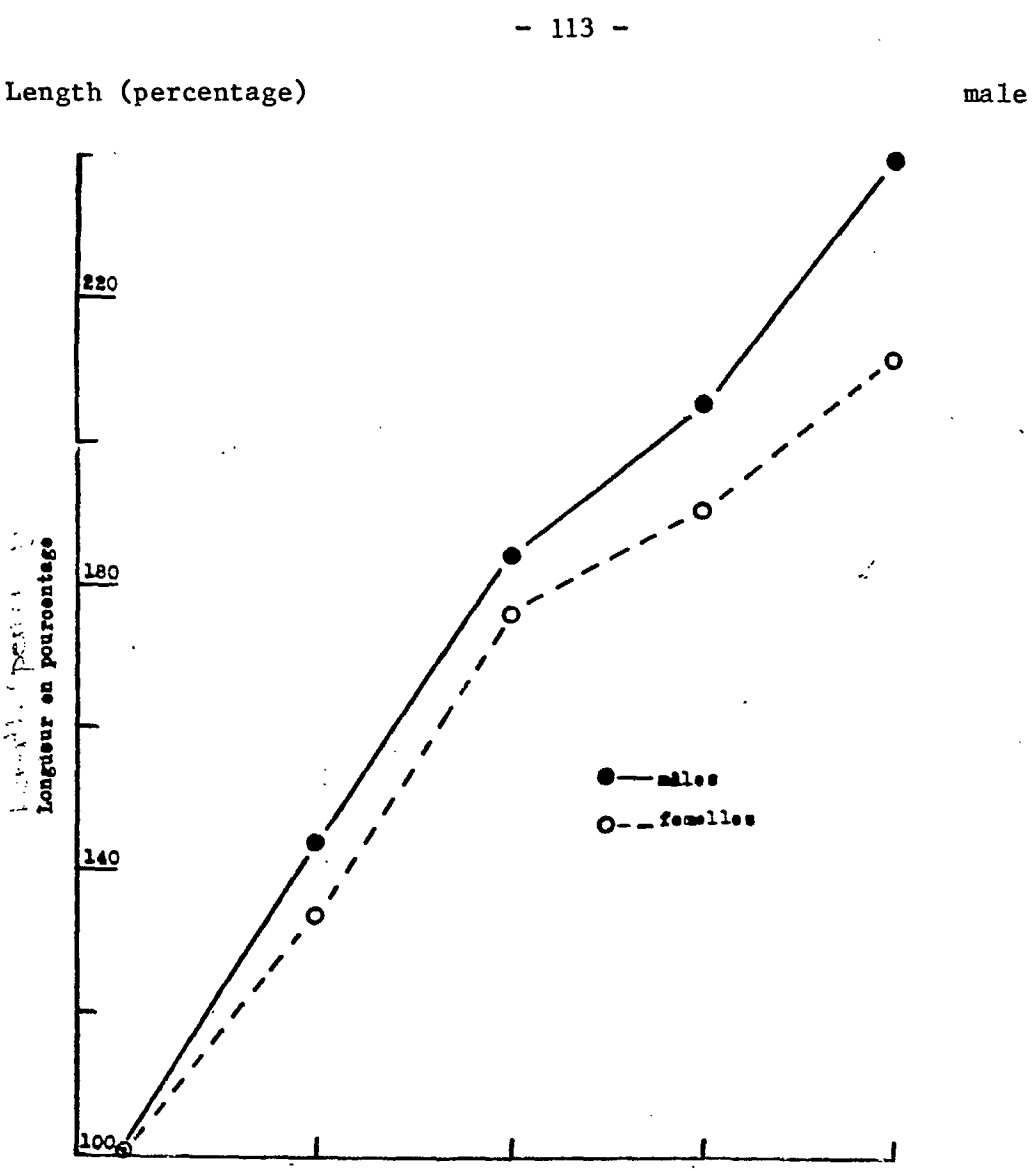


Fig. 36.- Growth in length, with age, of the St. Lawrence River Beluga. The average length of the newborn calf of each sex is considered as being equal to 100 and the size of the other groups is calculated on this base.

Secondary Sexual Dimorphism

The sex of Beluga can be determined by other external characteristics in addition to genital structure.

TABLE XIX.- Comparison of the breadth of the tail in males and females of corresponding size.

NO.	SEX	TOTAL LENGTH OF THE BELUGA			TAIL
		ft.	in.	cm.	cm.
47	♂	5 and	2	158	37
117	♀	5 "	3	160	35
130	♂	6 "	4	193	46.5
73	♀	6 "	6½	199	48.5
32	♂	7 "	5	226	55.5
104	♀	7 "	4	224	53
13	♂	8 "	7	262	59
331	♀	8 "	7	262	60
113	♂	9 "	5½	288	76
146	♀	9 "	6½	291	70
92	♂	10 "	10	330	82
72	♀	10 "	10	330	96
134	♂	11 "	0	335	98
58	♀	11 "	0	335	90.5
33	♂	12 "	5	379	100
129	♀	12 "	5	379	86
8	♂	13 "	2	401	112
103	♀	13 "	2	401	89
136	♂	14 "	8	447	112
79	♂	14 "	8	447	113
94	♂	14 "	8	447	118
115	♂	14 "	5½	411	134

Size.- Several recent authors (Degerboel & Nielsen, 1930; Douhovny, 1933; Birula, 1934 and others) have established that the male Beluga is the larger animal. We noted that this was also the case with St. Lawrence Beluga: in fact, our biggest female (No. 70) was only 13 feet 5 inches long (409 cm), and the largest male was 14 feet 8 inches (447 cm). This difference between the sexes is even more pronounced in Greenland Beluga where according to Degerboel & Nielsen (1930, p. 143), the maximum size of the female is 15 feet 7 inches (474 cm) and the male, 18 feet 9 inches (572 cm). Being larger, the male consequently weighs more than the female and also has thicker skin and a thicker layer of blubber.

Body proportions.- According to hunters (H. Chouinard), the head of the male is longer and flatter than the female's, which is short and more bulbous in shape. Our own observations were that, in the male, the distance from the snout to the eye and from the snout to the blowhole is slightly greater than in the female (Table XII).

The size of the fins, however, gives the best indication of the sex of the animal. The tail breadth of young Beluga of both sexes is more or less the same. In the adults, however, there is a very distinct difference: it is easy for an experienced St. Lawrence hunter to distinguish males from females even in the water, by the size of their tails. The tail of the adult male is wider in direct (Table XIX and Figs. 43 and 44) as well as in indirect relation to that of the female (Table XIII). The maximum width of the tail of the St. Lawrence Beluga is 38 inches (96 cm) for the female (No. 72) and 53 inches (134 cm) for the male (No. 115).

The width and length of the flippers are also greater in the adult male than in the female. This difference may sometimes be concealed in the male by an upward curve at the tips of the fins. This curious phenomenon was not described until recently (Vladykov, 1943), although Quebec whalers are well aware of it: they have no difficulty distinguishing the male from the female, even when they are swimming. These whalers also use the recurved flippers as "handles" to pull out of the water old males that have been killed (Figs. 21 and 22).

Although there is no published data on the subject, we know that the curvature of male Beluga flippers is not limited to the animals in the St. Lawrence. In fact, W.E. Swaffield, of the Hudson's Bay Company mentioned seeing this phenomenon often in the Canadian Arctic. Although Chapsky (1937, p. 50) makes no mention of it, photo No. 7 of his article clearly shows that the flippers of Beluga in the Gulf of Ob in Siberia curve upward.

Comparative Numerical Proportions of Males to Females

During the 1938 and 1939 seasons, we studied 162 young and adult Beluga: 54.5 per cent were males, 45.5 per cent, females. However, in the 1939 season only, when only 22 animals were killed, the ratios were different: 36.5 per cent were males and 63.5 per cent,females (Table I).

The large number of males killed in 1938 on the Manicouagan Bank was due, no doubt, to the way in which they were hunted: males are much easier to overtake when pursued by motorboats. It is interesting to note that, of the 169 Beluga caught in Greenland during the winters

of 1925-26 and 1926-27 (1), 55 per cent were males (Degerboel & Nielsen, 1930), whereas in 1931, in the Gulf of Ob, of the 159 Beluga that were caught with a net, only 40 per cent were males (Douhovny, 1933).

In 1938, of the 14 foetuses removed that would have been calves the following year, the numerical proportions were quite remarkable: 11 males (or 79 per cent), 3 females. On the other hand, among the newborn calves, that is, animals born in the spring of 1938, the sexes were almost equally represented: 4 males and 5 females. In 1939, 2 of three foetuses were males and the 1, female. Thus, during these two seasons, the proportion of male foetuses was much higher than female foetuses (Table XX). Does this data indicate that the proportion of male or female newborn calves varies from year to year? Is there a possibility that females of difference ages (younger or older ?) may carry more male rather than female embryos?

(1) In Greenland (Degerboel & Nielsen, 1930), motorboats are used to force the Beluga herds to enter the fjords where they are left captive at low tide. The hunting method used in this region is therefore similar to that used in Quebec; the animals that can swim the fastest (females) have the best chance of escaping, hence a greater proportion of males are left captive.

Average length in inches

Male

Female

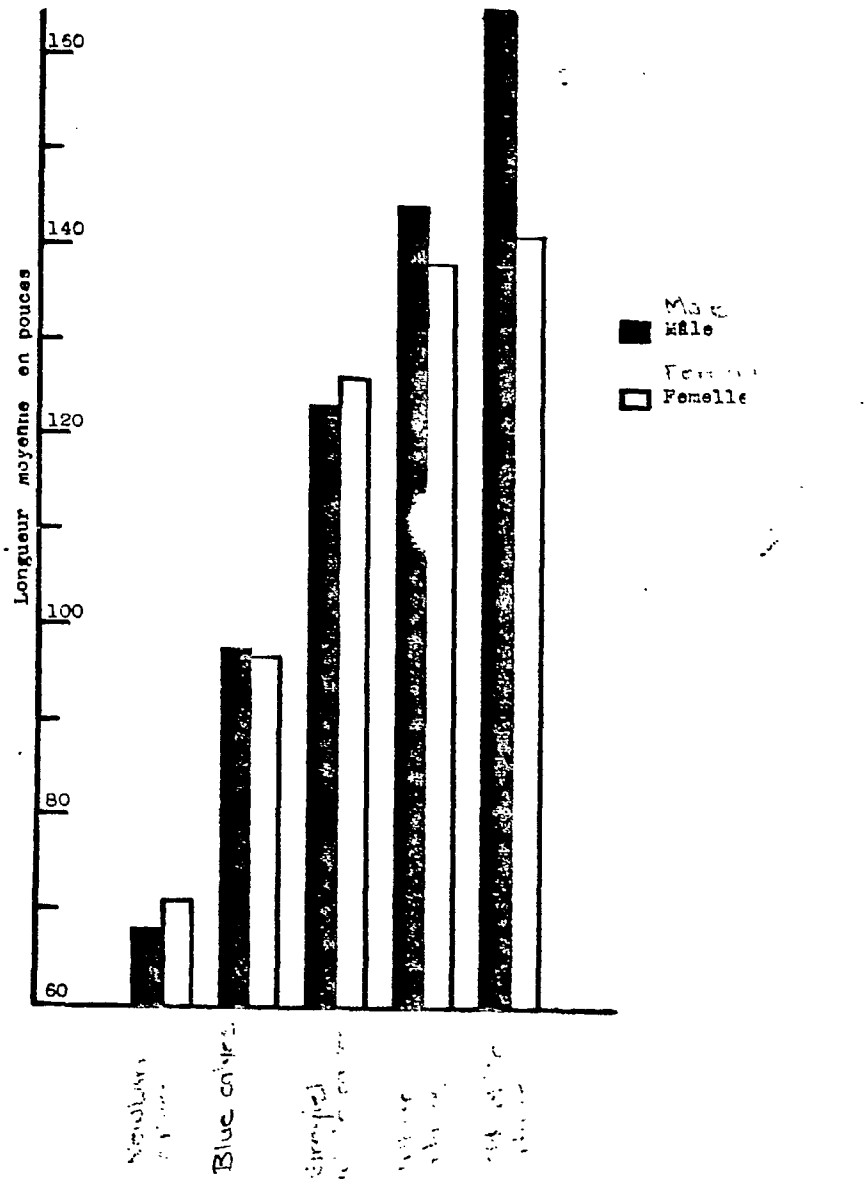


Fig. 37.- Comparison of the average lengths of male and female Beluga of different categories, caught in the St. Lawrence River in 1938 and 1939.

Besides the 17 foetuses available to us, four females with their calves were caught in the summer of 1938. The classification of these foetuses and calves into different categories according to the length of their mothers yields some interesting results:

LENGTH OF MOTHER (cm)	MALE		FEMALE	
	Foetus	Newborn calf	Foetus	Newborn calf
320-24	2	-	-	-
325-29	1	-	1	-
330-34	2	-	3	-
335-39	2	-	-	-
340-49	2	-	-	2
350-59	2	-	-	-
360-69	1	2	-	-
370-79	1	-	-	-
TOTAL	13	2	4	2

According to the above table, the female foetuses were removed from Beluga 325 to 334 cm in length, whereas the male foetuses were found in animals that varied considerably more in length: 320 to 379 cm. The Beluga in the 330-334 cm class however, were carrying mainly female foetuses. In 1938, the female newborn calves were accompanying mothers that were between 343 and 345 cm. long.

Although so far, no explanation has been found, it would appear that Beluga measuring approximately 10 feet 10 inches bore female rather than male young.

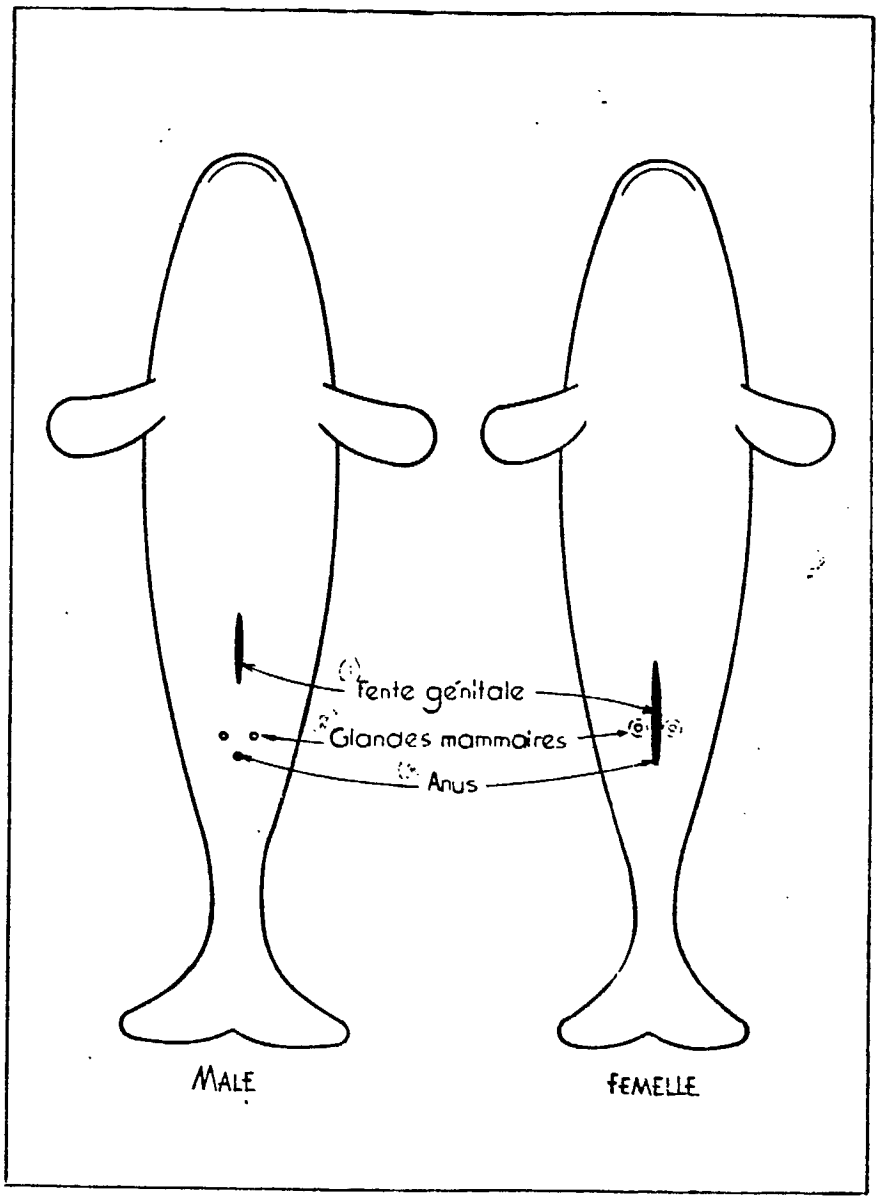
TABLE XX.- Data on the foetuses of Beluga caught in 1938 and 1939.

MOTHER				FOETUS			PROBABLE MATING DATE
DATE CAUGHT	NO.	LENGTH in.	LENGTH cm.	SEX	LENGTH mm.	AGE days	
21. VI.39	300	132½	337	♂	1,490	356	29. V.38
4. VII.39	308	138	351	♂	139	69	26. IV.39
8. VII.38	25	135	343	♂	113	63	7. V.38
15. VII.39	311	131	333	♀	131	66	10. V.39
27. VII.38	48	133	338	♂	218	86	2. V.38
19.VIII.38	84	131	333	♀	149	71	9. VI.38
19.VIII.38	82	140½	357	♂	332	110	1. V.38
25.VIII.38	93	130	330	♂	317	106	11. V.38
30.VIII.38	99	126	320	♂	284	100	22. V.38
30.VIII.38	101	127	323	♂	310	124	28. IV.38
31.VIII.38	106	128	325	♂	307	104	19. V.38
31.VIII.38	108	131	333	♂	318	107	16. V.38
31.VIII.38	102	143	363	♂	378	120	3. V.38
8. IX.38	121	149	379	♂	370	118	13. V.38
9. IX.38	127	137	348	♂	338	112	20. V.38
10. IX.38	128	128	325	♀	205	83	19. VI.38
12. IX.38	138	130	330	♀	384	121	14. V.38

(1) Genital Vent

(2) Mammary Glands

(3) Anus



Male Female

Fig. 38.- Sketch of the ventral side, showing the distinction between male and female Beluga.

REPRODUCTION

A detailed knowledge of Beluga reproduction can be of great help in controlling the population density of these animals in the St. Lawrence River.

TABLE XXI.- Growth in length of the human foetus

LUNAR MONTHS	LENGTH NOTED (Arey, 1940)	Calculated Length (1)	
		$\frac{L-1}{212}$	$\frac{L-1'}{184}$
	mm	mm	mm
1	2.5	14	31
2	30	30	62
3	98	92	98
4	180	154	160
5	250	216	222
6	315	278	284
7	370	340	346
8	425	412	408
9	470	474	470
Birth (268 days)	500	509	505

(1) Explanation of formulae: L - length observed at birth (500 mm); 1 - Length at the 56th day (30 mm); 1' - length at the 84th day (98 mm); 212 - difference between the 268th and 56th days; 184 - difference between the 268th and 84th days. Gestation lasts 268 days, i.e. 9 lunar months and 16 days (Arey, 1940).

Maturity of the Males

We have no specific information on the sexual maturity of Beluga males in this region. The development of secondary sexual characteristics, however, can serve as an indicator. An increase in the breadth of the tail in the male is no doubt a sign of approaching sexual maturity (1), which probably occurs when the St. Lawrence Beluga reaches a size slightly longer than 11 feet (350 cm).

As a general rule, the maturity of a male Cetacean is determined by looking for an increase in the size of the testicles or by taking a smear of the testicles or the epididymis to see if there are spermatozoa present (Mackintosh & Wheeler, 1929; Matthews, 1938, etc.).

Maturity of the Females

It is much easier to determine the state of sexual maturity of the female: of primary consideration is the presence of corpora lutea, the condition of the mammary glands, etc.

Female Beluga can be divided into four groups (Fig. 45), according to stage of sexual development:

1.- **Young.**- Animals less than 10 feet long, whose ovaries and mammary glands are not completely developed. This group consists mainly of newborn and blue calves which, without any doubt, cannot be impregnated.

(1) Data on the ratio of tail breadth to body length of Beluga of different sizes can be found in an earlier publication (Vladykov, 1943).

2.- **Virgins.**- These are greyish white calves which have probably just reached sexual maturity; that is to say, animals whose ovaries are completely developed but which have not yet been inseminated. It is quite possible, however, that the virgin specimens were actually young females. This latter hypothesis is supported by the fact that only four virgin females (Nos. 49, 71, 105 and 143) were caught in 1938 and 1939 and that their lengths varied little: 10 feet 1 inch to 10 feet 4 inches. The virgin female is therefore in an intermediate stage between youth and full sexual maturity. In this study, these Beluga will be classified as adult females.

3.- **Pregnant Females.**- These are gestating females (in a first or subsequent pregnancy); they therefore have a large corpus luteum and although the mammary glands have started to enlarge, they do not as yet contain milk.

4.- **Nursing Mothers.**- These are females that are suckling their young, i.e., females with very large mammary glands generally filled with milk; they are accompanied by their calves.

The youngest gestating females were greyish white calves (Nos. 99, 101, 106 and 128), 10 feet 6 inches to 10 feet 8 inches long. The smallest nursing female (No. 305) was a 10-foot 3-inch greyish white calf that was caught on June 28, 1939. This Beluga's mammary glands were swollen with white milk and she was accompanied by her calf. When this animal was inseminated the previous year, she must have been less than 10 feet long and can thus be considered the youngest adult female of our specimens.

Another young nursing mother (No. 145), caught on September 24, 1938, was 10 feet, 5 inches long. Her milk, however, was yellow rather than white. Furthermore, there was no information on the presence of a corpus luteum and thus the exact state of maturity of this specimen is open to question.

The three categories of adult females caught in 1938 and 1939 were divided into groups, according to length, as follows:

LENGTH in.	NUMBER OF FEMALES			
	VIRGINS	PREGNANT FEMALES	NURSING MOTHERS	TOTAL
120-24	4	-	1	5
125-29	-	4	1	5
130-39	-	10	15	25
140-49	-	3	13	16
150-59	-	-	2	2
160-64	-	-	1	1
TOTAL	4	17	33	54

The largest nursing mother (No. 70) was caught on August 4, 1938 and was 13 feet, 5 inches long. The largest pregnant female (No. 121) was only 12 feet 5 inches long.

The numerical relationship between virgins, pregnant females and nursing mothers can be expressed as follows: 1:4:8. Among the adult females (including virgins), there was a very high percentage of nursing mothers (61%). Even when the total number of females, young and adult, caught in 1938 and 1939 is considered, the percentage of nursing mothers is still high (43%).

Pregnancy

The exact length of the gestation of the Beluga is not known. Heptner (1930, pp. 36-40), for example, fixed it at 11 or 12 months. We believe that in the case of the St. Lawrence Beluga, pregnancy lasts 12 months, for the same reasons as Risting (1928, pp. 92-94) gave for large whales. As a matter of fact, if the gestation period were much longer, 14 to 15 months, for example, very small embryos and very well developed ones would be found at a certain time of year: such is not the case. The assumption that pregnancy lasts much less than twelve months (9 or 10 months) is also inconsistent with the facts. Indeed, the data for the St. Lawrence (Table XX and Fig. 46) indicates that the smallest foetuses were found in

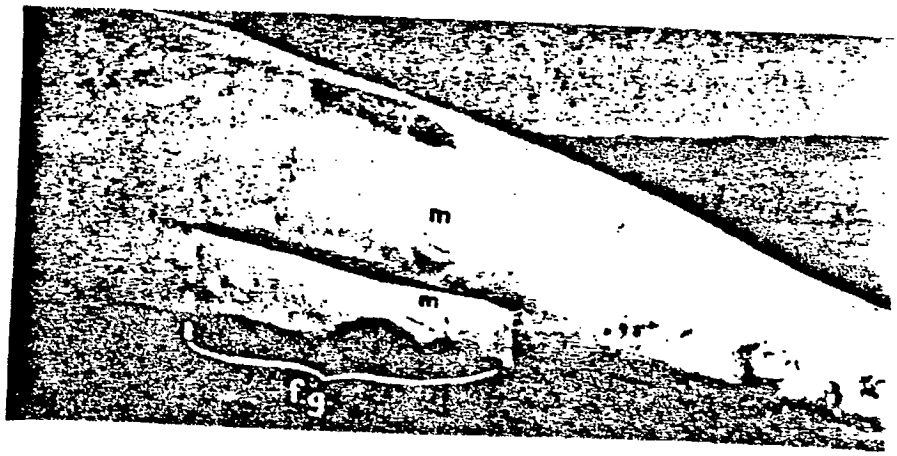


Fig. 39.- Abdominal view of a nursing female. There is no separation between the genital vent (f.g.) and the anus; the mammary glands are swollen with milk and the nipples (m) are visible.

July (1), and that they grow during the rest of the year until full maturity is reached in the spring, in May and June.

Degerboel & Nielsen (1930, p. 143) found that, in the Greenland region, the Beluga foetus "increases in length from November to April, consequently by far most of the young are born at about this latter month, most probably in March-May".

It is still not known definitely if the female Beluga produces young every year. Degerboel & Nielsen (1930, p. 143) noted that: "as a rule only one young at a time is born every second or most likely only every third year". Hunters along the St. Lawrence River seem to think that Beluga produce young every year, without taking a rest. They say that they often kill pregnant females that are accompanied by calves that sometimes are of different ages.

Among our specimens there were two interesting cases. Female No. 138, 10 feet 10 inches long, caught on September 12, 1938, was carrying a 15-inch (384 mm) foetus and was accompanied by a calf. Unfortunately, there was no information on the condition of her mammary glands. Another female Beluga, caught on July 4, 1939, 11 feet 6 inches long (No. 308), was carrying a 5½-inch (139 mm) foetus approximately 70 days old. Her mammary glands were swollen with white milk and she was accompanied by her calf. Hence, in certain cases, the St. Lawrence Beluga can bear young at least two years in succession.

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(1) Honoré Chouinard, of Pointe-Lebel, told us that towards the end of October, 1941, he had killed two pregnant female Beluga, one carrying a 17-inch foetus and the other a 20-inch one.

According to Sleptzov (1940), the gestation period of the Delphinus delphis is eleven months, the females reach sexual maturity at three years of age. Then they give birth every year for at least three years in succession, with barely two months' rest after each birth. During the third year of reproduction, calving therefore will take place in late autumn when the male has no active spermatozoa. Thus, a female in her fourth year of reproduction cannot be impregnated until eight or nine months after the last (third) time she gave birth.

In the female Delphinus delphis, ovulation occurs once a year, during the estrus period, and only one corpus luteum is formed. Impregnation takes place immediately after ovulation and thus the corpus luteum resulting from ovulation becomes the very large corpus luteum associated with pregnancy. The maximum number of scars in the corpus luteum of pregnancy is twelve, which corresponds to twelve years of reproduction (Sleptzov, 1940).

Fig. 40. - Ventral view of an adult male Beluga. The anus is well separated from the genital vent; a one-foot ruler indicates the distance between the base of the penis and the rudimentary mammary glands (g.m.) situated a little in front of the anus (a).

In the D. delphis, the corpora lutea scars associated with pregnancy are scattered about over the entire surface of the ovary. On the contrary, according to Nikolsky (1936), the scars in Beluga are located mainly at either end or in the middle of the ovaries(1).

Determination of the Age of the Foetus

Knowledge of the age of embryos facilitates the understanding of several important phenomena in the biology of the Beluga.

Guldberg (1886) was the first to try to determine the age of the foetuses of the large Cetaceans. A more accurate method was developed by Barrett-Hamilton & Hinton (1925), and particularly by Risting (1928). Their method was used successfully for the species belonging to the genera Balaenoptera (Mackintosh & Wheeler, 1929); Zenkovic, 1935; Matthews, 1938), Megaptera (Matthews, 1937) and Physeter (Matthews, 1938).

This procedure is based on the following assumptions:

1.- that the period of pregnancy in the Balaenoptera is twelve months (360 days), and that the foetus develops more slowly during the first stage of its embryonic life than it does in the final stage;

2.- that when it is born, the foetus is of a well-determined length which, naturally, varies with the species;

3.- that the age at which the foetus' sex can be determined is considered to be 60 days, and its length, 4 inches (10 cm);

4.- that the foetus grows much more rapidly during the next 30 days, and by the 90th day, reaches a certain length characteristic

(1) Unfortunately, the author was unable to consult the original version of Nikolsky's work (1936), and thus this observation is taken from Sleptzov's publication (1940, p. 46).

of each species;

5.- that after the 90th day ,the foetus grows at a uniform rate: its daily increase in size is $\frac{L-l}{270}$ where L is the length of the foetus at birth, l, its length on the 90th day, and 270 is the number of days from the 90th until birth.

The following are a few L and l values taken from Risting (1928) for certain species of Balaenoptera of the Northern Hemisphere (these values are higher in the Southern Hemisphere because the animals are larger):

SPECIES	l		L	
	cm.	in.	cm.	in.
B. borealis	30	11.8	480	189
B. physalis	40	15.8	600	236
B. musculus	50	19.7	800	315

This method implies certain approximations, such as the establishment of the 60th and 90th days as the dates when the growth rate changes and the 90th as the date after which growth is uniform. Nevertheless, this method is fairly accurate and generally gives good practical results.

In order to confirm its accuracy, we applied this method to data collected by Arey (1940, pp. 129-131) on human foetus growth, where the exact period of gestation and the monthly increase in the size of the embryo are known (Table XXI). The case of the human foetus clearly shows that the daily rate of growth of the foetus as it develops should not be assumed to be uniform. This assumption however, is necessary for practical purposes, at least for one or

another period arbitrarily chosen. Taking all of these remarks into consideration, one can see that although the method used is rather contrived, the final results agree in the main with the facts (Table XXI).

The data on the 14 Beluga foetuses in 1938 and the 3 in 1939, available for this study are given in Table XX. Unfortunately, this limited number of animals made it impossible for us to determine the probable differences in size between the male and female embryos at birth. For the same reason, a causal relationship between the age of the female and the size of her offspring could not be established.

In calculating the age of the foetuses, independent of sex, we took the length at birth (L) to be 150 cm. for the St. Lawrence region and 160 cm. for the Greenland region where the Beluga are generally larger (Degerboel & Nielsen, 1930). The length of the foetus on the 60th day (1) is set at 10 cm., i.e., it is assumed that the daily rate of growth during the first two months is 1.7 mm. Gestation lasts approximately 360 days; thus, the growth during the last ten months, for all practical purposes, is considered to be uniform and equal to 4.7 mm. per day. In other words, the formula used is $\frac{L-1}{300}$. No account has been taken of the probable variations in the rate of growth between the 60th and 90th days in the life of the embryo, as was done with the large Cetaceans (Hinton, 1925; Risting, 1928).

TABLE XXII. - Probable frequency of mating in Beluga in different months of the year.

MONTH	ST. LAWRENCE 1938-39		GREENLAND 1925-27	
	NUMBER	%	NUMBER	%
February	-	-	1	0.8
March	-	-	1	0.8
April	1	6.3	19	14.6
May	13	81.2	73	56.0
June	2	12.5	23	17.7
July	-	-	10	7.7
August	-	-	3	2.4
Total	16	100.0	130	100.0

Rutting Season

Knowledge of the age of the foetus makes it possible to calculate the probable copulation or impregnation date (Hinton, 1925; Risting, 1928).

Unfortunately, very little such data was obtained from the St. Lawrence specimens. Table XXII and Fig. 47 nevertheless show that spring, particularly May, is the prime mating season. The application of this approach for the Greenland region, indicates that the mating period there lasts for several months, from February to August, but that most mating occurs during May and June.

Our whalers are well acquainted with the way Beluga quarrel (squabble) during rutting season: often three or four males will pursue a female and fight among themselves (1). The whalers believe

(1) Spencer (1889, p. 79J) gives the following description of Hudson Bay Beluga mating: "Coition takes place under water. The two animals, with a noise as if they were rubbing hard against each other, rise to the water until nearly the whole body is visible, then come in sudden contact, and fall asunder. The time of mating is about the middle of June".

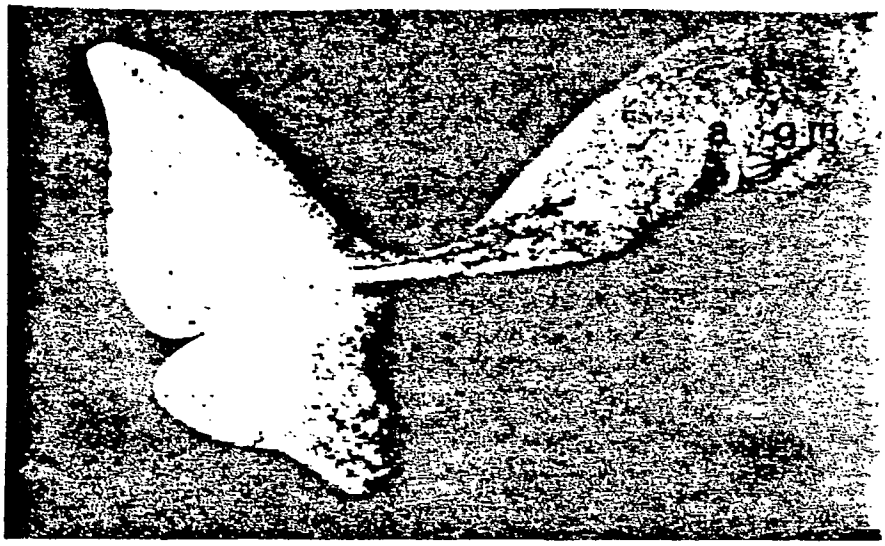

Fig. 41.- Ventral view of the posterior part of a male Beluga. A little to the front of the anus (a) there is a pair of rudimentary mammary glands (g.m.).

that Beluga mate at any time between May and September. Nevertheless, they admit that most of the squabbling occurs in May, and particularly in June. This agrees with our own conclusions: our three smallest foetuses (113-139 cm) that were two months old at the most were removed in July.

It is not known how many gestation corpora lutea appear in the female Beluga each year, but in the Dolphin Delphinus delphis there is only one (Sleptzov, 1940). In the larger whales, on the other hand, there are several corpora lutea a year, because they are polyestrous cycle animals (Mackintosh & Wheeler, 1929, p. 390; Wheeler, 1930, pp. 412-413).

Birth

If pregnancy for the Beluga lasts twelve months, the majority of births should occur in or around the months when mating is at its peak, i.e., May and June for the St. Lawrence River (Table XXIII).

The whale hunters say that along the North Shore (Les Escoumains and the Manicouagan Bank) June is the month in which the largest number of female Beluga accompanied by young sucklings are seen. Our limited number of specimens, prevented us from making any definite conclusion about this subject, but the only foetus that was fully developed and ready to be born (No. 300) was removed on June 21, 1939.

TABLE XXIII.- Monthly growth of Beluga foetuses and newborn calves.

MONTH	NUMBER OF ANIMALS	AVERAGE LENGTH		REGION
		in.	cm.	
		Foetuses		
July	4	5.9	15	St. Lawrence
August	8	11.8	30	St. Lawrence
September	4	13.0	33	St. Lawrence
October	2 (1)	19.0	48	St. Lawrence
November	22	22.4	57	Greenland (2)
December	40	34.3	87	Greenland
January	11	38.2	97	Greenland
February	19	51.2	130	Greenland
March	19	55.9	142	Greenland
April	6	58.6	149	Greenland
May	-	-	-	-
June	1	58.5	149	St. Lawrence
		Newborn calves		
July	3	61.7	157	St. Lawrence
August	1	64.0	163	St. Lawrence
September	2	74.5	189	St. Lawrence

(1) Information provided by Mr. Honoré Chouinard, of Pointe-Lebel.
(2) The Greenland data was taken from Degerboel & Nielsen (1930, p. 120).

During the summers of 1938 and 1939, young calves measuring 61 to 64 inches in length and no more than one month of age were caught between July and September. Thus, the births did not all occur in the same month but over the summer period although June and July were the peak months. According to Degerboel & Nielsen (1930), most Greenland Beluga are born in April.

There is no doubt that during normal birth the baby emerges head-first. Nevertheless, Degerboel & Nielsen (1930) state that Greenland Eskimos have occasionally seen the tail emerge first. Similarly, a female Tursiops truncatus in captivity delivered her calf tailfirst, but it was a stillborn; this abnormal birth took three hours. A series of photos on the subject was published in the American magazine "Life" (1940, pp. 28-29).

Les Escoumains hunters (Ernest and François Boulianne) have observed such abnormal tailfirst births on occasion. In these cases, the females were greatly weakened and after they had been killed it took "at least three men" to pull out the dead calf. From time to time in the St. Lawrence River, dead females are found with the tailfirst half-born calf caught by its flippers in the mother's womb.

Although no one here has yet seen the normal birth of a Beluga, it has sometimes been observed that when a female wounded by a harpoon gives birth, her calf emerges headfirst. Normal calving is very difficult to witness, probably because it happens very

quickly (1).

It is interesting to compare the length of the newborn calf of both the large whale and the Beluga with that of its mother. In the case of the large whale, such as the Balaenoptera physalis and B. musculus (Hinton, 1925), the length of the foetus at the time of birth is approximately 28% that of the adult female; and in one particular case, the proportion of B. physalis (Risting, 1928, p. 98) was found to be 31%. We found that the figure for the Greenland Beluga was approximately 41%. However, it can be even greater in some cases: for example, female No. 300, 337 cm. long, killed June 21, 1939 near Les Escoumains, was carrying a fully developed male foetus, whose length (149 cm.) was 44.3% of that of its mother.

In the summer of 1940, near Portneuf (Saguenay County), François Boulianne, an experienced hunter from Les Escoumains, killed a Beluga which he said was carrying a foetus 7 feet long (213 cm.). This length is certainly unusual; ordinarily a newborn calf is only about 5 feet or 150 cm. long.

(1) Several years ago, E. Boulianne was out hunting in June in the vicinity of Ile-Rouge: he and his companion spotted a mother Beluga surfacing. They fired at the animal but missed. She disappeared but after a few minutes the hunters found her again. She now had what must have been her new baby swimming along beside her, because the flukes of its tail were still bent downward.

Number of Calves

Generally speaking, the female's litter is one or two embryos (Heptner, 1930). In fact, in the seventeen pregnant females studied in 1938 and 1939 only one foetus per Beluga was found. St. Lawrence River females, however, are often seen accompanied by two calves. There are exceptions, though: J.-F. Moreau, a hunter from Les Escoumains, saw some time ago a mother Beluga accompanied by three calves; Degerboel & Nielsen (1930) observed triplets; Sutton and Hamilton (1932) report that a native of Hudson Bay saw seven embryos in the same mother.

In the large whales, the usual number of foetuses in a female is one. Twins have been reported, nevertheless: the most interesting cases are mentioned by Hinton (1925, p. 124) and Risting (1928, p. 113) who mention two B. physalis that had six foetuses each, and Risting (1928, p. 101) who reports a case of seven, in the B. musculus.

Lactation

We do not know the exact period of lactation, but believe that the mother nurses for at least six months: November 25, 1943 several females with sucklings were sighted near Ile-aux-Coudres. These calves did not feed rather, they always remained close to their mothers. The hunters have often noticed that young animals in their second year (blue calves) continue to accompany their mothers although it is doubtful that the

mothers still suckle them; all of the stomachs of the blue calves examined contained food other than milk.

When the female Beluga suckles her calf, she rolls to one side with one flipper out of the water; the baby comes up to nurse perpendicular to its mother who sways but does not move forward (1). The baby's feeding time for Beluga and other Cetaceans in general is short, Because of the peculiar structure of the mammary glands. These glands have reservoirs that hold the milk and are controlled by powerful muscles. Contact with the teat forces the milk to spurt out (Kellogg, 1938, pp. 661). The Beluga's milk "is plentiful and thick ressembling cow's milk if mixed with a large amount of carbonate of soda to give it an alkaline flavour" (Casgrain, 1873, p. 4).

The Beluga's milk like that of other Cetaceans must have a very high butterfat content. According to Clowes (1929, pp. 472-475) and Freund (1932, pp. 18-21), the butterfat content (2) of the milk varies from 20% to 46% in the various Cetacean species. Cow's milk contains only 3 to 5 per cent butterfat. The fact that the milk of Cetaceans is so rich in nutrients more than explains the rapid growth of their sucklings.

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(1) This description was provided by Joseph Morneau of Raguenau, Saguenay County.
(2) A detailed analysis of the milk of the large whales is given by Takata (1921), Takemura (1927) and Schmidt-Nielsen & Frog (1934).

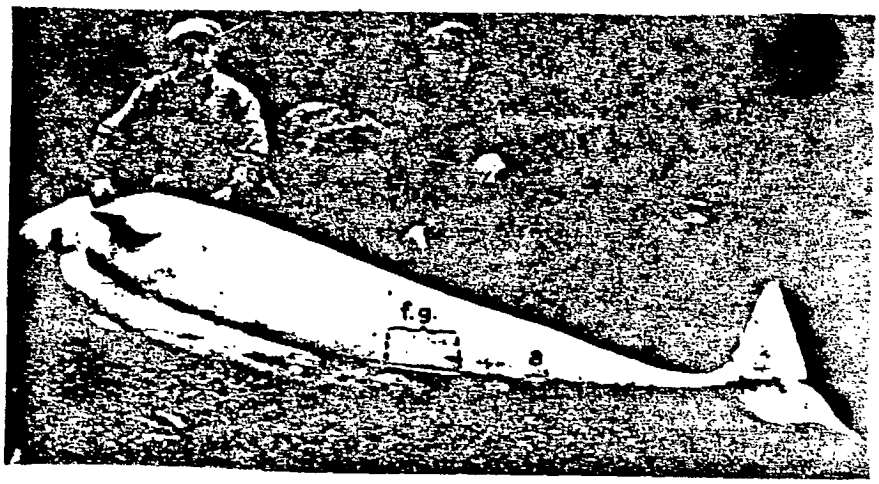


Fig. 42.- Abdominal view of a 10-foot, 9½-inch male Beluga caught on November 3, 1939 at Rivière-Ouelle. Some distance in front of the anus (a) is the genital vent (f.g.). The "scale" or epidermis of the tail and the caudal peduncle has been pecked at by birds. The flippers are beginning to recurve at the top; this specimen is very thin, in sharp contrast to the one in Fig. 22.

HABITS

Certain habits of the Beluga are of general interest, while others are important from an economic standpoint.

Food

A work soon to appear in print will focus solely on a study of the diet of the St. Lawrence Beluga. The author will merely indicate here the main conclusions reached in that study.

In the St. Lawrence River as elsewhere, the Beluga lives on fish and on other aquatic organisms. Because it is not a very fast swimmer several of the livelier fish, such as mackerel, salmon, etc., manage to get away. It does, however, eat the more sluggish fish that live the bottom of shallow waters, for example, flounder (Pseudopleuronectes americanus; Liopsetta putnami), sculpin (Myoxocephalus groenlandicus) and tomcod (Microgadus tomcod).

Small fish such as capelin (Mallotus villosus) and sand launce (Ammodytes americanus) that spawn in large numbers near the shore, are the main food of Beluga of all ages. In addition, large male Beluga also eat a certain number of Arctic cod (Gadus callarias) fingerlings and adult Greenland cod (Gadus ogac).

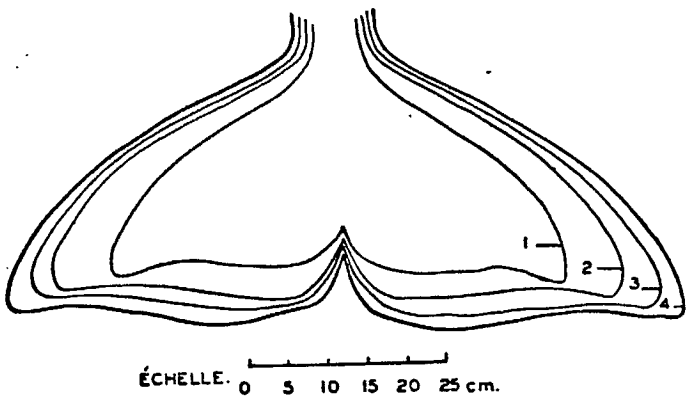
Besides the smaller fish, young Beluga devour a great many invertebrates such as shrimp, molluscs, etc. In summer Polychaete worms (Nereis) commonly known as "bloodsuckers" are the preferred diet of female Beluga. More complete information will be provided on the subject in a special study.

Parasites

Very little is known about Beluga parasites. The compilation put together by Yorke & Maplestone (1926) is the work usually referred to by later authors such as Freund (1932, p. 44), for example, and others.

According to Yorke & Maplestone (1926, pp. 170 and 273), the

nematodes Anisakis kukenthali (Cobbold), 1888, and A. simplex (Rudolphi), 1809, are found in large numbers in the stomachs of Beluga. A third nematode, the Stenurus arcticus (Cobbold), 1888, infests the bronchi and particularly the ear, near the drum (1).



Scale

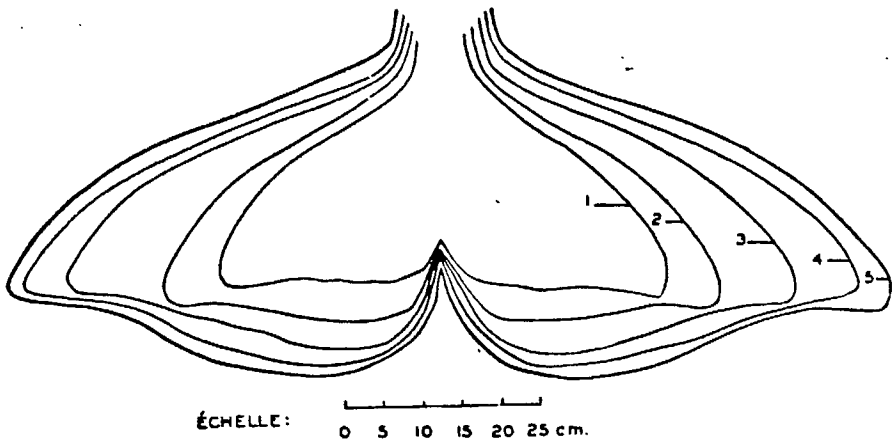
Fig. 43.- Increase in the breadth of the tail with size in the female Beluga. Life-size outlines of the tails were first traced on cardboard and then reduced. The relationships between the size of the tail and the length of the various Belugas are as follows: 1.- 58 cm, 263 cm.; 2.- 74 cm., 330 cm.; 3.- 78 cm., 338 cm.; 4.- 87 cm., 342 cm.

In the St. Lawrence River, any Beluga that, after being weaned, has begun to feed independently has parasites in its stomach. These parasites are mainly Anisakis simplex: roundworms a half-line in diameter and about three inches long. We have taken up to a gallon of them from one stomach. These worms live in the first section of the stomach where there is no actual digestion: the food is merely triturated. The author is of the opinion that these worms

(1) This is probably the same species that infests the ear cavity of the Canadian Arctic Beluga in such numbers that the natives, according to W.E. Swaffield of the Hudson's Bay Company, cut off the head and throw it away

aid the Beluga's digestion because they vigourously attack the food that has been swallowed: one often sees the head or body of a fish riddled with these worms. We also found another smaller parasitic worm in the stomach, an acanthocephalan, the Corynosoma strumosum (1). This was the first time this worm had been found in the stomach of a Beluga.

We did not notice any external parasites in the St. Lawrence Beluga, such as are often found in the large whales. Information on whale parasites is given by Baylis, 1929; Hart, 1935, Matthews, 1938 and others.



Scale

Fig. 44.- Increase in the breadth of the tail with size, in the male Beluga. Life-size outlines of the tails were first traced on cardboard and then reduced. The relationships between the size of the tail and the length of the various Beluga are as follows: 1.- 51 cm., 226 cm.; 2.- 69 cm., 282 cm.; 3.- 94 cm., 357 cm.; 4.- 108 cm., 376 cm.; 5.- 114 cm., 409 cm.

(1) Dr. Thomas W.M. Cameron, Director of the Institute of Parasitology, Macdonald College, was kind enough to identify the St. Lawrence River Beluga parasites.

Enemies

The Beluga probably has very few enemies. Among them, the most dangerous in the St. Lawrence River are the killer whale (Orcinus orca) and the Greenland shark (Somniosus microcephalus). In the Arctic, walrus (Odobenus rosmarus and O. divergens), according to Heptner (1930), occasionally pursue the Beluga.

The Greenland shark probably only attacks wounded Beluga. Whale hunters believe that the sharks eat only the lean meat of the White Whale, not the blubber.

The most dreaded enemy of the Beluga is a Cetacean known in the Province of Quebec as the "Espadon" (1) or "Epaulard" (Blackfish) (Vladykov, 1940), or in English, the "Killer whale" (Orcinus orca).

These animals grow to a length of 30 feet (the females are smaller) and are exceedingly powerful. The waters of the St. Lawrence teem with them especially in spring and fall, and the Belugas are so afraid of them that they press close to shore, losing their fear of the whalers.

Groups of five or six killer whales will chase a school of Beluga, singling out the large males in preference to any others. They kill them with their heads, usually striking them under the

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(1) When the killer whale, especially the male, swims near the surface, its high dorsal fin sticks up out of the water like a two-handed sword, or "espadon", as it is known locally. However, in France the name "Espadon" also is used for a large fish (Xiphias gladius) [swordfish]. Along the South Shore of the St. Lawrence, the Orcinus orca is called the "Epaulard", as in France.

flipper (1) with such a heavy blow that even an old Beluga weighing over 3,000 pounds is hurled into the air, three or four feet out of the water. In doing this, the killer whales shatter all the ribs of the victim which is killed on the spot. They then go for the animal with such ferocity that the surface of the water is turned into a sea of blood. As soon as a White Whale is killed, several other killer whales will draw near: as many as forty or more have been seen around an unfortunate victim (2). The hunters say that killer whales do not eat White Whale blubber, only the meat.

According to Tschirkowa & Folitarek (1930, p. 120), Russian whalers think that different species of seagulls attack Beluga on the water to peck at their epidermis ("scales"). We believe, however, that large numbers of aquatic birds circle above Beluga herds because food is present (small fish and crustaceans) and not because they mean to attack the Beluga themselves. It goes without saying that birds will attack Beluga that have been killed and hauled up on shore, as for example, the ones we saw in the fall of 1939, at Rivière-Ouelle (Fig. 42). Matthews (1938) has provided photographs of the epidermis of two specimens of the Right Whale (Eubalaena australis) which clearly show that they were pecked by birds.

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(1) The whalers also say that the Orcinus orca kills Beluga by biting them to death. At Ile-aux-Coudres, however, people think that the Orcinus orca kills the White Whale with a blow of its "sword" or dorsal fin.

(2) Comments made by Low (1906, p. 274) clearly show the voraciousness of Orcinus orca: "In the stomach of one (Killer) were found fourteen porpoises and fourteen large seals; it chocked to death swallowing the fifteenth".

Vocalization

Although none of the Cetaceans, including the Beluga, have vocal chords, there is considerable evidence that the Beluga is capable of uttering sounds. This is why it is often called the "Sea Canary" (Beddard, 1900, p. 245).

Watson & Young (1880, pp. 416-421) describe in detail the internal structure of the Beluga's larynx. They write:

"There is a complete absence of the true vocal chords; an appearance of such at first sight certainly exists, but upon more accurate examination this simulation of them is found to be due to the projection inwards of the sharp inferior borders of the arytenoid cartilages ... These sharp edges may serve the purpose of vocal chords in the Cetacea. The membrane lining the posterior wall of the larynx is thrown into numerous longitudinal folds, whilst at the base of the epiglottis it is projected forwards, so as to form on each side of the middle line a pouch of a size sufficient to admit the point of the forefinger. This pouch is subdivided into a number of little saccules, which communicate freely with one another. It corresponds in position to the ventricles of the larynx in other Mammalia (p. 416)".

The structure of the Beluga's larynx therefore probably enables it to utter sounds (1). Several authors have described these sounds,

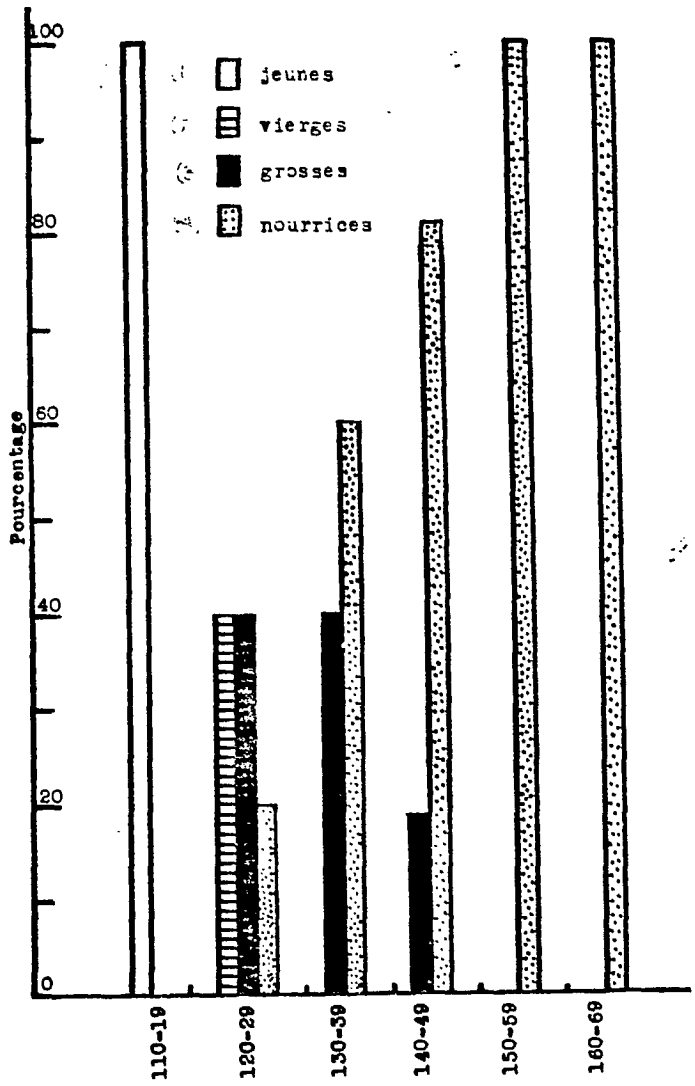
(1) According to St. Lawrence whalers, Beluga utter sounds with their mouths closed.

(1) young females

(2) virgin females

(3) pregnant females

(4) nursing mothers



Percentage

Length in inches

Fig. 45.- Variations in length of the various categories of Beluga females caught in the St. Lawrence River in 1938 and 1939.

foetus

newborn animals

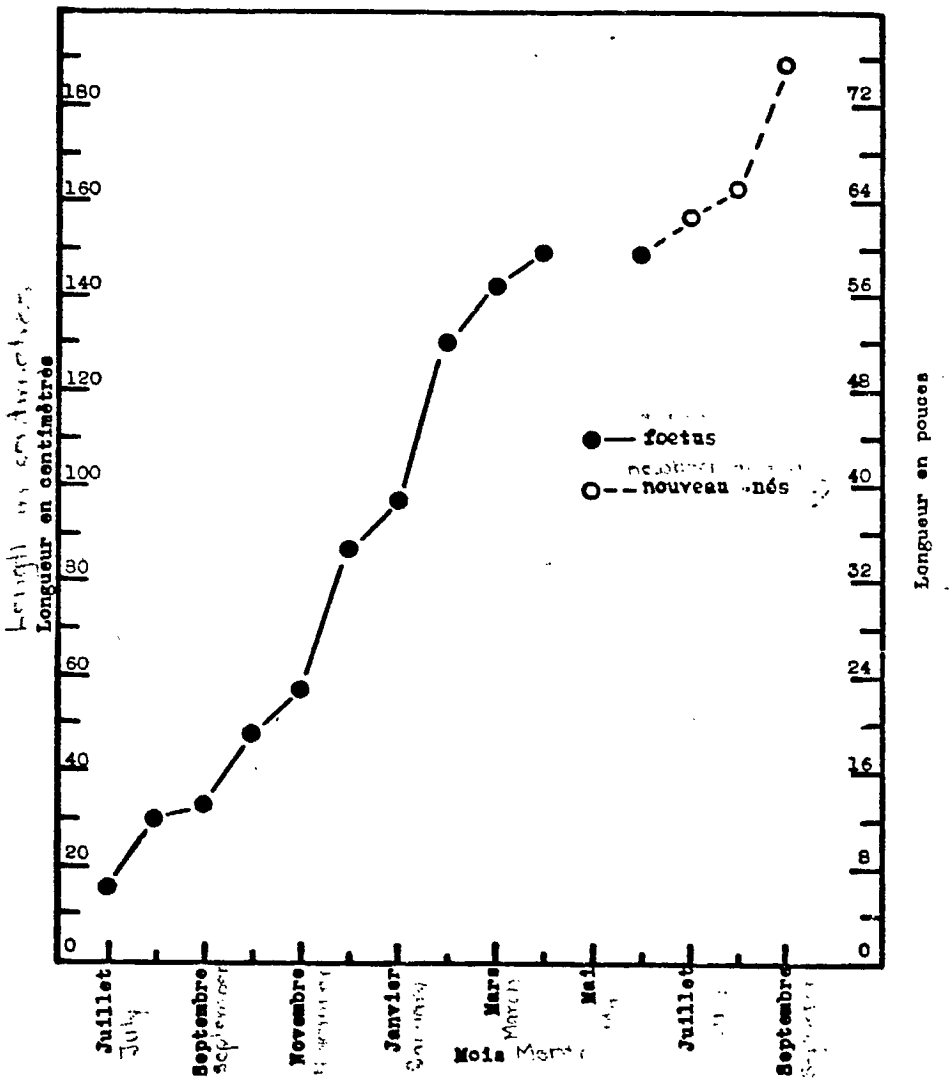


Fig. 46.- Monthly growth of foetuses and newborn Beluga. Data collected from the St. Lawrence River (Vladykov) and Greenland (Degerboel & Nielsen, 1930).

comparing them to squeaking noises (Nelson, 1918, p. 469); to the "put-put" of a fleet of motorboats (Andrews, 1925, p. 56), to the "sound produced by holding a heavy tin tray in the hand and shaking it vigorously but not striking it against another object" (Sutton & Hamilton, 1932, p. 93). etc... The Abbé Casgrain (1873, p. 4) commented as follows on this subject: "Nothing is as strange and singular in the still of the night as the sound of their (the Beluga's) loud sighs rising continually from all points on the horizon".

Whalers claim that now and then in the evening, they hear the wailing of Beluga out at sea. They also hear a sound like that of an animal that has just been wounded or is in its death throes (1). Whalers from Rivière-Ouelle and Ile-aux-Coudres say that frightened Beluga caught in a weir will wail, uttering cries on the same note.

Struthers (1896, p. 124) reported observations of an adult female captured in Scotland and kept alive for some time. After capture, it was held with a rope tied to the tail. The local children amused themselves by teasing it, "making it 'frantic', and it uttered low moans like the grunting of a pig, but not so shrill". (2).

Chapsky (1937, p. 57) tells of a very interesting case noted in the Gulf of Ob on August 15, 1935: as a herd of Beluga approached the nets, the lead male uttered a loud bellow very difficult to describe. This author compared it to "a loud repeated bellowing, suggestive of the gruff bellow of a bull and the grunt of a Walrus".

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(1) During the Beluga hunt in which we participated, the noise of the motor made it impossible to hear the sounds made by these animals.
(2) Tschirkowa & Folitarek (1930, p. 110) mention that Russian whalers also noted that when young Beluga (the calves) were stranded on the beach they "grunted like pigs".

Maternal Devotion

A Beluga's devotion to its young is truly touching: on several occasions a mother whose suckling was trapped in a weir let herself be grounded or killed outside of the trap rather than abandon her calf (1). During hunts by motorboat, we often have seen the mother protect her calf by swimming between it and the boat. Once, for example, a calf (No. 86) which was swimming above its mother's (No. 87) back was killed instantly. The mother wounded by the same bullet remained on the surface near her dead calf, and let herself be killed.

There is considerable evidence to prove that the young calf can attach itself to the mother's dorsal side (Tschirkowa & Folitarek, 1930, p. 113; Sutton & Hamilton, 1932, p. 93). Abbé Casgrain (1873, p. 3) gives a charming description of this:

"One sometimes sees the female carrying her calf on her tail; the calf, which is bluish-grey, seems to be firmly attached, as if there were a vacuum between it and its mother. When there are two calves they can be seen pressed against her on either side of her flippers. They seem, moreover, to be able to stick firmly to any part of their mother's body".

On several occasions, Arsenyev (1939, p. 60) has seen females and their calves trapped in the water by a large seine; according to him,

(1) When the tide drops the Beluga trapped in the weir keep together, with their heads in the centre, forming a star.

the calf merely remains very close to its mother, swimming above her, thus perhaps giving the impression that it is stuck to her.

Senses and Instinct

The Beluga's senses and instinct are probably the most highly developed of all Cetaceans.

Abbé Casgrain (1873, p. 4) noted sometime ago that the Beluga "has extremely sensitive hearing and the slightest sound startles it". It is said that the Beluga can see as well in the water as out and that its sense of smell is particularly well developed. According to Heptner (1930), in Norway, smoking is forbidden during the Beluga hunt because it is believed that these animals can smell tobacco, which causes them to flee. In northern Russia, whalers avoid making a fire near the water's edge lest the smell of smoke frighten off the Beluga herds. Norwegian whalers take the precaution of killing all the animals of the same herd that have been trapped in a fjord or caught in a seine in order to prevent escapees from keeping other Beluga away.

The brain of the Beluga is highly developed. According to Freund (1932, p. 6), the ratio of the weight of the brain to that of the whole animal in the large whales (Balaenoptera musculus and Balaena mysticetus) is 1:14,000 and 1:25,000 respectively. According to Dr. George Crile of the Cleveland Clinic Foundation (personal contact), in the Beluga this ratio is 1:230. The male Beluga studied was 12 feet long: it had been caught on the Churchill River in Hudson Bay. Its total weight was 1,149 pounds and its brain weighed almost 5 pounds

(2,355 gr.).

Wyman (1863, p. 611) gives a very interesting description of the behaviour of a St. Lawrence male Beluga that was kept in an aquarium in Boston for nearly two years:

"He was sufficienty well trained to allow himself to be harnessed to a car, in which he drew a young lady around the tank; he learned to recognize his keeper, would allow himself to be handled by him, and at the proper time would come and put his head out of the water to receive the harness or take food.

At times, he showed a playful disposiion, and amused himself sometimes with splashing about in the water, and at others with tossing stones with his mouth. He often took in his mouth a sturgeon and a small shark which were confined in the same tank, and, after playing with them for a while, allowed them to go unharmed".

Swimming and Diving

The Beluga's way of swimming as described by Pallas (1794, p. 196) is inaccurate, for he says that "when the animal swims, it draws its tail down underneath it like a crayfish; it thrashes the water behind it with such force that it shoots forward like an arrow".

Although its tail is a powerful propulsion device, the Beluga, like other Cetaceans, cannot tuck it under like a crayfish: the caudal peduncle is rigid thus allowing the tail to move only in an upward direction and with a limited amplitude. Occasionally the Beluga can propel itself by swimming on its side and thrashing its tail horizontally. In fact, we noted this particular

behaviour one day when an animal that was being chased by a hunter, was forced to swim in water that was so shallow that it could not use its tail effectively in the usual vertical position.

The Beluga is not a fast swimmer: its usual speed is about 6 miles per hour (Degerboel & Nielsen, 1930, p. 144). Arsenyev (1939, p. 63) saw a pod of Beluga of different ages being chased for 40 minutes by a boat moving at 8 miles an hour: he concluded that even sucklings can swim up to 7 miles per hour for some time, and that adults can easily reach a speed of 9 miles per hour and perhaps even more.

Frequency (percentage)

St. Lawrence

Greenland

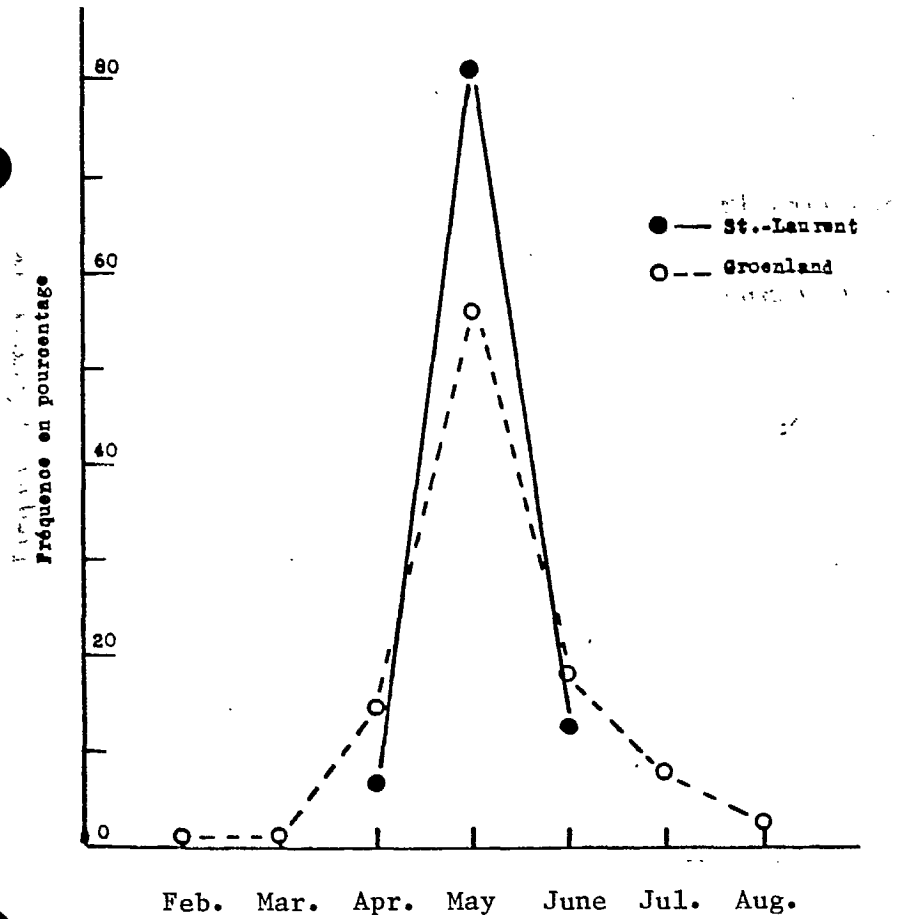


Fig. 47.- Probable mating frequency of Beluga in different months of the year.

In the St. Lawrence River, when chased by a motorboat doing about 10 miles an hour, the male Beluga will tire after 10 to 15 minutes, whereas the female can keep going for almost twice as long.

On June 17, 1939 in the morning, we made a few observations on the duration of dives made by two adult Beluga that were feeding in the vicinity of Les Escoumains. Five of these dives lasted 10 seconds each while another lasted only 5 seconds. A Beluga that is not disturbed thus surfaces very frequently to breathe. When it is frightened, however, it remains submerged for a much longer time: our whalers tell of seeing Beluga remain underwater for 15 minutes and even longer. Arsenyev (1939, p. 56) noted the duration of a dive of a Beluga trapped alone in a large seine. The animal remained submerged, for 10 minutes at first, then surfaced three times in succession, exhaling and inhaling each time, then dived again for 4 minutes. It reappeared three more times in succession, after which it was freed from the seine.

From a distance, Beluga surfacing to breathe look like white foam on the crests of waves. This is why even a trained observer often believes he has seen a herd of Beluga when the water is stirred by a breeze. Abbé Casgrain (1873, p. 3) describes a school of Beluga in these words:

"The sparkling whiteness of their skin contrasts with the dark green of the waves and makes them look like snow-covered ice floes. When they appear the first thing one sees is their round heads, then the jet of water which they blast from their blowholes a few feet into the air, and then their necks and backs."

The common belief, that the Beluga shoots sea water from its blowhole when it breathes, must be corrected. In point of fact, the Beluga, and other Cetaceans, cannot blow sea water from the blowhole because their respiratory structure differs from that of land mammals: the blowhole connects directly to the trachea rather than to the throat by means of a special passage. The "fountain" that can be seen above the Beluga's head when it emerges does not consist of sea water. It is exhaled breath under very high pressure and which is laden with water vapour (Kellogg, 1938, p. 659). Arsenyev (1939, p. 59), however, explains the nature of the Cetaceans' "fountain" differently: the exhalation of the Beluga begins while its head is still underwater. Thus the air released from the blowhole shoots sea water into the air, like a vaporizer. Therefore, the "fountain", in fact, can consist of vapour and sea water.

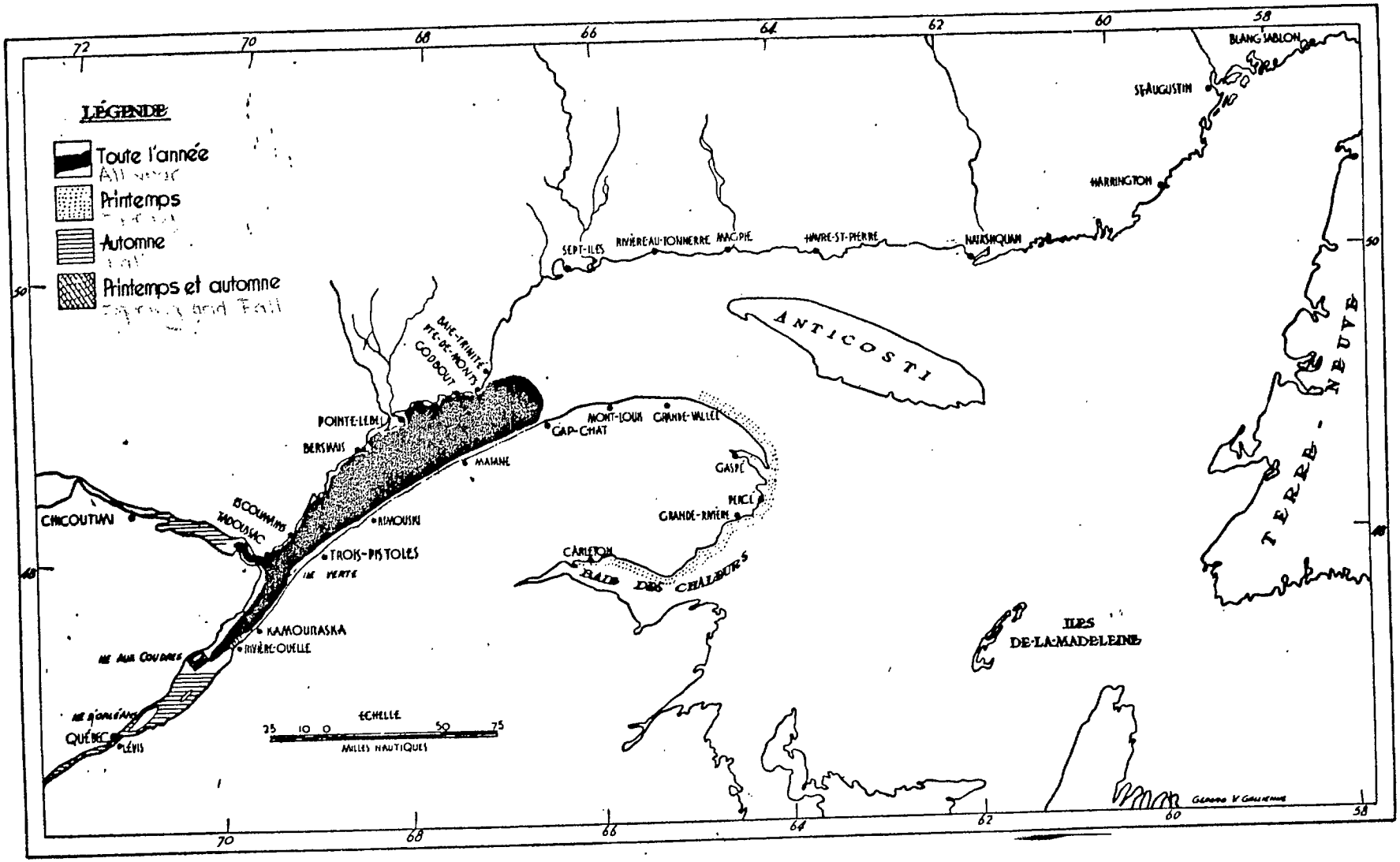
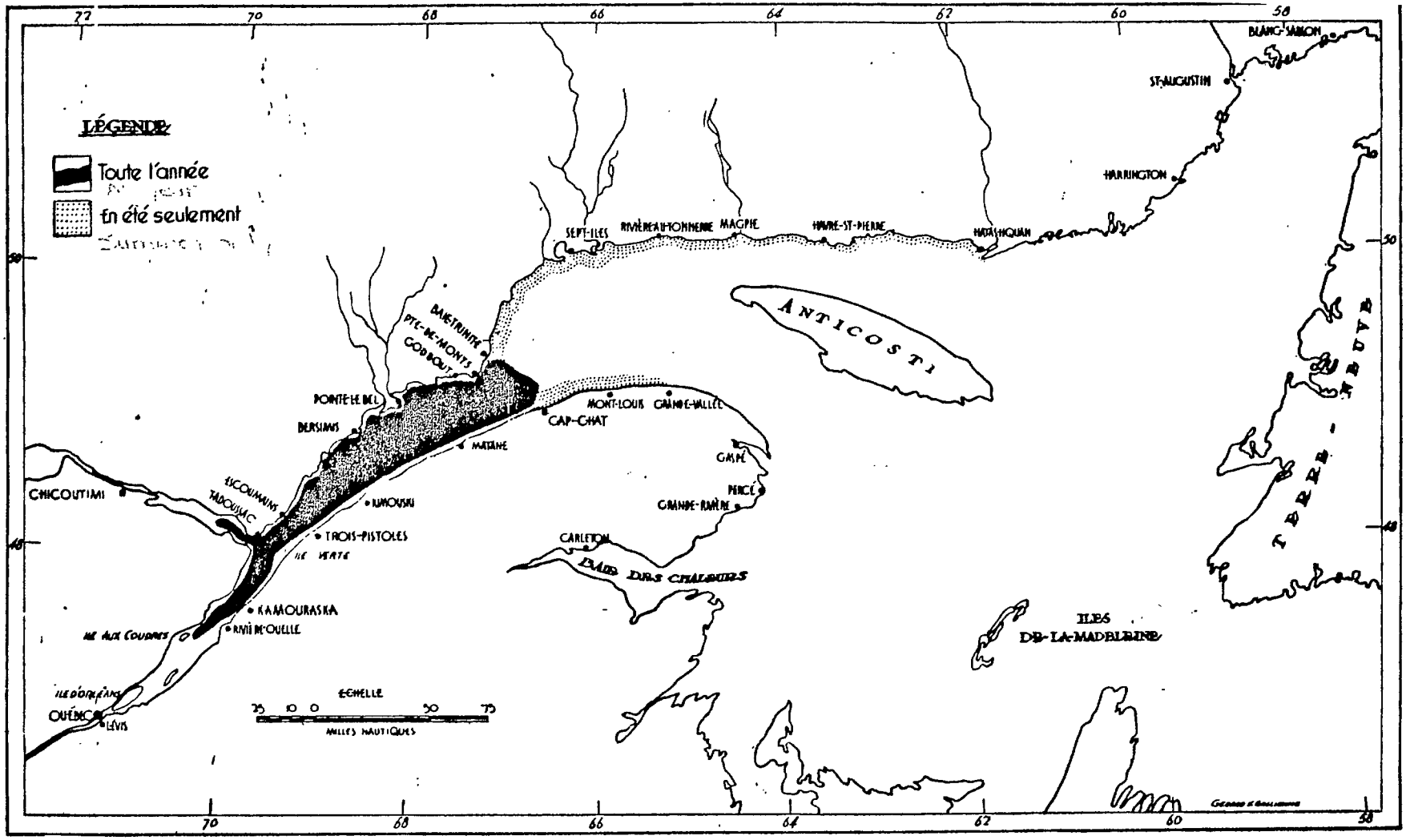


Fig. 48.- Beluga concentrations in the St. Lawrence River and Gulf in the spring and fall.



Scale

Nautical Miles

Fig. 49.- Beluga concentrations in the St. Lawrence River and Gulf in summer.

MIGRATION

A knowledge of the migratory habits of the Beluga will help us to better understand the conditions that prevailed in the St. Lawrence around 1928, a year in which the fishermen say there were very large numbers of these animals in our waters. Furthermore, seasonal movements must be taken into consideration in the planning of a more profitable hunt. Thus information on the movements of the St. Lawrence Beluga and data about their extensive migrations will be extremely useful.

Seasonal Movements in the St. Lawrence

The Beluga, an arctic animal, is well adapted to living in northern latitudes. One can even say that it enjoys cold temperatures more than a temperate environment. Its distribution shows that it inhabits only the cold waters of the Northern Hemisphere, a good indication of this animal's preferences. (Fig. 17).

From observations made in the St. Lawrence, it would appear that Beluga migrations correspond with the seasons, and even more so with temperature variations of the layers of cold water near the surface (1).

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(1) The temperature of the water can affect the Beluga, either directly or indirectly, by creating conditions that are favourable to fish or invertebrates which are the main food of our Cetacean.

Arsenyev (1939, p. 90), though, noted a concentration of Beluga herds in the Sea of Okhotsk and the Bering Sea in water temperatures that varied from 39° to 69°F. However, it is not known at exactly what depth these temperature readings were taken and it is quite likely that they were taken near the surface only. If such is the case, Arsenyev's conclusion that the Beluga can adjust to quite a broad temperature range is not entirely correct because the water in the arctic seas is often layered in the summer, that is, it can be relatively warm at the surface and at the same time very cold a few feet down. An illustration of these conditions is given by Gaudry (1938, p . 12), for example, for the Saguenay River.

Information about the hydrological conditions of the St. Lawrence has been given in one of the earlier chapters so that it suffices to draw general conclusions here. It appears that Beluga are reluctant to remain for any length of time in water warmer than 60°F. Below are a few temperature readings taken near the surface at times when Beluga were quite plentiful.

DATE	PLACE	TIME	TEMPERATURE, °F
	Les Escoumains		
10 June 1939 ..	Wharf	4.25 P.M.	39.2
21 June 1939 ..	Wharf	9.15 P.M.	42.8
24 Aug. 1939 ..			
1 Sept. 1942 ..	Wharf	8.30 A.M.	45.0
2 Sept. 1942 ..	Anse-aux-Basques	5.00 P.M.	37.8
3 Sept. 1942 ..	Wharf	9.20 A.M.	41.0
	Ile-aux-Coudres		
25 Nov. 1943 ..	Wharf	9.30 A.M.	35.6
25 Nov. 1943 ..	Wharf	4.45 P.M.	35.6

The table shows that all the temperatures were below 50°F., however, Beluga were observed where temperatures ranged between 50° and 60°F. In fact, at sunset on October 3, 1944 (6:30 p.m.), the author saw four adult Beluga in the vicinity of Ile d'Orléans, between Ile-aux-Reaux and Ile-Madame. The temperature of the water taken at this time was 55°F. near the surface. This is about the time of year when the Beluga usually arrive in these parts.

The high temperature of the water is probably why Beluga do not remain either in the Baie des Chaleurs or along southern Gaspé during the summer. Without a doubt this is also why they do not go upriver beyond Ile-aux-Coudres until fall when the water has cooled down sufficiently. The changes in water temperature during the year may well explain the seasonal movements of Beluga in the St. Lawrence River. Detailed information is given below.

Winter (December - March).- Although we are not sure of the winter conditions best-suited for Beluga, the question of food is certainly not of great importance at that time. In fact, we have already seen in the chapter on "Blubber Thickness" (page) that Beluga are thinnest in winter. Nevertheless, it is quite likely that they seek locations where the turbulence of the water inhibits broad expanses of ice that would prevent the animals from surfacing to breathe.

According to the whale hunters, there are at least two places in the St. Lawrence River where a few herds of Beluga winter. In each of these locations there is quite a strong current. The first location is in the vicinity of the Saguenay, between its mouth and the area offshore from Les Escoumains. The people of this village have seen

them several times during the winter.

A second concentration is in the vicinity of Godbout. Local seal hunters have provided the following information:

"Alfred Côté saw 5 Beluga during the winter of 1932 and 3 and during the winter of '35, and Auguste Morin saw 5 in February and 3 in March of 1937. Théodore Côté, a whaler and former fisheries officer, told us about his very interesting observations:

In February 1942, while seal hunting, he saw a Beluga herd of white adults and blue calves, about half a mile from shore, 1½ miles east of Godbout.

On or about January 20, 1943, at about the same spot, he came across a huge herd breaking a recently formed thin sheet of ice in order to surface to breathe. This herd consisted of large white adults and blue calves.

In March 1943 he saw another huge school of adult and young animals between floating chunks of ice, about 1½ miles out from shore and 5 miles east of Godbout."

We do not have enough information to determine whether or not all St. Lawrence Beluga winter in these two locations only, or whether other places are frequented by this Cetacean this time of year. The latter is quite possible.

Spring (April - May).- During this season Beluga begin and active migration, mainly to the west. Each spring, towards the end of April, about a week after the ice has disappeared, the herring come inshore

to spawn. At this time, pods of adult Beluga (1) are seen along the Gaspé coast and in Baie des Chaleurs as far as Carleton. Apparently, in spring, Beluga follow the South Shore against the Gaspé current. Two weeks later, about the 15th of May, there are no Beluga left in these waters (Fig. 48).

In April as well, or sometimes earlier, herds of Beluga appear near the mouth of the Ouelle River and in the vicinity of Les Escoumains. They spend several months at the latter place but near the Ouelle River they stay for only a maximum of four weeks which generally correspond to the smelt and herring season there.

At about this same time, the Beluga begin to congregate near Ile-aux-Coudres, where they are particularly plentiful in May in herring season. In May, or sometimes earlier, large herds arrive at the Manicouagan Bank where they remain until fall.

Summer (June - August).- During summer, the water begins to warm up and many fish and marine invertebrates are to be found inshore. Probably because of the abundant supply of food, the Beluga stay in the shallow water then, coming inshore twice a day with the rising tide, and going out again when the tide ebbs. The whalers record these daily movements in their hunting logs (Fig. 49).

In early summer along the North Shore, enormous schools of caplin, a favourite food of the Beluga, go inshore to spawn. According to Sleggs (1933, pp. 19-20), caplin spawning around

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(1) As an exception to the rule that Beluga herds in this region are made up of adult animals, one might mention an account given by Napoléon Boudreault, a Carleton fisherman. On or about May 20, 1934, he caught three Beluga in his salmon weir, one of which was a young animal 7 feet long. During that same year, White Whales were exceptionally plentiful in the Baie des Chaleurs.

Newfoundland is at its peak in temperatures between 47° and 51°F. It is at this time that pods of adult Beluga appear between Baie-Trinité and Natashquan (1). Primarily they frequent the river estuaries between Sept-Iles and Magpie. Some Beluga may stay in this area until August (2).

In order to learn more about the distribution of Belugas along the North Shore, we took a boat trip there, from July 21 to September 6, 1943. During that summer when conditions seem to have been similar to those of the two preceding years, we visited the major fishing centres between Quebec City and Blanc-Sablon.

We saw Beluga in the following locations:

1. July 21, at about 1:00 p.m., a few adults offshore from Ile-aux-Coudres;
2. July 21, between 4:30 and 5:30 p.m., a few small schools of adult females accompanied by their calves, young ones in particular, between Ile Blanche and the estuary of the Saguenay, and even a few miles farther down;
3. July 23, at about 9:00 a.m., about twenty adults, near Magpie, a short distance downstream from the village.

As a rule, every year, in the summer, the largest concentration of Beluga occurs in the "area of annual abundance". Practically every day, pods of Beluga can be seen there at the mouth of the Saguenay (Howell, 1935). Others can also be seen east of Ile-aux-Coudres at

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(1) At this time salmon also swim up several of the rivers on the North Shore thus accounting for the unfounded accusation that the White Whale goes inshore to feed on salmon.
(2) In all probability, it is the caplin fingerlings, known locally as "whale-bait", that keep the Beluga in these waters. In fact, during his visit to Rivière-au-Tonnerre, from August 21 to 26, 1943, the author caught a great many caplin fingerlings.

Pointe-de-Monts, along the North Shore between Kamouraska (1) at Cap-Chat and even at Grande-Vallée, along the South Shore. No doubt the cold current of the Saguenay attracts them.

During summer and early fall, however, probably the largest concentration anywhere in the St. Lawrence can be seen on the Manicouagan Bank, between the Bersimis and Manicouagan Rivers. Most of the White Whales caught in the past few years were in this area.

According to Honoré Chouinard, an experienced hunter from Pointe-Lebel, the Beluga herds that frequent the Manicouagan Bank remain in the area for the duration of the hot season. In fact, on several occasions, he has recognized the same animals from clearly visible wounds or scars.

The Beluga found at Les Escoumains, on the other hand, move around more in the summer. For example, Ernest Boulianne shot an old male there in June 1937 but the animal got away. Two weeks later he found and killed the same animal near Iles-Pèlerins, about 35 miles west of Les Escoumains. Therefore, Beluga apparently have little difficulty crossing the St. Lawrence River, from the Saguenay to the South Shore or in the opposite direction.

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(1) Mr. Joseph-P. Ouellet of Quebec City spends his summers in Kamouraska and has seen several small schools near Grosse Ile every year, in July and August. The western limits of the area where Beluga gather in great numbers can be said to be in the vicinity of the Rivière-Ouelle pier. (Cf. page 59 of this paper).

During the summer, Beluga generally swim in pods which often consist of animals of both sexes. During these months, the females stay with their young in the many coves in the vicinity of Les Escoumains and in the waters of the Saguenay, whereas the males go farther out. This same tendency can be observed on the Manicouagan Bank where females with young stay closer to land and males are out in deeper water. In July and August, pods consisting of young Beluga only can be seen. These pods are called "schools of inquisitive observers".

Fall (September - November).— When the water begins to get cold in the fall, the Beluga once again reunite in large herds. Although the largest migrations are towards the Gulf, a certain number of adult Beluga, probably males for the most part, head west.

They then go up the Saguenay as far as Anse-Saint-Jean and some have even been seen a short distance below Chicoutimi. They also go beyond Ile-aux-Coudres and on into fresh water. The appearance of Beluga in the western part of the St. Lawrence estuary coincides with the time of year when eels swim downriver to the sea, i.e., from the end of September to the beginning of November (1). The presence of Beluga at that time of year is well known to the eel fishermen between Rivière-Ouelle and Ile d'Orléans.

Several people have testified to this, including, for example, Mr. Uldéric Lemieux, captain of the Lévis ferry, who has seen White Whales every year, in October, near Quebec City. According to Clément

(1) It is probably not the eels going downriver that attracts the Beluga but rather the smelt, tomcod and white fish which swim upstream this time of year.

Leclerc , a Limoilou fisherman, the White Whale also swims up into the Saint-Charles River as far as the Samson bridge.

The presence of Beluga near Quebec City has already been noted by DeCharlevoix (1744, p. 217), who wrote: "I have seen many of them, amusing themselves in the Port of Quebec. They hardly ever go farther upstream than this".

The odd Beluga, however, may go as far as Champlain's old city, even in springtime, when the water is still cold: as a matter of fact, in April 1941 (1), a young Beluga was caught at Wolfe's Cove, about three miles above the city.

We have been assured by a number of people that in the autumn, the Beluga may go up the St. Lawrence for a distance of about 40 miles beyond the Lévis ferry. Their appearance there is mainly due to storms from the northeast. Listed hereafter are the names of the people who have seen White Whales offshore from their respective villages: at Saint-Nicolas, Emmanuel Rousseau, the owner of a sawmill; at Saint-Antoine-de-Tilly, Albert Daigle, a fisherman, and at Sainte-Croix, Joseph Bergeron, a mechanic. The narrowing of the river above Pointe Platon and the strong current as a result of this, are probably what prevent our animal from going further upstream. Beluga appear regularly every year only up as far as Saint-Nicolas.

The best spots for catching Beluga in the fall are at Ile-aux-Coudres and Rivière-Ouelle, where the construction of White Whale weirs is a long-standing custom. The only difference is

(1) A photo and description of a "queer fish at Wolfe's Cove" appeared in "Le Soleil", a Quebec City dailey, on April 25, 1941, p. 15.

that the Rivière-Ouelle location is frequented almost exclusively by adult animals, whereas around Ile-aux-Coudres there are Beluga of all ages.

In the fall, towards the end of September or in October, huge herds of White Whales are seen along the North Shore between Les Escoumains and Pointe-Lebel, heading towards the Gulf. François Boulianne, a whale hunter from Les Escoumains, tells rows and rows of Beluga covering area of about two acres. The animals swim along in this formation for five to six hours in numbers estimated to be in the several thousands. In 1937, J.-F. Moreau, another whale hunter from Les Escoumains, came across a huge school near Baie-Comeau that covered approximately ten acres.

In both fall and spring, these huge herds are followed by killer whales (Orcinus orca). The whalers think that the Beluga join forces because of the presence of this mortal enemy. It is quite likely, however, that this concentration is more a natural phenomenon that occurs regularly twice a year as the Beluga go up and come back down the Lower St. Lawrence, and is not due to the killer whales.

The most reliable way of determining the movements of Beluga in the St. Lawrence would be to brand the live animals. Branding consists of replacing bullets with metal tubes bearing the necessary information. Beluga shot in the thick layer of blubber covering the back would thus be marked without being crippled. When these animals are caught again at some later date, they would provide accurate information about their movements and other biological data. This method has been used by English scientists on large whales in the South Atlantic with excellent results (Kemp, Hardy & Mackintosh,

1929, pp. 208-210; Peters, 1937, pp. 14-15).

Extensive Migrations

There are two unusual cases worth mentioning regarding the extensive migration of Beluga due to climatic changes: one was in Norway, at the beginning of the century; the other in Greenland, over the past twenty years.

The observations in Norway prove that White Whales may go some distance south when the temperature of the water becomes colder than usual. The case in Greenland, on the other hand, shows that they go north when the water becomes warmer. Further information about these migrations may throw some light on the conditions that prevailed in the St. Lawrence around 1928, a year when, according to fishermen, Beluga were very abundant in our waters.

Norway.- Scattered groups of Beluga appear almost every year off the north coast of Norway. However, during the harsh winter of 1902-03, when polar ice extended down much closer to the Norwegian coast than usual, huge herds of Beluga appeared: several hundred were caught, especially in Varanger Fjord, and a few animals were caught as far south as Christiania Fjord. A certain number of migrant Beluga apparently lingered near the coast until the fall of 1904. Great numbers of harp seals (mainly the Phoca groenlandica and the Ph. hispida (1)) followed the Beluga herds.

(1) These two species of seals are common in the St. Lawrence region: the former is known locally as the "Brasseux" (breast-stroke swimmer), "Loup-marin-à-coeur" (harp seal), "Bedlamer" (immature seal), etc.; the latter is commonly called the "Cruche" or jug.

In subsequent years, with the return of normal conditions, the polar ice remained out at sea and the temperature of the coastal waters moderated. Beluga once again were seldom found near Norway and there were also fewer harp seals. Further information on the subject is available in publications by such authors as: Harmer (1927, p. 16), Freund (1932, p. 44) and Birula (1934, p. 14).

Greenland.- There are a great many Beluga west of Greenland and they are a major source of food for the Eskimos. Over the last twenty years, Beluga numbers have greatly decreased (Cf. page 53 of this paper) and shifts in migratory patterns have also been noted. In fact, Degerboel & Nielsen (1930, pp. 143-144) noted the following for the 1926-29 period:

"As regards the occurrence of the White Whale at West Greenland it ought to be pointed out that in the latest years a shifting has taken place in the dates of their autumn and spring passage. For the last 3 years the Whale has arrived at Sukkertoppen (2) in the middle of November, formerly in the middle of October, and left already in the month of January, whilst formerly it did not leave until April or the beginning of May. Evidently this is no isolated phenomenon, but must be regarded as corresponding to the shifting which has in later years occurred in the life of other animals (Cf. the abundant Codfishing)."

During this same period (1926-29), arctic species other than Beluga were also forced to alter their migratory patterns: for example, the caplin, a favourite food of Beluga, found in enormous schools from

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(1) This is shown as 3b in Figure 17 of this paper.

Disco Bay to the south of Greenland, disappeared almost entirely from that area during these years and went north.

On the other hand, species of fish from more temperate regions, species such as herring, haddock, pollock (Pollachius virens) and others, which were completely unknown west of Greenland and caught only rarely, appeared in these waters in large numbers during those years. What was most remarkable was the appearance of large numbers of arctic cod (Gadus callarias). According to Jensen & Hansen (1931, pp. 7-9), very few of these fish were caught along the west coast of Greenland in 1911, for example, a year when the water was cold, a usual condition for this region. From 1926-30, however, when the water was warmer than usual, annual catches of arctic cod were exceptionally high.

Details appear below:

YEAR	COD CATCH (pounds)
1911	40,000
1926	4,530,000
1927	7,253,000
1928	8,113,000
1929	12,420,000
1930	17,990,000

Jensen & Hansen (1931, p. 40) attributed changes in the hydrological conditions along the west of Greenland from 1926 to 1930 mainly to the following:

"The western ice has generally had a more restricted distribution than before; the winters have been unusually mild, etc. Much indicate that the polar current, which descending from the Arctic bends round the south point of Greenland and runs farther along the south-west coast as a cold stream, has been much less prominent than in earlier years."

These same authors (1931, p. 40) warn us, however, that these unusual conditions, especially the unusually large catch of cod west of Greenland, are not permanent. This is why "one must be prepared ... for a swing back to the earlier condition, which naturally would exercise an influence on the fish stock".

The St. Lawrence River.- It should be stresed that it was not until 1928 that St. Lawrence fishermen began to complain that increasing numbers of Beluga were destroying large numbers of cod, salmon and other commercially valuable fish. Unfortunately, there were no direct biological observations. This is why we had to consult such diverse sources to uncover past conditions.

The data acquired in Norway and Greenland, presented at the beginning of this chapter, provided us with a basis of comparison for the St. Lawrence region. Fisheries statistics also yielded additional information. Let us consider the latter.

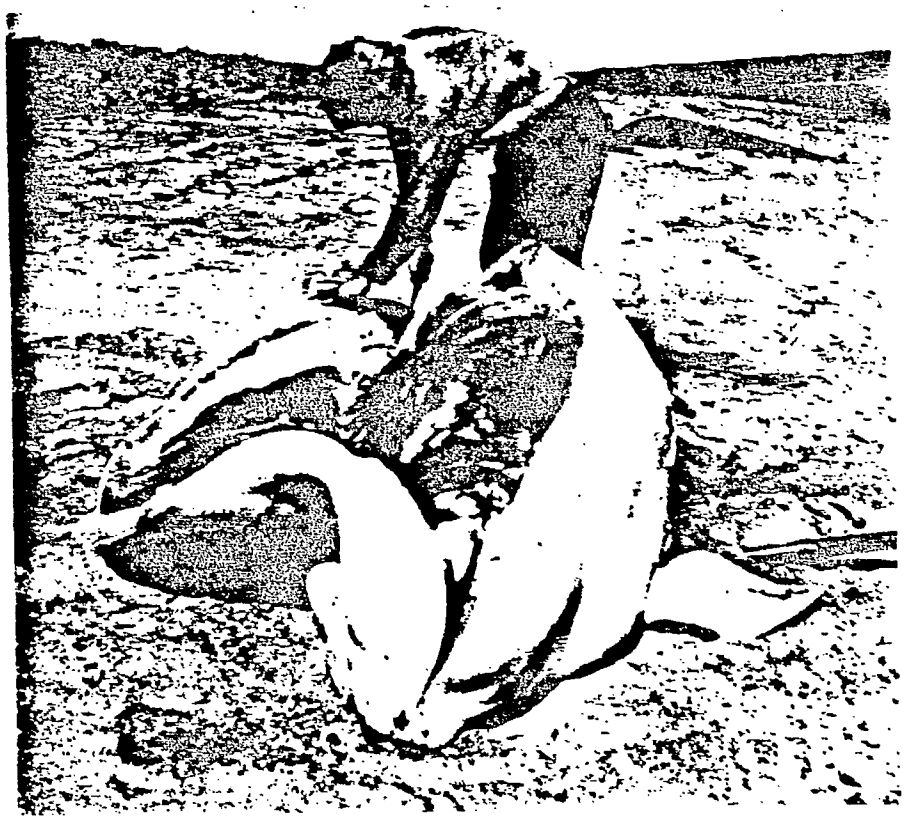

Fig. 50.- Starting to flense a female Beluga, at Pointe-Lebel. The blubber on the back is very thck; the flippers are almost flat, in sharp contrast with the ones in Fig. 23.

As we shall see later (page 185), the information given in Fisheries Statistics of Canada regarding the number of Beluga caught annually is not always complete. Information about seals, however, appears to be much more accurate. Thus, with certain exceptions, the data on the annual seal harvest in the St. Lawrence will allow us to judge more or less accurately how plentiful Beluga were in our area over the same period. As a matter of fact, we have already seen

in the case of Norway, that during the years (1) in which seals were in abundant supply, there were also a great many Beluga, and vice versa.

According to official statistics, the annual seal harvest in the St. Lawrence region over the twenty-year period from 1922 to 1941, was as follows:

YEAR	NUMBER OF SEALS CAUGHT PER YEAR		
	MINIMUM	MAXIMUM	AVERAGE
1922-26	2,964	4,842	3,983
1927	-	-	53,306
1928-32	4,416	10,906	7,230
1933-37	4,732	17,432	12,515
1938-41	16,828	24,506	22,275
General Average (except for 1927).....			10,985

With regard to the 1927 season, S.-T. Gallant, a fisheries inspector at Iles-de-la-Madeleine, reported:

"The increase (compared with 1926) in the number of Seals caught was 49,157. The catch amounted to 50,357 Seals, which is a record

(1) The water temperatures were unusually cold in these years.

catch for the Magdalens" (1).

This enormous catch was unusual not only for the Iles-de-la-Madeleine but for all of the Province of Quebec as well.

It is reasonable to assume that during the hunting season in the winter of 1926-27 and in the early spring (1927), the hydrological conditions (temperature, current, etc) in the St. Lawrence favoured the influx of huge numbers of seals. It can be assumed also that the 1927 season was cold all or part of the season and therefore favourable to Beluga. This latter assumption is not far from the truth, especially since in the following year, 1928, fishermen began to complain of the unusually large number of Beluga in our waters. There are also indications that 1929 was a good year for Beluga-hunting as well: on May 21, 1929, 107 Beluga were caught in the Rivière-Ouelle (2) weir in a single tide, and 187 animals in all were caught there that spring. In later years the Rivière-Ouelle catch dropped to about 15 Beluga per year.

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(1) This quotation is from the English version of the 61st Annual Report of the Department of the Sea and Fisheries, Ottawa (1928, p. 58).

(2) After catching so many Beluga in a single tide, the hunters had to spend about 18 days extracting the oil and preparing the hides. Although a large amount of oil was lost, they nevertheless managed to extract nearly 10,000 gallons. I should add that this exceptional catch is not mentioned in official statistics.

Articles by Forbin (1930, pp. 543 and 546) and Scott O'Connor (1935, p. 184) contain a series of photos of the Beluga caught that day. It is unfortunate that under one of these photos, O'Connor gives a completely erroneous description of the fishing method used, the number of Beluga caught and their diet. To illustrate the extraordinary exagerations, this author is quoted in full:

"These mammals (Beluga) are trapped at low tide by long nets of heavy twine or steel mesh strung across the mouth of an inlet at high water. French Canadians catch each spring many of the thousands that swim into the river to feed on Halibut, Haddock, and other fish".

The very large number of Beluga in our region in 1928 and 1929 is also corroborated by many St. Lawrence fishermen. We know that Beluga were also plentiful in 1927, at least on the North Shore. In fact, Reverend Father L. Garnier, a missionary at Rivière-au-Tonnerre on the North Shore, wrote in an article (1) that the sharp decrease in the number of cod caught between Mingan and Sept-Iles during those years was due to "the havoc wrought by the White Whales" which were unusually plentiful in those waters at the time. He writes:

"Prior to 1926, at the end of the fishing season, each of the main villages of the district weighed in three, four, even five thousand quintals of cod. Of late, particularly in the summers of 1926, 1927 and 1928, hardly one tenth of this amount of dried cod could be found in any of these villages".

Thus, 1927 to 1929 can be considered a period when Beluga were unusually plentiful in our province.

Where do these White Whales come from? The following text will attempt to provide a few answers to this question. There are two main possible explanations for the large numbers of Beluga in our region during the 1927-29 period:

1. Was the large number of Beluga seen during this period at several locations in the St. Lawrence the result of an increase in the local population through reproduction only? The facts contradict this assumption because Beluga are not very prolific animals and thus cannot suddenly become plentiful and not be observed progressively increasing in number from year to year. In fact, the

(1) This article, entitled "Les ravages du Marsouin" (Havoc Wrought by the White Whale), appeared in "Le Soleil", a Quebec City daily, on October 1st, 1930, p. 3.

accounts given by several whalers do not indicate that the large number of Beluga seen during those years was preceded by an unusual increase in the local population.

2. The large number of Beluga in the St. Lawrence during the 1927-29 period can therefore be attributed to the influx of herds from elsewhere. The fact that during this same period, temperatures in the North Atlantic around Greenland were moderating, would tend to give additional support to this hypothesis. The warming of the water forced cold water animals such as the Beluga to seek refuge in more favourable environments: either north of the Arctic Circle or perhaps in the St. Lawrence River.

Indications are that, strange as it may seem, as the temperature of the water around Greenland was rising, it was becoming colder in the St. Lawrence region, particularly along the North Shore. Hachey (1939a) published detailed water temperature readings taken along the Atlantic coast of Canada. The most valuable data for our study is that for Sable Island, off Nova Scotia; Scatari Island, east of Cape Breton Island; Grande-Entrée, Iles-de-la-Madeleine, and, Iles Sainte-Marie, southwest of Harrington, off the North Shore of the Gulf of St. Lawrence.

The following table, taken from a study by Hachey (1939a) shows the annual variations in average water surface temperatures (F) for a four-month period, from July to October:

PLACE	1929	1930	1931	1932	1933	1934	1935
Sable Island	59.7	60.4	61.5	58.6	59.7	61.2	58.5
Scatari Island	57.6	58.8	57.7	57.2	58.1	59.5	57.7
Grande-Entrée	-	59.7	57.6	58.3	57.0	58.6	57.7
Iles Ste. Marie	-	49.8	50.7	49.1	-	46.8	49.1

The maximum temperatures along the North Shore clearly often do not correspond with maximum temperatures in other locations, even in the St. Lawrence Gulf. This difference was especially pronounced during the 1934 season when the water was exceptionally warm, not only along the east coast of Canada but also around Newfoundland (Hachey, 1939, pp. 346-347). However, it was in the vicinity of the Sainte-Marie islands that surface temperatures dropped the most during the 1930-1935 period. One should therefore not be surprised to find even greater differences in hydrological conditions between the St. Lawrence and Greenland region.

What actually occurred in the St. Lawrence River in those years will probably always remain a mystery. Nevertheless, numerous biological observations indicate that around 1928 there was a distinct change in the hydrological conditions of the St. Lawrence region.

It seems that after 1929 the Beluga that had migrated here began to leave the St. Lawrence River. In fact, around 1930 large herds could be seen in the Gulf near Vieux-Fort and later, a huge concentration was seen in the Baie des Chaleurs. It was in 1930 as well that the newspapers wrote (1):

(1) An article under the heading "Mr. Gibaut says fishing will be much better" appeared in the Quebec City daily "Le Soleil" on June 17, 1930, p. 20.

"The large voracious herds of White Whales that ravaged and devastated the fisheries of the gulf and coastal areas over the past few years seem to have completely disappeared from the North and South Shores; let us hope that they have gone forever. We are not yet sure of this but there are some good signs. Joseph Lizotte who caught two hundred White Whales last year caught only eight this summer".

Although between 1927 and 1929 the temperature of the water in the St. Lawrence was lower than usual, from 1930 to 1936 it probably reached the other extreme, becoming very warm. In fact, large herds of "épaulards" or "Blackfishes" (Globicephala melaena), Cetaceans commonly found in temperate regions and are rarely seen in the Gulf of St. Lawrence, appeared in 1930 off the east coast of Canada. On August 30th of that year, a herd of at least 200 animals became stranded on the beach between the Percival and Enore Rivers in Prince Edward Island (Needler, 1931). On August 31st, another herd of 19 animals ran aground near Trois-Pistoles and in early October, several blackfish were caught around Ile d'Orléans (Préfontaine, 1930). A second group appeared on September 6, 1934; Mathewson (1935) counted 26 on the beach near Métis. The Globicephala appeared a third time: they were more numerous than in 1934, but less than in 1930. Some ran aground in the area of Ile d'Orléans and near Saint-Grégoire de Montmorency (2).

(1) The correct use of the word "épaulard" is to designate Orcinus orca.

(2) A photograph of one of these Cetaceans appeared on page 3 of the October 3, 1936 issue of the Quebec City daily, "Le Soleil". Through the kindness of Mr. Alphonse Beaumont, of F. Canac-Marquis Ltée., manufacturers of glue and chemical fertilizers in Quebec City, we found in the company's records much information about where the Globicephala went aground in 1930 and 1936.

In addition to the appearance of considerable numbers of Globicephala, another more important event occurred during that same period: the eel-grass (Zostera marina) was disappearing from almost the whole of eastern Canada including the Saint Lawrence (1). Brother Marie-Victorin (1935, p. 640) writes the following:

"In 1932, the Zostera suddenly began to disappear along the Atlantic coast from the Carolinas to Nova Scotia; in 1933, eel-grass canker had reached the St. Lawrence and the plant was on its way to complete extinction".

Other information on the disappearance of this plant from our region can be found in publications by Lewis (1931) and Tremblay & Gaudry (1936).

Changes in the hydrological conditions of the St. Lawrence during the past twenty years are recurrent and can be explained by "Atlantic transgressions", for example. These have been described by LeDanois (1938, pp. 150-170) as follows:

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(1) According to Marie-Victorin (1935, p. 640) eel-grass was harvested commercially in Quebec, particularly in the vicinity of Ile-Verte where about 1,000 tons were harvested every year and sold at $15 to $18 a ton. In addition to its industrial uses, it is the main food of the Canada goose (Branta canadensis).

Fig. 51.- Flensing a Beluga at Pointe-Lebel.

"'A periodic movement, varying in amplitude, of Atlantic waters from the tropics, resulting in temporary encroachment of these waters on polar and continental waters'. During its periodic encroachments, the Atlantic Ocean flows into the northern regions, including the St. Lawrence, making the water there warmer and saltier. Transgression years then, in common parlance, can be called "warm years", and the years in which the waters of the Atlantic draw back (recede) can be called "cold years".

These transgressions, in order of size, are as follows:

(a) Secular transgressions, 111 years;

(b) Octo-decennial transgressions, 18.6 years;

(c) Novennial transgressions, 9.3 years;

(d) Semi-novennial transgressions, 4.6 years;

(e) Annual transgressions, 1 year.

It should be added that, as a general rule, the longer the period the more far-reaching the transgression's influence. Thus it is that the influence of a secular transgression lasts at least 9 years and there are consequential effects over a period of 18 years. Octo-decennial transgressions also have very serious effects: in fact, the 1921 transgression was very disruptive to fishing, as far as cod, herring and, indirectly, oysters were concerned (1).

According to Le Danois, (1938, p. 169) the most recent maximum transgressions were as follows:

August 1921, octo-decennial maximum

February 1926, semi-novennial maximum

November 1930, novennial maximum

May 1934, semi-novennial maximum

Fig. 52 Fleshing a Beluga skin on a roller, at Pointe-Lebel.

(1) Details of the relationship between transgressions and commercial fishing are given in works by Le Danois (1938, pp. 246-278) and Beaugé (1931).

On the basis of the information given in this chapter, conditions in the St. Lawrence can be summarized as follows:

(a) Beluga were very plentiful during the "cold years" (Atlantic regressions), of 1927-1929; but there were no Globicephala to be found.

(b) There were very few Beluga during the "warm years" (Atlantic transgressions) of 1930, 1934 and 1936 (the migrant animals left the region). The Globicephala on the other hand appeared in large numbers. It was also during this period that eel-grass disappeared almost entirely from eastern Canada, including the St. Lawrence region.

Cod-fishing, particularly along the North Shore, was also influenced by the periodic changes in the hydrological conditions of the St. Lawrence. Around the warm years 1921 and 1926, fishing was excellent, but during the cold period, 1927 to 1929, it dropped off considerably.

During the past few years, hydrological conditions in the St. Lawrence seem to have returned to "normal", that is, to pre-1928 conditions: for example, cod-fishing, particularly along the North Shore, continues to improve and no appreciable increase in the White Whale population has been noted in the St. Lawrence.

The increase in the number of seals caught, especially over the past five years, should not be directly attributed to hydrological changes, but to the fact that we are fighting a war: since the beginning of hostilities, the ships from Newfoundland have stopped hunting seals (particularly baby seals) off Iles-de-la-Madeleine. Without a doubt, this has caused an increase in the number of adult

seals (Phoca groenlandica) which visit the St. Lawrence region in winter.

ECONOMIC VALUE

In this study, the Beluga is considered an economically viable species. Its potential damage to fisheries shall be discussed in the following publication on the food of this animal.

RATIONAL EXPLOITATION

During recent years, conditions governing the hunting of large whales have been regulated by an international convention (see The Whaling Treaty Act, 1936). As yet, however, there is no law protecting the Beluga. Thus it would be easy to work out a plan for commercial hunting.

To establish a profitable industry, the Beluga must first be abundant enough so that the number of animals caught annually would not endanger the survival of the species. With the data available, only general conclusions can be made on this subject. It should also be kept in mind that Beluga hunting methods are still rather primitive and inefficient. Hunting methods must be improved. A few suggestions are given in the chapter entitled **Hunting Methods Used Elsewhere** . Here are a few figures for Beluga catches in various regions:

Canadian Arctic.- Soper (1928, p. 75) and Anderson (1934, p. 74) make some interesting comments on Beluga hunting in Arctic waters. The Hudson's Bay Company post at Pangnirtung, obtained

the following number of Beluga in Cumberland Bay only: 600 in 1923, 800 in 1924, a large number in 1925 as well and approximately 300 in 1928. Hunting has decreased in the past few years due to the uncertainty of a market for Beluga products. With assured markets and the use of more efficient hunting methods there is no question that the Beluga harvest for the whole of the Canadian Arctic could be as high as 3,000 to 4,000 animals a year. Low (1906, p. 275) said the following on the subject: "there is little doubt that, with the opening of Hudson bay, the White Whale fishery will become an important industry in many places in the bay and strait, and also along the coast to the northward".

St. Lawrence River.- Rivière-Ouelle has the longest history of commercial Beluga hunting. Around 1870, l'Abbé Casgrain (1873, p. 12) spoke of the enormous numbers of these animals there: up to 500 were caught in a single tide, and 1,800 during the summer months. Over the past thirty years, the best season was 1929 when 187 animals were caught at Rivière-Ouelle. In subsequent years, the annual catch has been only about 15 animals; and since 1940, the weir at this location has not been in operation.

At Ile-aux-Coudres the best season in recent years was 1923 when in May alone, 125 mainly large Beluga were caught. The following years saw a sharp drop in the number of animals caught and around 1927, all Beluga hunting operations there ceased.

Fisheries Statistics of Canada were consulted in the hope of finding figures for the number of Beluga killed annually in the Province of Quebec. Unfortunately, there was no statistical information for several of the years prior to 1930 and that for the

years often does not tally with the actual catches. For example, in 1938 the statistics (1) show that only two Beluga were caught in the Province of Quebec, despite the fact that that same year we measured 143 Beluga killed by whalers and brought to shore at Pointe-Lebel; the Département des Pêcheries Maritimes paid a bounty for 336 animals (including our 143 specimens) killed that year (Vladykov, 1939). Thus it would be wise to calculate the number of Beluga caught in the Province from the records of the Département des Pêcheries Maritimes de Québec rather than from federal statistics.

YEAR	NUMBER OF BELUGA
1932	177
1933	208
1934	433
1935	558
1936	0 (2)
1937	521
1938	336

(1) Fisheries Statistics of Canada for 1938 (1940, p. 115).
(2) In 1938 the payment of a bounty was discontinued, and for this reason hunting dropped off drastically. The number of Beluga killed that year according to federal statistics was 28.

Admittedly, the reason Beluga were hunted during the above-mentionned period was the $15.00 per animal bounty paid by the Government. Markets for Beluga products (hide and oil) were not very attractive.

The number of Beluga killed in a single year was never greater than 600, even with a bounty. Obviously, this is not enough to support an industry for this product alone.

If hunting in the St. Lawrence were better organized, as many as a thousand Beluga a year could be caught. However, it is difficult to say whether the destruction of so many of these animals would jeopardize future stocks.

Fig. 53.- Salting a Beluga skin, at Les Escoumains.

The Skin

An earlier work (Bonin & Vladykov, 1940) discussed in detail the

histological structure and industrial use of Beluga skin, which is mistakenly called "porpoise hide". The skin of true porpoises ("Marsouins" Fr.) (Phocaena and Tursiops) cannot be used for leather because it is too thin. Of all Cetaceans, only the Beluga (Delphinapterus leucas) provides a superior quality hide because of its durability and suppleness.

Leather.- De Charlevois knew the excellent properties of Beluga skin: (1744, p. 217)

"The skin ... can be tanned and made into a kind of Moroccan leather. To begin with, it is soft as butter and an inch thick; and although it is very thin, thin enough for making jackets and breeches, it is nevertheless very strong, and can resist a shot. Some skins are eighteen feet long and nine feet wide: they say that there is no better covering for a coach roof".

Pennant (1784, p. 182) described Beluga leather as follows: "of their skins is made a sort of Morocco leather, thin, yet strong enough to resist a musquet-ball" . This description was no doubt based on the information provided by De Charlevoix.

Towards the middle of the nineteenth century, C. Têtu of Rivière-Ouelle, began experimenting on the currying and tanning of Beluga hides. His invention was patented and he was presented with a medal and given honourable mention at the London and Paris World Fairs (Casgrain, 1873, pp. 15-16). His efforts, unfortunately, were forgotten and nowadays Beluga skins are no longer dressed in Canada on a commercial scale. In Europe, however, (mainly in England) there are a number of tanners who profit from this industry. In spite of this, the general public is not familiar with White Whale leather.

This is why Harmer recently explained (1930) that laces made of a material known as "porpoise leather" are really made of Beluga hide.

Beluga hides marketed in halves or "sides". These hides have already been "fleshed", that is, stripped of the epidermis and blubber and salted (Bonin & Vladykov, 1940, pp. 276-277). The fleshed and salted hide (two "sides") of an average-size Beluga weighs 20 to 40 pounds; the hide of a large male can weigh up to 70 pounds. Hides that have been treated with salt (Figs. 50-53) can be kept for several years without deteriorating.

A Beluga hide is very large and is of almost uniform thickness and texture from one end to the other. Land animals, on the other hand, have smaller hides because of the neck and four feet, and the leather is much thicker on the back than on the belly.

The measurements of a few Beluga "sides" with the blubber intact appear below:

LENGTH OF THE ANIMAL (in.)	SKIN MEASUREMENTS		
	LENGTH (in.)	WIDTH (in.)	SURFACE AREA (Sq. ft.)
103	75	25-28	24
130	111	27-30	27
140	116	27-30	28

According to Mr. Hector Riou, a Trois-Pistoles tanner, there are three methods for tanning Beluga hides: with a vegetable solution (hemlock bark), oil (chamois finish) or chromium salt. Chromium salt tanning does not yield good results because Beluga hides shrink too

much from 30 to even 40 percent. Oil tanning yields an excellent product: the author of this paper had a vest made of chamois-finish leather and it is still in good condition after five years' wear.

Vegetable tanning is best suited for Beluga hides. The following data on Beluga leather tanned by this process was kindly provided by Mr. H. Riou:

SIDE NO.	LENGTH (in.)	WIDTH (in.)	AREA (Sq. ft.)	WEIGHT (Lbs.)
1	120	43½	31	17½
2	112	40	26	14¾
3	98	36	18	9½
4	96	37½	19	9½
5	58	23	7	3½

A histological examination of the Beluga has shown that the fibres of the dermis run mainly along the length of the animal and are interwoven with very few cross fibres (Bonin & Vladykov, 1940). The fibres of land animals, however (the cow, for example) do not run in any definite direction.

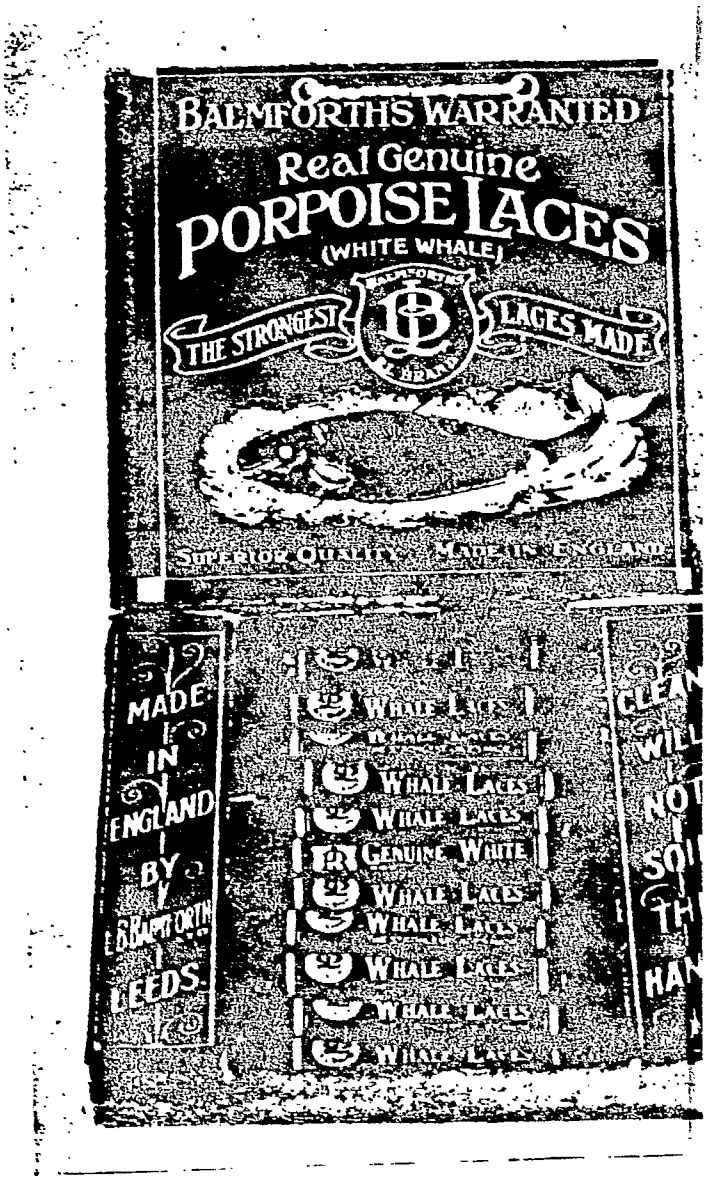

Fig. 54.- A box containing one dozen Beluga hide laces made by an English firm by the name of E.B. Balmforth (Leeds). Size reduced by one half.

This peculiarity of the Beluga's dermal structure is the probable reason for the durability of the leather: it s very strong, particularly lengthwise. It is preferred over other leathers for the manufacture of shoe and boot laces. The best laces, made of cowhide, break at 45 pounds' tension whereas Beluga laces have a tensile strength of up to 64 pounds (Bonin & Vladykov, 1940, p. 282). This simple experiment clearly shows that Beluga leather is superior. In short, Beluga laces (Figs. 54, 55) are the strongest laces and the best for mountain and lumbering boots, and for any activity requiring strong and hardwearing shoes or bootlaces.

Generally speaking, Beluga hides can be used wherever a very strong material is required. Because of its elasticity, Beluga leather is ideal for belts, haversac straps, etc. On average, Beluga leather is about a line thick. The leather can be split into several layers (at least four). These thin layers can be used for luggage, etc. The author was told an interesting story illustrating the strength of Beluga hide: Mr. Joseph Tremblay, a Les Escoumains shoemaker, states that his father wore a pair of shoes made of Beluga leather for 14 years; he resoled them several times but the uppers were impossible to wear out (1).

(1) According to Tschirkowa & Folitarek (1930, p. 126), natives of the Barentz Sea apply tar to Beluga skins with the epidermis still on. This results in particularly strong leather that is used for making soles that last for several years.

Beluga skin has no hair or glands and therefore no pores. The finished leather has no grain, as does that of land animals, and acquires a superb patina. This property would no doubt be useful in the manufacture of strops for sharpening razors and knives (1).

In the province of Quebec, the current price for a salted Beluga hide in the Province of Quebec is about 15 cents a pound. Green hides are graded as follows, by price:

A. one bullethole;

B. three or four bulletholes, or the same number of knife cuts;

C. five or six bulletholes, or several knife holes.

In Canada, there is no central market for these skins presently. Before this war, the skins were shipped abroad mainly to Great Britain. To our knowledge, April 1, 1943, there were at least 11,000 pounds of fleshed and salted Beluga hides for sale in the province.

It is hoped that Canada's military authorities will consider equipping our airmen, for example, with shoelaces, vests, gloves, etc., made of Beluga leather.

Food - Eskimos consider Beluga skin a delicacy. It is called "mukluk" in Hudson Bay's (Binney, 1929, p. 19) or "muktuk" (Bagby, 1940, p. 69) and "matak" in Greenland. According to Dr. Degerboel (1939, personal contact), "matak" so popular with Greenlanders

(1) A number of years ago, razor strops were made of Beluga hide. One of these is owned by Mr. Louis-Abraham Tremblay of Ile-aux-Coudres, and is in very good condition after more than 30 years of frequent use.

that nearly all the skins of Beluga caught there are also eaten there.

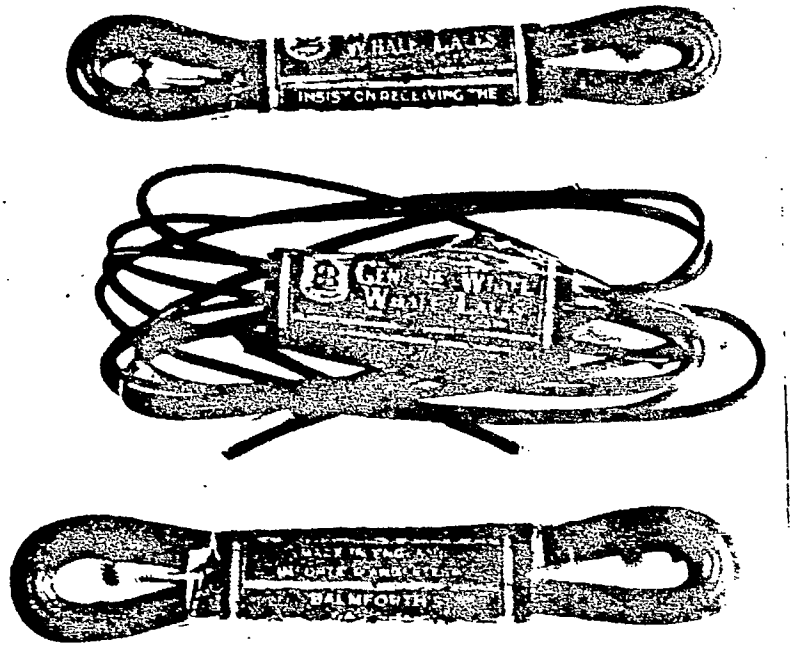

Fig. 55.- Beluga laces made by Balmforth. Round ones in the middle and flat ones above and below.

Probably it is the epidermis that is eaten; it is thick and white in the adult animal and particularly rich in protein but does not contain collagen (Bonin & Vladykov, 1940, p. 276). Binney (1929, p. 19) however, says that "the white gelatinous substance, which forms the inner coating of the hide, is regarded as a great delicacy".

Bagby (1940, p. 69) gives an interesting description of the flavour of Beluga "muktuk" which seems to be the name given to the two surface layers of the skin (epidermis and dermis). It is prepared as follows:

"They first stripped off the skin or muktuk, which is about a half-inch thick. The Eskimos consider muktuk a delicacy. They chew it raw. We took home a slab of it, which the hotel cook boiled and served in small squares with butter and seasoning. Its flavor is what might be attained by combining the white of very fresh poached egg and a thick, cultivated mushroom. We tried muktuk chopped up and mixed with scrambled eggs for breakfast. Not bad. Not good maybe, but not bad".

Oil

One of the main reasons Cetaceans have been hunted so intensively and for so long is for their abundant supply of fat (1). The amount of oil that can be extracted depends on the species, size, condition of the animal and the method of extraction used. It is estimated that ten pounds of blubber yield about one gallon of oil. According to the whalers, the estimated amount of oil, in gallons, that can be extracted from Beluga during the summer is as follows:

8-foot blue calf, 20 gallons

12-foot white adult, 70 gallons

14- to 14½-foot white adult, 100 gallons.

(1) Information on the composition and uses of oil from Cetaceans other than the Beluga can be found in other works, for example: Bolton, (1928), Brocklesby (1941), Lewkowitsch & Warburton (1922) and Tressler (1923).

An exceptionally fat animal may yield as much as 130 gallons of oil or even more (1); the average per Beluga is between 40 and 50 gallons. Lewkowitsch & Warburton (1923, p. 467) estimated that the amount of oil that can be extracted from a White Whale is 1 to 3 hogsheads, with a capacity of 31½ gallons each.

The amount of oil varies depending on the season: Beluga are thinner in autumn and winter and fatter from the end of May to the beginning of July. Animals caught during the summer, however, also contain a large amount of blubber. Therefore, if they are being hunted for their oil, they should be hunted in the best season for this. The amount of oil extracted from a fat animal can be double or even triple the amount extracted from a thin animal.

Extraction Methods.- To improve this local industry, it is important to analyse the methods of oil extraction oil currently used by hunters in this province. Oil is obtained either by exposing the blubber to sun or by heating it in a vat over fire or, less often, in a water bath.

To obtain a clear oil, the type most in demand, the people of Pointe-Lebel melt the fat in the sun, in a metal container of some sort. There are two main disadvantages to this process:

(1) A 17-foot male Beluga killed by Walter Bond on July 6, 1943 near La Chaloupe (Saguenay County) yielded 135 gallons of oil from the body. The entire amount of oil would easily have exceeded 150 gallons if the head with its fat and a few pieces of blubber from the body had not been discarded.

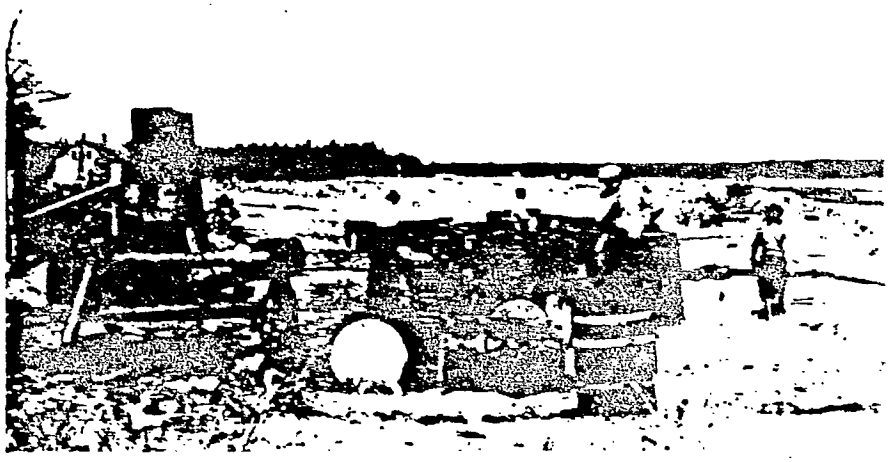

Fig. 56.- Extraction of Beluga oil by warming in the sun in steel drums, at Pointe-Lebel.

1. Due to the slowness of the extraction process, the fat remains in contact with the air for a long time, which gives the oil a very high fatty acid content;

2. Different impurities such as blood, pieces of skin, etc., find their way into the container with the blubber, eventually contaminating the contents and making it foul-smelling (Fig. 56).

To illustrate this point, with the permission of Mr. Hector Riou, a Trois-Pistoles tanner, we quote a few lines from a letter he received from the Clough Chemical Company, Saint-Laurent:

"We deeply regret having to inform you that, due to the odour of your White Whale oil (1) during sulphonation, the police of this town have ordered us to discontinue this process".

(1) Purchased by Mr. Riou on the North Shore (V.D.V.).

The most common oil extraction method for Beluga blubber and seal oil is heating the fat directly over the fire in some sort of boiler, often homemade from a steel drum. Les Escoumains hunters, for example, use this method (Fig. 57). The oil obtained this way is rather brownish in colour and not entirely uniform: the first batch of oil is pale-coloured; the last is much darker. If the fire gets too hot, however, the oil catches fire and turns black. Even though its free fatty acid content is quite low, it drops in value because of its dark colour.

The oil produced at Rivière-Ouelle by the brothers Joseph and Émile Lizotte seems to be of better quality; it is practically odorless and colourless. The oil is extracted using the water bath method. Unfortunately their facilities are rather modest and as a result, when several Beluga are caught at a time, the oil cannot be extracted the same day. This delay lowers the quality of the oil by increasing the content of free fatty acids which attack metals. A good lubricating oil should contain only minimal amounts of these harmful acids. Mr. H.E. Wordell, treasurer of William F. Nye, Inc. (Lubricating oil for fine machinery), New Bedford, Mass., in a letter to the author, dated March 22, 1938, made the following comment that also applied to the oil extracted at Rivière-Ouelle:

"One observation that I have made of their methods is that they don't use sufficient care and do not try the oil out soon enough after the Beluga is killed, with the result that the product is very high in F.F.A. (1) content".

(1) F.F.A. stands for "free fatty acids".

Properties.- An analysis of the oil extracted from Beluga blubber was made by Belopol'skii & Maksimov (1934). According to these authors, Beluga oil is similar to the oil of the small Odontocetans and has the following properties:

Iodine number	92.8 - 128.3
Acid number.....	0.2 - 2.8
Saponification value	200.2 - 225.4
Non-saponifiable substance(%).....	1.9
Reichert-Meissl index	16.7 - 35.3

A special kind of oil, known as "jaw-oil", is extracted from the jaw blubber of Beluga, and several species of dolphins (Delphinus) and true porpoises (Phocaena and Tursiops) (1). Oil from the head is excellent for lubricating delicate mechanisms such as watches, typewriters, scientific instruments, etc. A few years ago, this oil sold for $25.00 a gallon. Today, it has been replaced by a mineral oil that is less expensive but which is inferior to blubber oil.

Our whale hunters are aware that the oil from the head of the Beluga is an excellent lubricant and thus keep it separate. According to Tschirkowa & Folitarek (1930, p. 125), hunters in the Barentz Sea are very fond of Beluga-jaw blubber and for this reason separate it from the blubber from the rest of the carcass.

(1) This "jaw-oil" contains a high percentage of isovaleric acid and other fatty acids with a low molecular weight (Brocklesby, 1941, p. 417; Tressler, 1923, pp. 645, 646).

Tests have been run recently in Canada (Fisheries News Bulletin, 1942, p. 4) to determine the vitamin content of Beluga oil.

According to authorities at the Fisheries Experimental Station in Prince Rupert, B.C., this oil contains approximately 50 International Units of Vitamin D per gram and traces of Vitamin A. These results are summarized as follows: "the vitamin potencies of the blubber and jaw oils are too low to make these oils of any value as vitamin sources." However, in two samples of Beluga oil from Hudson Bay, Bailey (1944, p. 29) found that one had a vitamin A content of 6000 units, and the other, 14,000 units (U.S.P. units per gram of oil). These same samples showed a vitamin D potency of 60 International Units per gram, in the one case, and 100 I.U. per gram in the other.

Beluga oil seems to have the property of clarifying more readily than other sea mammal oil when left to stand awhile. Because of this property, it is used industrially and commercially mixed with seal oil. These blends are in great demand.

Uses.- Even after several years' storage, Beluga oil can be used for lubricating guns and various machinery because it does not oxidize when exposed to air. Oil from the head is particularly suitable for this use.

According to Mr. Hector Riou and Mr. H.I. Wordell, of New Bedford, Mass., Beluga oil can be used successfully in tanning if it is carefully processed. Sulphonated oil, i.e., oil treated with sulphuric acid, can be used for tanning hides to obtain a chamois finish, as well as for other uses in this industry.

Sufficiently hydrogenated oil (1) is solid at normal temperatures and does not oxidize readily. In the solid state, it can be used in soap-making and cooking fats such as lard or margarine (2).

In a letter to the author, dated June 21st, 1939, Dr. M. Degerboel of Copenhagen wrote as follows:

"It is correct that the fresh blubber from Beluga is shipped from Greenland to Denmark. I can inform you that White Whale blubber is bought by "Den groenlandske Handel" and sent to Denmark in barrels in salted condition. In Denmark, oil is extracted in the oil factory situated on Den groenlandske Handels Plads. This oil is employed in the margarine industry".

Mixtures of Beluga and seal oil are used in the paint industry. It seems that, generally seal oils cannot be used alone. According to Brocklesby (1941, p. 418):

"They do not possess any drying properties but, on absorbing oxygen, become thick and sticky. They have been used as adulterants for cheap paints, but their use for this purpose should be discouraged".

The main faults with the oil processed by St. Lawrence whale hunters are: high fatty acid content, dark colour, unpleasant odour, and contamination by various impurities, particularly sand. All of these can lower the value of the finished product by 10 or even 25 cents a gallon. It is not always the hunters

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(1) Hydrogenation is brought about mainly by introducing nickel as a catalyst (Bolton, 1928, pp. 302-316).

(2) The process consists of mixing hydrogenated oil with milk in specific proportions (Brocklesby, 1941, p. 312).

who are to blame, however. It is often difficult to find enough metal containers for the oil. In addition, the firms that buy the oil send containers that are not always clean. However, it would be possible to obtain high quality Beluga oil if the blubber were removed shortly after the animal died. The blubber could also be salted and put in drums which could then be sent to a centrally-located plant to extract the oil. For all of these reasons, it would be advisable for the whalers to obtain good-quality steel barrels and install oil extractors at least in the main whaling centres, such as Pointe-Lebel and Les Escoumains. The type of extractor suggested by Labrie (1937) for extracting cod liver oil might be suitable for this, provided it were larger.

In 1943, the price for Beluga oil paid to the whalers was somewhere between 50 and 60 cents a gallon.

Meat

The consumption of Cetacean meat increases yearly. In several countries such as Norway, Russia, Germany, Japan, etc., meat from large whales generally comes to market frozen (Peters, 1937, pp. 18-22), but in New Zealand it is canned. Around 1917 fresh or frozen whale meat was also available in the United States (Tressler, 1923, pp. 632-634; Radcliffe, 1918).

According to Tressler (1923, p. 634), whale meat is cut into 45-pound pieces then frozen and packed in boxes. The meat ressembles beef, but is darker and tastes rather like venison. The "Humpback" (Megaptera nodosa) which is famous mainly for the flavour of its meat,

Fig. 57.- Extraction of oil by heating, at Les Escoumains

will yield an average of 6 tons per carcass, and the "Finerst" or finback (Balaenoptera physalis), 8 tons. Whale meat is prepared like beef. The best results are obtained by braising the well-seasoned meat slowly over low heat. Pot roast, stew or steak (1) are the most popular dishes.

In Italy (Brunelli, 1931, p. 170), dolphin (Delphinus delphis) is used to make what is commonly called "canned tuna". The meat is cut up into filets about 25 inches long and 2 to 3 inches in diameter; they are left to drain, then put into a pickling brine.

We tried Beluga meat and found it excellent; it is

(1) Radcliffe (1918) collected 32 recipes for preparing Cetacean meat.

very dark in colour and extremely tender; its flavour is much like venison or calves' liver (1). Eskimos eat a great deal of it, and in the Mackenzie River delta, large amounts of it are dried or buried to be eaten during the winter (Anderson, 1934, p. 74).

Beluga meat can also be used as food for dogs, silver foxes or other furbearing animals (2). A similar experiment was conducted some time ago in Matane, where meat from the Globicephala malaena was kept in cold storage. This meat, used in Prince Edward Island for foxes, gave excellent results (Mathewson, 1935, p. 234).

The meat, and the skeleton in particular, can be made into fertilizer or meal for animals. Unfortunately, this industry was completely neglected in 1938 and 1939.

Where Beluga are plentiful, it might be wise to save organs and glands such as the pituitary (3), the thyroid and the pancreas, which contain fluids valuable to medical science. This is done in the large whale industry (Peters, 1937), p. 20).

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(1) Because the meat of Cetaceans is very bloody, some of St. Lawrence whalers soak Beluga or seal (Phocaena phocaena) meat in cold water before cooking it.
(2) In 1939, the Royal Canadian Mounted Police caught 300 Beluga in the Canadian Arctic to feed sled dogs (Fish. News Bull., 1940).
(3) Geilung & Robbins (1936) published an interesting treatise on the use of the pituitary hormones of various Cetaceans, including the Beluga.

Game Hunting

As a source of additional revenue for North Shore inhabitants, the organization of Beluga game hunting can be recommended, by motorboat as is done today on the Manicouagan Bank, or by sail-driven canoe (Vladykov, 1939).

Beluga hunting is very exciting and demands coolness, endurance and skill. The scenery is magnificent and Beluga hunting combines the attractions of hunting, fishing and yachting. The quarry is often ivory white and marvellously supple. This sport could become a tourist attraction second to none. (Bagby, 1940) gives a very enthusiastic account of his impressions of Beluga hunting in Hudson Bay (1).

During the summer, Baie-Comeau, in the vicinity of the Manicouagan Bank, and Tadoussac, because of its location in the estuary of the Saguenay, would be perfect spots for sportsmen. Rowboats with sails could be used for the hunt, but it would be preferable to have fairly powerful motorboats (12 to 15 miles per hour) manned by a crew of 3: helmsman, mechanic and navigator.

In the fall, when the Beluga swim up the St. Lawrence estuary, they can be hunted even around Iles d'Orléans. This would become an additional attraction for Quebec City, where tourists could enjoy the utmost in modern accommodations.

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(1) In the July 6, 1941 issue of the Quebec City newspaper "Action Catholique" (page 4), there appeared an article with no byline, entitled "Beluga Fishing in Hudson Bay" (tr.). This article mentioned that the Canadian National Railway Company was organizing for August an excursion to Churchill on which the tourists would be invited to take part in the Beluga hunt.

CONCLUSIONS

The information presented in this paper can be summarized as follows:

1.- In the course of this work, 165 Beluga caught in 1938 and 1939 in the St. Lawrence region were examined: 145 on the Manicouagan Bank, 17 at Les Escoumains and 3 at Rivière-Ouelle. At least 8 measurements were taken for each specimen, and in the case of females, 3 additional measurements were taken.

2.- The Beluga studied were caught by three different methods: on the Manicouagan Bank they were chased by motorboat; in the vicinity of Les Escoumains they were chased by sail-driven canoe and at Rivière-Ouelle they were caught in a large trap made of poles called a "weir". All of these methods commonly used in the St. Lawrence are rather primitive and inefficient.

3.- Ten Beluga were weighed; their weights varied from 185 pounds for a young suckling to 2,981 pounds for a 14-foot, two-inch male. Older animals can weigh as much as 4,000 pounds. The ratio of weight (in pounds) to length (in inches) of Beluga increases with the animal's age: for the suckling it is close to 3; for 83- to 88-inch-long animals it is about 5; for a 138-inch animal it is $9\frac{1}{2}$, and for old animals it is close to 17 (Table III).

4.- Although the distances between various parts of the body are relatively smaller in the young Beluga than in the older ones (the distance from snout to eye or snout to blowhole, for example), the ratio of these different parts of the Beluga to total length decreases with age (Tables XII and XIII). This is due to a faster

growth rate in length than in overall size.

5.- The blubber thickness of our Beluga, measured on the back varied from 1½ to 10½ inches. The ratio (expressed as a percentage) of blubber thickness to the total length of the animal can be used as an "index of condition": the higher the index, the fatter the Beluga, and vice versa. The average index of condition is from 2.12 to 5.26 per cent (Tables X and XI). The young animals are thinner than the adults (Tables IV and V). The specimens from our region appear to be fattest in May and June; they grow thin during the summer, and even thinner between November and March.

6.- The Beluga, which in the Province of Quebec is called "Marsouin blanc", goes through four successive stages of coloration between birth and adulthood: dark brown, bluish, greyish white and finally, white. For this reason, local whalers call them "Veau" (newborn dark brown calf), "Bleuvet" (blue calf), "Blanchon" or "Blafard" (greyish white young animal) and "Blanc" (White adult).

7.- The Beluga specimens collected in the St. Lawrence may be classified according to age as follows:

The **calf** is an animal whose colour is typically brown, rarely verging on blue. It varies in length from 61 to 83 inches. It has no teeth and always accompanies its mother who suckles it; it is either a newborn calf or a young animal a few months old.

The **blue calf,** is bluish in colour, and is in the next stage after the "Veau". This is a young animal, in its second year. It often continues to accompany its mother but finds its own food; its teeth are beginning to break through the gums but there are only a few. It is between 7 and 9 feet long.

The **greyish white calf** is three, perhaps four years old. The dark pigment of the earlier stages is beginning to fade. The general colouring is pale grey or greyish white, but the flippers are still dark, especially at the tips. This stage marks the beginning of sexual maturity for the female, but this is probably not the case with the male. On average, the female is two inches longer than the male. The most common length for both sexes is 10 to 11 feet.

The "White Whale" is the milky white adult. This group consists of animals of different ages: animals with dark flipper tips are at least 4 years old; the average length of the male is 11 feet, 9 inches and female, 11 feet, 6 inches. We consider animals whose flippers no longer have dark edges and whose teeth are badly worn to be 5 years or older.

8.- During the second and third years, annual growth in both sexes is approximately 2½ feet. During the fourth year, the female grows about 1 foot in length, and the male 1½ feet.

9.- Beluga females are smaller than Beluga males. Occasionally males up to 17 feet long are seen in the St. Lawrence region. In our specimens, the maximum size for a male was 14 feet, 8 inches, whereas the largest female was 13 feet, 5 inches. The males have larger flippers and the tail in particular is larger than that of the female (Tables XIII and XIX). In females, even old ones, the flippers are only slightly turned up, whereas in males, the flippers are so curved at the top that they can be used as a "handle" for lifting the animal out of the water.

10.- The male Beluga probably does not reach sexual maturity until it is 11 feet long, that is, not before the age of 4. Most

females reach sexual maturity at the age of three when they are still greyish white (Table XVIII). The smallest nursing mother was 10 feet, 3 inches long: the minimum length of four pregnant females varied from 10 feet, 6 inches to 10 feet, 8 inches. Female adults in the three categories, that is, virgins, pregnant females and nursing mothers, were in a ratio of 1:4:8.

11.- The gestation period of St. Lawrence Beluga is probably 12 months: a fully developed 59-inch foetus was removed in June, and three smaller ones ($4\frac{1}{2}$ -$5\frac{1}{2}$ inches) in July (Table XXIII). Some females can bear young at least two years in succession: for example, animal No. 308, measuring 11 feet, 6 inches in length whose mammary glands were swollen with white milk, was carrying a $5\frac{1}{2}$-inch foetus and at the same time, was accompanied by her calf.

12.- The method used to determine the age of a Beluga foetus is a modification of the method used for big whales. On the basis of this method, we determined the probable mating time of St. Lawrence Beluga, namely: April to June, with the peak time in May (Table XXII).

13.- Only one foetus per Beluga was found in the 17 pregnant females, although females are often seen accompanied by two calves. In the St. Lawrence region, most births take place in June, but can occur throughout the summer until September. A newborn calf is about 5 feet long, or 40% of its mother's length. In one particular case, (No. 300), however, this proportion rose to 44.3 per cent.

14.- The percentage of adult Beluga males to adult females noted was due mainly to the type of hunting method used: in 1938, males pursued by motorboat were easier to kill than females and thus there were more males among our specimens (Table I). There was

approximately the same number of male and female calves, but of the foetuses removed in 1938 and 1939 there were 13 males and 4 females.

15.- Any of the Beluga in our specimens that had been weaned and were beginning to find their own food had parasitic worms in their stomachs. The nematode Anisakis simplex predominated; it was often accompanied by an acanthocephala, the Corynosoma strumosum. The Beluga's most dreaded enemy, the killer whale or (Orcinus orca) is especially dangerous in spring and fall.

16.- Throughout the year, St. Lawrence Beluga live mainly in the area that extends from the Ile-aux-Coudres and Kamouraska district to the region of Pointe-de-Monts and Cap-Chat. During the summer, they are also found between Baie-Trinité and Natashquan, along the North Shore, and downriver, along the South Shore, as far as Grande Vallée. In early spring, small pods of Beluga appear in Baie des Chaleurs and off the Gaspé peninsula. In fall, a few may venture up the St. Lawrence as far as Saint-Antoine-de-Tilly, about 30 miles above Quebec City.

17.- The number of Beluga in the St. Lawrence varies from one period to another. For example, during the 1927-29 period, when the water was very cold, they were exceptionally plentiful. We attribute this abundance to an influx of hérds from elsewhere. Furthermore, during 1927 the seal hunt around Iles-de-la-Madeleine had been exceptionally good: 50,357 seals were caught, i.e., 5 times the annual average for all of the Province of Quebec. The situation was the opposite in the 1930-36 period when the water was particularly warm: the Beluga that had migrated to our area probably left, and the number of Beluga that remained was more or less the same as in the

years prior to 1927, that is, far less numerous than during the 1927-29 period.

The warm years (1930, 1934 and 1936) marked the appearance of huge herds of blackfish (Globicephala melaena) not only in the lower St. Lawrence but even around Ile d'Orléans. Also, during that same period, eelgrass (Zostera marina) disappeared from almost all of eastern Canada, including the St. Lawrence.

Cod-fishing in the St. Lawrence along the North Shore in particular, was subjected to significant changes as well: around 1926 and particularly around 1921 when the water was warm, cod-fishing was excellent, unlike in the cold period of 1927 to 1929, when it dropped off considerably. It recent years, it has started to recover.

In Le Danois' (1938) opinion, all of these periodic changes in the hydrological and biological conditions in the St. Lawrence region can be explained by the phenomenon of marine transgressions of the Atlantic waters.

18.- Today's commercial products from the Beluga are oil and hide, both of good quality. In 1943, a gallon of oil sold locally for 50 to 60 cents. A raw skin, fleshed and salted, was offered at about 15 cents a pound.

19.- The current market value of an average-size Beluga (about 12 or 13 feet long) can be calculated as follows: 50 gallons of oil at 60 cents a gallon, $30.00; 30 pounds of salted skin at 15 cents a pound (if there is a buyer), $4.50. Operating costs (gas, ammunition, salt, labour, etc.) of $2.00 to $4.00 per animal must be subtracted from total receipts leaving a net value per Beluga of approximately $30.00. Utilization of the meat as a food for humans or animals and

meal-processing can bring in approximately $15.00 more.

20.- Assuming that present-day hunting methods will be refined, and market conditions improved, the annual catch could be as high as 3,000 Beluga in the Canadian Arctic and close to 1,000 in the St. Lawrence. Therefore, once this industry has been properly organized, it could bring in about $100,000.

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APPENDIX

Tables XXIV - XXVIII have been added to make it easier to refer to each of the Beluga studied in this paper. The greyish white are included with the adult Beluga, irrespective of their state of sexual maturity. The smallest greyish white (No. 47a) is 9 feet 3 inches long. The young Beluga, i.e., the calves and the blue calves are not usually more than 9 feet long: blue calf No. 309 is an exception, measuring 9 feet, three inches in length.

1.- Common signs

-- - indicates a lack of information;
? - indicates that the accuracy of the information is questionable.

2.- Abbreviations under the heading "Location"

B.B. - Banc Blanc, part of the Manicouagan Bank;
B.G. - Banc de Glaise, part of the Manicouagan Bank;
B.V. - Banc Vert, part of the Manicouagan Bank;
L.E. - Les Escoumains;
P.M. - Pointe Manicouagan, near Pointe-Lebel;
P.O. - Pointe aux Outardes;
M.R. - Estuary of the Manicouagan River;
O.R. - Estuary of the Outardes River;
R. Ou. - Near Rivière-Ouelle, Kamouraska

3.- Abbreviations under the heading "Colour"

B - mostly white in colour; animal is called a White Whale;
B, ex-g - white body, but pectoral fins and especially the tail have dark gray borders; head is sometimes gray also; animal is called a White Whale;
G - mostly greyish white; animal is calld a greyish white calf;
G-b - mostly greyish blue; animal is called a blue calf;
V - mostly dark brown; tips of flippers are almost black; animal is called a calf.

4.- Abbreviations under the heading "Maturity"

pf - pregnant female
im - young female
nf - nursing female
vf - virgin female

5.- Abbreviations in columns with other headings

Ci - maximum circumference;
N - distance from snout to nostrils (blowhole)
E - distance from snout to eye
F - length of pectoral fins (flippers)
T - maximum breadth of the tail

TABLE XXIV.- Data on male adults caught on the Manicouagan Bank in 1938.

No	Date	Location / Endroit	Length of / Longueur du Béluga		Colour / Couleur	O	N	P	Q	Ci	Blubber / Lard
			pi. ft. po. in.	cm.		cm.	cm.	cm.	cm.	cm.	cm.
1	10.VI	B.V.	12 et 5½	380	B	39	48	48	114	254	15 2
2	15.VI	B.B.	12 " 4	376	B	34	44.5	44	108	232	16.5
3	15.VI	B.B.	13 " 5	409	B	38	47	41	114	280	19.1
6	16.VI	B.B.	12 " 7	384	B.ex-g	32.5	45	41	120	240	16.5
7	16.VI	B.B.	14 " 1	429	B	38	53	50	107	270	18.5
8	24.VI	B.V.	13 " 2	401	B	38	48	50	112	236	17
9	24.VI	B.V.	13 " 7	414	B	38	48	46	106	280	17
12	27.VI	B.V.	12 " 6	381	B.ex-g	32	39	46.5	97	240	17
14	28.VI	R.M.	11 " 5	348	B	32.5	46.5	43.5	88	280	17.8
16	27.VI	R.M.	11 " 8½	357	B	36	42	36	94	280	11
18	30.VI	B.V.	14 " 1	429	B	36.5	50	50	103	233	19
19	30.VI	B.V.	9 " 9	297	G	30	38.5	37.5	77	202	9.1
20	1.VII	B.V.	12 " 9	376	B	32	47	47	—	214	—
21	1.VII	B.V.	10 " 3½	314	G	25.5	33.5	34	62	166	9.5
22	1.VII	B.V.	12 " 6	381	B	31.5	46	43.5	95	213	15
26	7.VII	B.V.	13 " 5	409	B	36.5	49.5	46	106	282	17
27	8.VII	B.V.	13 " 5	409	B	34.5	44.5	45	116	256	11
28	8.VII	B.V.	13 " 8	417	B	31.5	34	49.5	120	268	11.5
33	13.VII	B.B.	12 " 5	379	B	36	47	47.5	100	203	13
36	14.VII	B.V.	10 " 2	310	G	29.5	36.5	36	78	180	9.5
38	18.VII	B.G.	13 " 8	417	B	38.5	46	48	119	306	22
39	18.VII	B.G.	10 " 2½	311	G	29.5	35	38	78	212	10
40	18.VII	B.G.	13 "10	422	B	39	48.5	48.5	116	278	15
41	18.VII	B.B.	12 " 9	389	B	36	44	48	114	248	13
42	20.VII	B.V.	11 " 7	353	B.ex-g	34	42	44	90	212	17
45	20.VII	B.G.	12 "11½	395	B	34	47	43	102	200	11
46	20.VII	B.G.	14 " 2	432	B	36	47	43	105	264	16.5
47a	27.VII	B.B.	9 " 3	282	G	27	35	38.5	69	187	10
52	27.VII	B.V.	14 " 0	427	B	36.5	51	50	108	270	18
53	28.VII	B.V.	13 " 7	414	B	38.5	50	53	106	232	13?
54	1.VIII	B.V.	14 " 1	429	B	38	46.5	48	102	282	23
55	1.VIII	B.V.	13 " 9	419	B	38.5	50.5	50	117	261	20
59	30.VII	B.G.	13 " 9	419	B	38	45	41	116	238	15
63	1.VIII	B.B.	11 " 4	345	G	34.5	39.5	43.5	86	214	10
64	1.VIII	B.B.	13 "10	422	B	38	46.5	45.5	112	302	27
65	3.VIII	B.B.	13 " 7	414	B	37.5	49	47	119	260	16
66	3.VIII	B.B.	13 " 4	406	B	36.5	48	49	180	280	14
67	3.VIII	B.V.	13 " 4	406	B	37.5	51	44	109	280	15
68	3.VIII	B.G.	13 " 1	399	B.ex-g	36	49	45	101	233	14

TABLE XXIV (cont'd).- Data on male adults caught on the Manicouagan Bank in 1938.

No	Date	Location / Endroit	Length of Beluga / Longueur du Béluga		Colour / Couleur	O	N	P	Q	Ci	Blubber / Lard
			pi. ft. po. in.	cm.		cm.	cm.	cm.	cm.	cm.	cm.
69	3.VIII	B.V.	14 et 1	429	B	38	48	48	99	286	20
76	9.VIII	B.B.	13 " 11	424	B	36	48	49	115	267	16
78	1.VIII	R.P.R.	11 " 6	351	B	—	—	—	—	—	—
79	15.VIII	B.G.	14 " 8	447	B	36.5	46.5	44	113	266	17
80	18.VIII	B.B.	12 " 7	384	B	38	41	51	114	267	17
83	19.VIII	B.G.	14 " 1	429	B	38.5	52	48	115	290	15.8
85	19.VIII	B.V.	13 " 8	417	B	36	49	48	94	232	11.5
88	20.VIII	B.B.	14 " 3	434	B	33.5	50	49	107	225	16
91	23.VIII	B.B.	14 " 1	429	B	36	49.5	49	111	245	20
92	23.VIII	B.B.	10 " 10	330	G	32	41	43	82	214	15.5
94	27.VIII	B.V.	14 " 8	447	B	39	53	52	118	258	15.5
95	23.VIII	B.V.	14 " 0	427	B	37	53	55	100	290	16
96	27.VIII	B.V.	14 " 0	427	B	45?	49	48	99	266	15.5
107	31.VIII	B.G.	14 " 4	437	B	37	50	48	100	294	16
113	2.IX	B.B.	9 " 5½	288	G	29	39	36	76	86	11.5
114	2.IX	B.B.	14 " 2	432	B	40	53	54	100	310	20
115	2.IX	B.B.	14 " 5½	441	B	38	53	56	134	280	17.5
116	3.IX	B.V.	13 " 9½	420	B	35.5	49.5	47	110	266	17.5
118	7.IX	B.V.	12 " 7	384	B	34.5	47	49	109	246	16
119	7.IX	B.V.	13 " 11	424	B	35.5	52	57	113	227	21
120	8.IX	P.M.	13 " 6	412	B	35.5	45	47	107	218	18
126	9.IX	B.G.	12 " 4	376	B	34.5	46	45	90	224	19.5
133	10.IX	B.V.	14 " 2	432	B	37	46	44	107	274	17
134	10.IX	B.B.	11 " 0	335	G	33.5	46	43	98	244	12
136	11.IX	B.G.	14 " 8	447	B	37	50.5	46	112	260	18
139	16.IX	R.M.	10 " 9	328	G	30.5	37.5	38.5	77	204	10
141	23.IX	B.G.	10 " 2	310	G	29	39.5	41	82	198	12.5
144	23.IX	B.B.	12 " 9	389	B	35	47	44	95	220	14

TABLE XXV - Data on adult females caught on the Manicouagan Bank in 1938.

No	Date	Location / Endroit	Length of / Longueur du Béluga			Colour / Couleur	O	N	P	Q	Ci	Blubber / Lard
			pi. ft.	po. in.	cm.		cm.	cm.	cm.	cm.	cm.	cm.
5	16.VI	B.B.	11	1	338	B.ex-g	30	38.5	37.5	73.5	220	12.7
15	28.VI	R.M.	11	2½	342	B	29	39	38.5	87	222	16
25	7.VII	B.V.	11	3	343	B.ex-g	31	38	37	79	204	11
30	11.VII	B.V.	11	4	345	B	28	34	54	86	246	14
35	14.VII	B.V.	11	11	363	B	32.5	44	46	93	248	15.2
37	14.VII	B.G.	11	6	351	B	30	39.5	43.5	81	222	11.5
44	20.VII	B.V.	11	4	345	B.ex-g	29	39	45.5	80.5	218	12.5
48	27.VII	B.B.	11	1	338	G	30	38	45	78	240	10.5
49	28.VII	B.B.	10	4	315	G	27	37	39	76	230	14
50	28.VII	B.B.	12	0	366	B	32	38.5	42.5	85	260	13
58	1.VIII	B.B.	11	0	335	B.ex-g	30.5	38.5	34	90.5	186	15
60	1.VIII	B.B.	11	7	353	B	30.5	37	45	83.5	186	15
62	1.VIII	—	11	11	361	B	32	38.5	42.5	90	234	13
70	4.VIII	B.G.	13	5	409	B	41.5?	41.5	41.5	—	190?	17
71	7.VIII	B.B.	10	2	310	B	27.5	35	37.5	88	172	10.5
72	7.VIII	B.B.	10	10	330	B	32.5	40	37	96	180	12.5
81	19.VIII	B.G.	11	9½	359	B.ex-g	30.5	43.5	43	83.5	216	15
82	19.VIII	B.B.	11	8½	357	B	33.5	41.5	49.5	80	230	11
84	19.VIII	B.B.	10	11	333	G	29.5	41	38	72	216	11.5
87	20 VIII	B.B.	11	3	343	G	30	47	37	72	182	12
93	25 VIII	B.B.	10	10	330	G	28.5	39	36.5	74	188	12.5
99	30 VIII	B.B.	10	6	320	G	28	36	36.5	70	162	10.1
100	30 VIII	B.G.	11	6	351	B.ex-g	28.5	38.5	42	82	209	17
101	30 VIII	B.B.	10	7	323	G	28.5	41	41	84	110?	15
102	31 VIII	B.B.	11	11	363	B	35	40	40	76	202	14.5
103	31 VIII	B.B.	13	2	401	B	34	45	48	89	215	12.5
105	31.VIII	B.G.	10	1	307	G	29	39	40	—	196	12
106	31.VIII	B.G.	10	8	325	G	35	38	43	74	200	10.6
108	31.VIII	B.B.	10	11	333	G	29	40	40	78	212	13
109	2.IX	B.B.	12	3	373	B	31	41	48	84	202	15
111	2.IX	B.B.	12	7	384	B	32	42.5	50.5	87.5	232	17.4
112	2.IX	B.B.	9	11	302	G	26	34.5	37	—	176	10
121	8.IX	P.O.	12	5	379	B.ex-g	33.5	43	47	84	232	18
123	8.IX	P.M.	11	11	363	B	30	38	44	74	196	14
125	8.IX	P.M.	12	1	368	B	32	41	40	81	222	15
127	9.IX	B.G.	11	5	348	B	29	38.5	49	77	228	18
128	10.IX	B.B.	10	8	325	B	29	37.5	37	80	214	12
129	10.IX	B.B.	12	5	379	B	32	43	40.5	86	222	15
132	10.IX	B.V.	10	11	333	B	29	37	36	74	196	11
135	11.IX	B.G.	11	10	361	B	33	42	41	86.5	222	12.5
137	11.IX	B.G.	9	11½	304	G	26	36	34.5	68.5	208	12.2
138	12.IX	B.G.	10	10	330	G	30	41	38	77.5	200	13
140	23.IX	B.G.	11	9½	359	B	30.5	38.5	40	84	220	15
143	23.IX	B.B.	10	1	307	G	28	36.5	37.5	75	184	10
145	24.IX	B.B.	10	5	318	B	31	39	42	81	214	11.5
146	24.IX	B.G.	9	6½	291	G	27	36	33.5	70	186	11.5

TABLE XXVI.- Data on adults caught in the St. Lawrence River in 1939.

No	SEX. SEXE	DATE	LENGTH OF BELUGA LONGUEUR DU BÉLUGA pi. ft. po. in.	LENGTH OF BELUGA LONGUEUR DU BÉLUGA cm.	COLOUR COULEUR	O cm.	N cm.	P cm.	Q cm.	Ci cm.	BLUBBER LARD cm.
					Les Escoumains						
300	♀	21.VI	11 et ½	337	B	—	—	—	81	—	—
303	♂	25.VI	11 " 7	353	B,ex-g	31.5	44	41	88	240	15.2
304	♂	26.VI	13 " 3	404	B	39	45	45	—	270	16.5
305	♀	28.VI	10 " 3	312	G	29	36	40	74	182	12.7
306	♀	30.VI	11 " 4	345	B	29	36	45	82 5	220	12.7
307	♀	30.VI	12 " 0	366	B	30	39.5	41.5	84	230	15.2
308	♀	4.VII	11 " 6	351	B	29.5	38.5	45	82	234	14.6
311	♀	15.VII	10 "11	333	G	28.5	37.5	43.5	82	210	17.8
312	♀	22.VII	11 " 2	340	B,ex-g	28.5	38	43.5	80	206	12.7
314	♀	24.VII	10 "11	333	B	30	42	41	83	188	12.2
315	♂	31.VII	9 " 4	285	G	25.5	34.5	35	68	196	12.2
316	♀	2.VIII	11 " 3	343	B	28 5	39	41	78.5	212	14.6
					Manicouagan Bank *Banc de Manicouagan*						
318	♀	27.VIII	12 " 3	373	B	32.5	43	45	85	233	14
					Rivière-Ouelle						
332	♀	25.X	11 " 8	356	B,ex-g	—	—	—	80	206	11.5
333	♂	3.XI	10 " 9½	329	B,ex-g	—	—	—	79	183	7

TABLE XXVII.- Data on young Beluga caught in the St. Lawrence River in 1938 and 1939.

No.	SEX Sexe	DATE	LOCATION Endroit	LENGTH OF BELUGA LONGUEUR DU BÉLUGA pi. po. ft. in.	LENGTH OF BELUGA LONGUEUR DU BÉLUGA cm.	COLOUR COULEUR	O cm.	N cm.	P cm.	Q cm.	Ci cm.	Blubber LARD cm.	Lait dans l'estomac Milk in the stomach
					Manicouagan Bank *Banc de Manicouagan*, 1938								
4	♂	16.VI	B.B.	8 et 7½	263	G-b	25	32	34	58	180	12.7	non no
10	♂	24.VI	B.G.	8 " 4	254	G-b	24	32	32	61	180	7.6	non no
11	♀	25.VI	B.V.	7 "10	239	G-b	24.5	33	32	53	175	8	non no
13	♂	27.VI	B.G.	8 " 7	262	G-b	26.5	31.5	33	59	190	16	non no
24	♂	7.VII	B.V.	7 " 8	234	G-b	23	29	26.5	49.5	163	10.5	non no
29	♀	11.VII	B.V.	7 " 4	224	G-b	21	23	29	55	134	5	non no
31	♀	13.VII	B.V.	7 " 3	221	G-b	23	30	32.5	50.5	148	5	non no
32	♂	13.VII	B.B.	7 " 5	226	G-b	23.5	30.5	31	55.5	168	8.2	non no
34	♀	14.VII	B.B.	8 " 1	246	G-b	23	29.5	34.5	60.5	169	7.5	non no
43	♀	20.VII	B.V.	5 " 1	155	V	15.5	23	26	38.5	100	6	oui yes
47	♂	22.VII	B.B.	5 " 2	158	V	15.5	18.5	26	37	91	—	oui yes
51	♂	28.VII	B.B.	5 " 2	158	V	15.5	19.5	24	37	91	4.9	oui yes
61	♂	1.VIII	B.B.	8 " 3	252	G-b	25.5	39.5	40	59.5	168	11	non no
73	♀	6.VIII	B.B.	6 " 6½	199	V	16.5	27	25.5	48.5	53+	4.5	non no
74	♀	9.VIII	B.B.	8 " 7½	263	G-b	22	31	33	67	178	15	non no
86	♀	20.VIII	B.B.	5 " 4	163	V	15	19.5	25.5	37	114	5.5	oui yes
97	♀	30.VIII	B.B.	6 "11	211	G-b	22	27	32	53	134	8	non no
98	♀	30.VIII	B B.	7 " 6	229	G-b	26	29.5	29	60	164	8	non no
104	♀	31.VIII	B.B.	7 " 4	224	G-b	22	29.5	35	53	138	12	non no
110	♀	2.IX	B.B.	8 " 9½	268	G-b	25	33	34	65	176	9	non no
117	♀	2.IX	P.M.	5 " 3	160	V	15	21	22	35	107	6	oui yes
122	♂	8.IX	P.M.	5 " 6	168	V	12.5	12?	24	40	104	10	oui yes
124	♀	9.IX	B.G.	7 "10	239	G-b	23	29.5	33	49.5	152	10.5	non no
130	♂	10.IX	B.V.	6 " 4	193	V	19.5	22	21	46.5	134	7	oui yes
131	♀	10.IX	B.V.	5 " 4	163	V	16.5	21.5	19.5	38	102	4	oui yes
142	♀	23.IX	B.G.	6 " 1	185	V	17	23.5	28	42.5	118	6.5	oui yes
					Les Escoumains, 1939								
301	♂	21.VI	L.E.	6 " 6½	199	V	—	—	—	46	—	—	non no
309	♀	8.VII	L.E.	9 " 3	282	G-b	25	34.5	35	61	194	12 2	non no
310	♂	13.VII	L.E.	8 " 4	254	G-b	25	32	37	58	175	11.4	non no
313	♂	24.VII	L.E.	7 " 8½	235	G-b	22.5	22	29	53	151	8.3	non no
317	♂	3.VIII	L.E.	5 " 2½	159	V	16	20	23.5	35	101	8.3	oui yes
					Manicouagan Bank *Banc de Manicouagan*, 1939								
319	♀	27.VIII	B.B.	6 " 8	203	G-b	20	24	29	47	130	8 3	oui yes
					Rivière-Ouelle, 1939								
331	♀	25.IX	R.Ou.	8 " 7	262	G-b	—	—	36	60	150	8.5	non no

(+) No. 73 was very thin; it had a stomach ulcer.

TABLE XXVIII.- State of sexual maturity of females caught in the St. Lawrence River in 1938 and 1939.

No	Date	Length of Beluga / Longueur du Béluga pi. ft. po. in.	cm.	Colour / Couleur	Maturity / Maturité	Number of calves / Nombre de veaux	Mammary glands / Glandes mammaires
		Manicouagan Bank, 1938 / Banc de Manicouagan, 1938					
5	16.VI	11 et 1	338	B, ex-g	vi	0	vides empty
15	28.VI	11 " 2½	342	B	no	1	pleines de lait full of milk
25	7.VII	11 " 3	343	B, ex-g	gr	0	vides empty
30	11.VII	11 " 4	345	B	no	2	pleines de lait full of milk
35	14.VII	11 "11	363	B	—	—	liquide verdâtre greenish liquid
37	14.VII	11 " 6	351	B	no	2	pleines de lait full of milk
44	20.VII	11 " 4	345	B, ex-g	no	1	pleines de lait full of milk
48	27.VII	11 " 1	338	G	gr	0	vides empty
49	28.VII	10 " 4	315	G	vi	0	vides empty
50	28.VII	12 " 0	366	B	no	1	pleines de lait full of milk
58	1.VIII	11 " 0	335	B, ex-g	no	1?	liquide jaune yellow liquid
60	1.VIII	11 " 7	353	B	no	1?	liquide jaune yellow liquid
62	1.VIII	11 "11	361	B	no	1	pleines de lait full of milk
70	4.VIII	13 " 5	409	B	no	1	pleines de lait full of milk
71	7.VIII	10 " 2	310	B	vi	0	vides empty
72	7.VIII	10 "10	330	B	no	1	pleines de lait full of milk
81	19.VIII	11 " 9½	359	B, ex-g	no	1	pleines de lait full of milk
82	19.VIII	11 " 8½	357	B	gr	0	liquide verdâtre greenish liquid
84	19.VIII	10 "11	333	G	gr	0	liquide verdâtre greenish liquid
87	20.VIII	11 " 3	343	G	no	1	pleines de lait full of milk
93	25.VIII	10 "10	330	G	gr	0	vides empty
99	30.VIII	10 " 6	320	G	gr	0	vides empty
100	30.VIII	11 " 6	351	B, ex-g	no	1	pleines de lait full of milk
101	30.VIII	10 " 7	323	G	gr	0	vides empty
102	31.VIII	11 "11	363	B	gr	0	vides empty
103	31.VIII	13 " 2	401	B	no	2	pleines de lait full of milk
105	31.VIII	10 " 1	307	G	im	0	vides empty
106	31.VIII	10 " 8	325	G	gr	0	vides empty
108	31.VIII	10 "11	333	G	gr	0	vides empty
109	2.IX	12 " 3	373	B	no	1?	pleines de lait full of milk

TABLE XXVIII (Cont'd).- Sta[illegible]ght in the St. Lawrence River in

No	Date	Length of Beluga / Longueur du Béluga								
		pi. ft.	po. in.	cm.						
111	2.IX	12	et 7	384						full of milk
112	2.IX	9	"11	302						empty
121	8.IX	12	" 5	379						greenish liquid
123	8.IX	11	"11	363						full of milk
125	8.IX	12	" 1	368						full of milk
127	9.IX	11	" 5	348						empty
128	10.IX	10	" 8	325						empty
129	10.IX	12	" 5	379						full of milk
132	10.IX	10	"11	333						
135	11.IX	11	"10	361	B	—	0	—	—	
137	11.IX	9	"11½	304	G	im	0	—	—	
138	12.IX	10	"10	330	G	gr	1?	—	—	
140	23.IX	11	" 9½	359	B	no	1	lait jaune	yellow milk	
143	23.IX	10	" 1	307	G	vi	0	vides	empty	
145	24.IX	10	" 5	318	B	no	1	lait jaune	yellow milk	
146	24.IX	9	" 6½	291	G	im	0	—	—	
		Les Escoumains, 1939								
300	21.VI	11	" ½	337	B	gr	0	—	—	
305	28.VI	10	" 3	312	G	no	1	pleines de lait	full of milk	
306	30.VI	11	" 4	345	B	no?	—	liquide jaune	yellow liquid	
307	30.VI	12	" 0	366	B	no	1	pleines de lait	full of milk	
308	4.VII	11	" 6	351	B	gr et no	1	pleines de lait	full of milk	
309	8.VII	9	" 3	282	G-b	im	0	vides	empty	
311	15.VII	10	"11	333	G	gr	0	vides	empty	
312	22.VII	11	" 2	340	B, ex-g	no	1	pleines de lait	full of milk	
314	24.VII	10	"11	333	B	no	—	peu de lait	little milk	
316	2.VIII	11	" 3	343	B	no	1	pleines de lait	full of milk	
		Manicouagan Bank *Banc de Manicouagan*, 1939								
318	27.VIII	12	" 3	373	B	no	1	pleines de lait	full of milk	
		Rivière-Ouelle, 1939								
332	25.X	11	" 8	356	B, ex-g	no	1	—	—	

TABLE XXVIII (Cont'd).- State of sexual maturity of females caught in the St. Lawrence River in 1938 and 1939.

No	Date	Length of Beluga / Longueur du Béluga pi. ft.	po. in.	em.	Colour / Couleur	Maturity / Maturité	Number of calves / Nombre de veaux	Mammary glands / Glandes mammaires	
					Manicouagan Bank, 1938 *Banc de Manicouagan. 1938*				
111	2.IX	12	et 7	384	B	no	2	pleines de lait	full of milk
112	2.IX	9	"11	302	G	im	0	vides	empty
121	8.IX	12	" 5	379	B. ex-g	gr	0	liquide verdâtre	greenish liquid
123	8.IX	11	"11	363	B	no	1	pleines de lait	full of milk
125	8.IX	12	" 1	368	B	no	1	pleines de lait	full of milk
127	9.IX	11	" 5	348	B	gr	0	vides	empty
128	10.IX	10	" 8	325	B	gr	0	vides	empty
129	10.IX	12	" 5	379	B	no	1	pleines de lait	full of milk
132	10.IX	10	"11	333	B	no	1	—	—
135	11.IX	11	"10	361	B	—	0	—	—
137	11.IX	9	"11½	304	G	im	0	—	—
138	12.IX	10	"10	330	G	gr	1?	—	—
140	23.IX	11	" 9½	359	B	no	1	lait jaune	yellow milk
143	23.IX	10	" 1	307	G	vi	0	vides	empty
145	24.IX	10	" 5	318	B	no	1	lait jaune	yellow milk
146	24.IX	9	" 6½	291	G	im	0	—	—
					Les Escoumains, 1939				
300	21.VI	11	" ½	337	B	gr	0	—	—
305	28.VI	10	" 3	312	G	no	1	pleines de lait	full of milk
306	30.VI	11	" 4	345	B	no?	—	liquide jaune	yellow liquid
307	30.VI	12	" 0	366	B	no	1	pleines de lait	full of milk
308	4.VII	11	" 6	351	B	gr et no	1	pleines de lait	full of milk
309	8.VII	9	" 3	282	G-b	im	0	vides	empty
311	15.VII	10	"11	333	G	gr	0	vides	empty
312	22.VII	11	" 2	340	B. ex-g	no	1	pleines de lait	full of milk
314	24.VII	10	"11	333	B	no	—	peu de lait	little milk
316	2.VIII	11	" 3	343	B	no	1	pleines de lait	full of milk
					Manicouagan Bank *Banc de Manicouagan. 1939*				
318	27.VIII	12	" 3	373	B	no	1	pleines de lait	full of milk
					Rivière-Ouelle. 1939				
332	25.X	11	" 8	356	B. ex-g	no	1	—	—