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More on the Question of Inconsistencies in Studying the Scotian Shelf Silver Hake Growth Rate by the Soviet and Canadian Scientists

by

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INTRODUCTION

Age and growth studies are indispensable for apprehending the sequencial development of the organism in the ontogenesis and the processes taking place in the population. The data on the age composi- of the catches and mean weight by age are used as the input para- meters in the V.P.A.. Many efforts have been made by the scientists in order to work out a valid method of age and growth parameter de- termination for reliable forecasting the stock and catch sizes and the TAC.

To reach a common viewpoint on this question, the meetings of the Working Groups of experts from the USA, Canada, USSR and Cuba were held within the framework of the NAFO Scientific Council in 1977 and 1978. As a result of discussions at those meetings, it was agreed that two methods were equal of worth, and the use of both methods was approved (Grinkov, ?). However till now the inconsistencies in estimating the age and growth parameters persist in some aspects, namely, age composition of the cathes, rate of linear and weight growth and stock size and TAC assessment.

In this paper these inconsistencies are considered once again, and an attempt is made to elucidate the reasons causing them. We believe that this question has to be dealt with until ultimate solu- tion is reached.

RESULTS

1. Age composition. Table 1 contains the data on the age composi-

tion of the catches (%) presented by the Canadian (A) and Soviet (B) sides.

The Canadian estimates for the catch at age are greater for age groups 1 and 2, the Canadian and Soviet estimates for age group 3 are comparatively equal, and the Soviet estimates for age group 4 and older fish exceed the Canadian ones.

Hant (1987) also reported such data for 1980 - 1985, and derived the coefficients of the ratio of the Canadian and Soviet estimates of the age composition of the catches by dividing the Canadian estimate for age groups 1-9 by the Soviet estimate. The resultant coefficients for age groups 1-5 were 2.09, 1.24, 1,05, 0.68 and 0.82, respectively.

It is evident that the ratio coefficients above 1.0 are indicative of greater Canadian estimates while those below 1.0 show greater Soviet estimates for each age group.

According to Hant, the ageing technique does not play a significant role in inconsistency of estimates. After the example of 1984, he stated that according to the Canadian data, the individuals of the 1983 year class at age 1 constituted 23% of the catches, and in the Soviet data that estimate amounted to only 5%. If a part of the stock estimated by the Canadian side as age group 1 were considered by the Soviet part to be age group 2 specimens, the Soviet estimate for age group 2 was expected to be greater. However in fact we had actually similar estimates for the specimens at the age of 2 (9.4 and 10.1, respectively). It is hardly probable that the youngs of the year were aged by the expert older than 2 years old. Unlike Hant, we beleive that a part of the age group 1 may be related to age group 2, and a part of age group 2 - to age group 3, etc. The pelagic zone on the otoliths is not always distinct.

Within the framework of the program on the exchange of the silver hake otoliths between the USSR and Canada, the age reading coincided in 85% of cases,in 14% of cases the Soviet estimates were 1-2 years greater compared with the Canadian estimates, and only in 1% of cases the Soviet estimstes were lower (Senina, Stulova, 1986).

It is worth noting that since 1977, i.e. after the meetings of the NAFO Scientific Council, the proportion of age groups 1 and

2 has considerably decreased in the Canadian data, and the propor-
tion of age groups 3, 4 and 5 has markedly increased so that the
age composition pattern has become almost similar to that of the
Soviet side (fig. 1a, b, c, d, e).

A question arises why the age composition of the catches chang-
ed just in the years that followed the NAFO meetings. It is true
that since 1977 the silver hake fishery has been conducted in the
area open for the fishery, but it is hardly probable that consider-
able changes might have taken place in the age structure of the
catches as no such tendency had been observed in the Soviet data,
and the silver hake fishery carried out by the Soviet side has been
quite intensive.

2. Rate of weight growth. On the Soviet side, the mean weight
by age was reported by Noskov (1985) (1984 data), Rikhter (1988)
(1977-1986 data) and Ngujen Fuong (1989) (same data for 1978-1986
but classified by sex) (table 2).

On the Canadian side, the mean weight by age was reported by
Clay (1980) (1970-1979 data), Clay and Beanlands (1980) (1958-1979
data). However some estimates of the two authors are inconsistent.
They differ for one and the same year and age, so we present all
the tables to ensure easy comparison.

The data from table 3 are quite doubtful: the difference
between the estimates of fish weight by year at the same age is
too great. For example, at age 1 the estimates ranged from 0.040 kg
in 1971 to 0.81 kg in 1963; at age 7 from 0.226 kg in 1960 to 1.333
kg in 1975; at age 8 from 0.301 kg in 1959 to 1.263 kg in 1972; at
age 9 from 0.284 kg in 1959 to 1.635 kg in 1975; at age 10 from
0.149 kg in 1959, 1962 and 1968 to 1.726 kg in 1973.

In many cases, the mean weight of older age groups was lower
than that of the younger age groups. This can be observed in years
1959, 1962, 1965, 1968, 1971, 1972, 1975, 1976 and 1978.

Thus the tables do not give a clear idea of the mean weight
by age.

Waldron, Fanning and the other authors reported several times
on the mean weight of the silver hake by age. We will analyse only
the recent publications as the data are practically similar for
different periods (except the 1982 report on the 1984 data) (table 4).

Like in Clay (?), the data reported by these authors also lack consistency in some cases though the fluctuations of the mean weight by year are smaller.

The diagram of the mean weight growth by age is shown in fig.2. The Soviet data (Ngujen Fuong, 1989) are represented by the mean long-term estimates for 1971-1986, and the Canadian data (Waldron and Sinclair, 1983) for 1970-1982. Tendencies of weight growth are almost the same in the Soviet and Canadian data, however, the Canadian estimates are mostly greater.

It may mean that when ageing the silver hake, the Canadian scientists attribute a number of specimens of each age group to a lower age class.

Though a series of the longterm data is long enough the Canadian scientists may be pressed for the data on older age groups as the increase of the mean weight estimates does not seem to be logical.

3. Dynamics of mean weight index by year. Fig.3 (a,b) shows the diagrams of the index dynamics from the data of the Soviet (Ngyjen Fuong, 1989) and Canadian scientists (Waldron et al., 1988).

Compared to our data, the fluctuation of this index by year is obviously greater in Waldron.

The weight by age is one of the morphological indices for any species and changes depending on environmental conditions (mainly depending on food base) or on appearance of subgenera having their own morphological characteristics. None of these factors might have influenced this index, especially since 1977-1978.

4. Biomass. The biomass estimates by age cannot be correct if the estimates of mean weight by age are wrong. This opinion has been expressed by the Canadian authors. For example, Clay and Beanlands (1980) stated that some inconsistencies existed between the actual and calculated cathes which probably had been caused by an error in mean weight by age estimates (incorrect data collection) and misrepresentation of the catch statistics.

Also Hant (1987), presenting his table "Catch sizes by age group, % " based on the Canadian and Soviet sources of age determination in 1985, wrote that the differences between catch statistics (between the actual and calculated data) by age group (%) based

on the Soviet age determinations are minimum and are indicative of
the situation when the catch in pieces by size group was estimated
using the mean weight values in a sample and not the size-weight
ratios. The differences between the catch statistics by age group (%)
based on the Canadian age determinations are more significant.

Indeed, compared to the size-weight ratios, the mean weight
estimates (massive measurements) is a better tool to determine
the catch in pieces. Firstly, it is a direct method which prevents
from introduction of casual errors and secondly, when constructing
the size-weight ratio,the Canadian scientists proceed from the data
collected in a single cruise carried out in July with the limited
number of specimens at hand.

Conclusion

In the studies of the Scotian silver hake age and growth some
inconsistencies in age determination by different scientists, and
hence in age composition of the catches, have been observed. Unlike
the Soviet scientists, the Canadian experts attribute a part of
specimens of each age group to a younger age group. The Canadian
scientists use the size-weight ratio to estimate mean weights by
age, which often leads to incorrect estimates especially when the
number of specimens is not adequate for such a procedure. This has
caused a difference between the Canadian and Soviet stock size and
TAC assessment.

When this paper was written,we received a new Canadian paper
(Waldron, Bourbonnais and Showell, 1989) containing a great deal
of reconstruction and new data:

  - Age composition data: the proportion of age group 1 still
    more reduced; modal group is represented by age group 3.
    Thus the picture of age composition of the catches has become
    closer to that in the Soviet scientists.

  - Mean weight estimates by age: a difference remained large
    between the years; mean body weight is mainly small in the
    fish at the age of 9. A question arises: what is the age
    of the hake having, for example, the weight of 1500 g ?

We continue to study the recent paper and will try to find
the cause of differences.

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Table 1

Age composition of Nova Scotia silver hake, %

a) Canadian data

Age, years	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	15,0	27,1	38,4	11,9	15,3	21,7	23,7	1,3	10,0	4,2	3,0	0,8	7,8	1,8	23,2	9,4	-	-	-
2	39,5	45,0	46,7	71,6	58,9	54,7	58,9	26,5	31,8	21,2	29,1	10,2	20,5	45,7	9,4	42,9	-	-	-
3	17,3	19,2	7,3	4,7	22,8	7,9	11,2	47,7	31,4	30,3	39,4	58,1	26,6	27,4	44,6	16,4	-	-	-
4	4,8	8,2	4,9	5,2	1,1	9,1	4,8	18,0	15,0	20,4	17,2	20,1	26,3	15,0	16,8	22,7	-	-	-
5	1,7	2,4	1,8	4,7	1,5	5,8	0,9	4,3	6,8	13,0	7,3	7,5	13,8	6,9	4,5	5,6	-	-	-
6	0,8	0,2	0,8	1,0	0,5	0,7	0,4	1,2	3,0	7,4	3,0	2,9	3,5	2,4	1,3	2,2	-	-	-
7	0,3	0,6	0,1	0,7	-	-	0,1	0,3	1,1	2,2	0,8	0,4	1,1	0,6	0,2	0,8	-	-	-
8	0,2	0,2	-	0,3	-	-	-	0,3	0,7	0,8	0,2	0,1	0,4	0,3	-	0,2	-	-	-
9	0,1	0,2	0,1	-	-	-	0,1	0,3	0,2	0,5	-	-	-	-	-	0,1	-	-	-

b) Soviet data

Age, years	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	11,5^x	5,6^x	7,0^x	6,2	5,1^x	4,8	8,3	2,7	2,2	6,2	1,4	0,7	4,9	1,4	5,0	5,4	7,4	1,6	+
2	10,8	10,8	26,9	9,3	11,8	13,6	45,2	8,9	21,7	21,9	16,8	9,9	14,9	42,6	10,1	33,7	12,9	59,3	42,4
3	32,8	39,4	33,3	43,0	42,8	39,7	30,0	44,1	34,0	36,4	36,2	42,6	24,1	27,0	38,6	29,9	45,1	21,0	41,3
4	34,3	34,4	21,4	25,8	28,7	29,8	11,0	35,9	30,2	20,3	32,4	33,0	37,6	20,6	33,1	21,8	28,8	14,5	13,8
5	9,5	7,8	10,0	11,7	7,9	8,7	4,4	7,1	9,3	7,1	9,6	10,3	12,8	5,8	10,5	7,7	5,3	2,8	2,4
6	0,7	1,0	0,9	2,4	1,7	2,1	0,7	1,0	1,7	1,6	2,2	2,6	4,1	1,9	2,0	1,2	0,4	0,6	0,1
7	0,3	0,4	0,2	0,8	1,1	1,0	0,3	0,3	0,6	0,4	0,6	0,7	1,1	0,5	0,6	0,3	0,1	0,2	+
8	0,1	0,1	0,1	0,3	0,8	0,2	0,1	+	0,2	0,1	0,5	0,1	0,4	0,1	0,1	+	+	+	+
9	+	0,2	0,1	0,1	0,1	0,1	+	+	0,1	-	0,2	0,1	0,1	0,1	+	+	+	-	-
10	-	-	+	0,1	+	-	-	-	0,1	-	0,1	0,1	0,1	+	+	-	-	-	-

Note: data only for Subarea 4W

Table 2   Mean weight, kg, by age of silver hake from Subarea 4VWX
from Soviet data

Age Sources:	Sex	1	2	3	4	5	6	7	8	9	10
from Rikhter, mean value for 1977-1986		0,044	0,117	0,187	0,262	0,384	0,459	0,652			
from Noskov, data for 1984		0,044	0,110	0,156	0,207	0,307	0,392	0,454			
1978	♂	0,076	0,127	0,185	0,231	0,304					
1978	♀	0,061	0,118	0,162	0,307	0,356	0,453	0,602	0,755	1,049	
1979	♂	0,073	0,165	0,226	0,292	0,337					
1979	♀	0,071	0,156	0,242	0,367	0,411	0,584	0,722	0,946	1,298	1,310
1980	♂	0,038	0,121	0,185	0,245	0,277					
1980	♀	0,039	0,129	0,199	0,252	0,363	0,455	0,522	0,810	1,276	1,536
1981	♂	0,069	0,113	0,163	0,216	0,252	0,311				
1981	♀	0,033	0,105	0,188	0,239	0,334	0,413	0,564	0,799	1,214	1,502
1982	♂	0,047	0,124	0,179	0,228	0,273	0,440				
1982	♀	0,041	0,120	0,232	0,283	0,392	0,430	0,640	0,729	1,087	1,538
1983	♂	0,044	0,086	0,189	0,233	0,281	0,380				
1983	♀	0,044	0,120	0,187	0,270	0,364	0,471	0,632	1,080	1,138	
1985	♂	0,053	0,087	0,148	0,213	0,277	0,316	0,373	0,653		
1985	♀	0,059	0,135	0,190	0,290	0,392	0,474	0,642	0,771	1,113	
1986	♂	0,047	0,111	0,168	0,236	0,296					
1986	♀	0,044	0,128	0,187	0,273	0,389	0,487	0,634	0,957		
		0,050	0,112	0,176	0,235	0,292	0,325				
Mean	♂	0,047	0,127	0,197	0,264	0,370	0,459	0,591	0,803	1,186	1,523
Mean	♀	0,048	0,118	0,185	0,252	0,360	0,446	0,591	0,803	1,186	1,523

From Nguyen Phuong

Table 3

Weight, kg, by age of silver hake of Subarea 4VWX from Clay

(both tables for 1980)

A:

Age, years	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
I	57	56	55	46	68	64	62	52	43	42
2	127	131	113	128	137	153	147	126	100	146
3	182	197	194	233	224	229	232	198	168	198
4	251	248	258	263	353	276	273	279	218	250
5	351	361	361	365	392	327	317	374	254	333
6	556	569	605	590	528	525	525	684	684	412

B:

Age, years	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
I	0,076	0,077	0,077	0,035	0,067	0,067	0,072	0,067	0,072	0,078	0,075	0,062	0,060	0,040	0,056	0,045	0,063	0,067	0,063	0,062	0,049	0,061
2	0,112	0,113	0,113	0,096	0,104	0,129	0,140	0,151	0,128	0,150	0,128	0,133	0,126	0,128	0,119	0,128	0,129	0,155	0,148	0,147	0,110	0,154
3	0,178	0,184	0,183	0,001	0,160	0,185	0,189	0,195	0,195	0,196	0,175	0,175	0,167	0,188	0,209	0,216	0,204	0,243	0,246	0,246	0,174	0,200
4	0,232	0,241	0,239	0,001	0,216	0,251	0,241	0,240	0,240	0,25	0,233	0,214	0,222	0,234	0,240	0,250	0,310	0,237	0,273	0,290	0,226	0,245
5	0,255	0,282	0,276	0,001	0,256	0,313	0,302	0,288	0,278	0,322	0,309	0,230	0,303	0,315	0,274	0,295	0,396	0,477	0,407	0,397	0,283	0,285
6	0,001	0,316	0,279	0,001	0,304	0,373	0,362	0,336	0,311	0,376	0,376	0,290	0,404	0,450	0,557	0,439	0,539	0,457	0,528	0,516	0,329	0,344
7	0,001	0,316	0,226	0,001	0,310	0,407	0,391	0,355	0,324	0,385	0,382	0,293	0,470	0,587	0,483	0,485	0,975	1,133	0,838	0,667	0,382	0,411
8	0,001	0,301	0,001	0,001	0,531	0,550	0,308	0,418	0,340	0,446	0,417	0,351	0,705	0,832	1,263	0,875	1,156	1,257	1,251	1,077	0,498	0,520
9	0,001	0,284	0,001	0,001	0,284	0,719	0,721	0,518	0,371	0,445	0,406	0,451	0,828	0,612	0,886	1,174	0,001	1,635	0,859	1,089	0,784	0,553
IO	0,001	0,149	0,001	0,001	0,149	0,735	1,031	0,410	0,265	0,417	0,149	0,298	0,875	0,712	0,001	1,726	1,508	0,946	1,818	1,001	0,659	1,189

Table 4

Commercial mean weight (Kg) at age for 4VWX silver hake (from Waldron et al., 1988)

| Age, years	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0.060	0.040	0.056	0.045	0.063	0.067	0.063	0.062	0.049	0.061	0.041	0.036	0.056	0.054	0.063	0.077	0.062	0.045
2	0.126	0.128	0.119	0.128	0.129	0.155	0.148	0.147	0.110	0.154	0.141	0.143	0.148	0.130	0.147	0.156	0.159	0.127
3	0.167	0.188	0.209	0.216	0.204	0.243	0.246	0.210	0.174	0.200	0.213	0.193	0.223	0.203	0.190	0.206	0.201	0.174
4	0.222	0.254	0.240	0.250	0.310	0.237	0.273	0.290	0.226	0.245	0.280	0.248	0.289	0.246	0.249	0.240	0.229	0.223
5	0.303	0.315	0.274	0.295	0.396	0.477	0.407	0.397	0.283	0.285	0.322	0.318	0.329	0.303	0.278	0.276	0.272	0.261
6	0.404	0.450	0.557	0.439	0.539	0.457	0.528	0.516	0.329	0.344	0.366	0.369	0.399	0.362	0.366	0.326	0.300	0.300
7	0.470	0.587	0.483	0.485	0.975	1.133	0.838	0.667	0.382	0.411	0.520	0.672	0.481	0.387	0.454	0.417	0.403	0.434
8	0.705	0.832	1.263	0.875	1.156	1.257	1.251	1.077	0.498	0.520	0.601	0.550	0.582	0.653	0.597	0.599	0.490	0.399
9	0.828	0.612	0.886	1.174	0.001	1.635	0.859	1.089	0.784	0.553	0.892	0.794	0.949	0.809	0.753	0.630	0.650	0.406
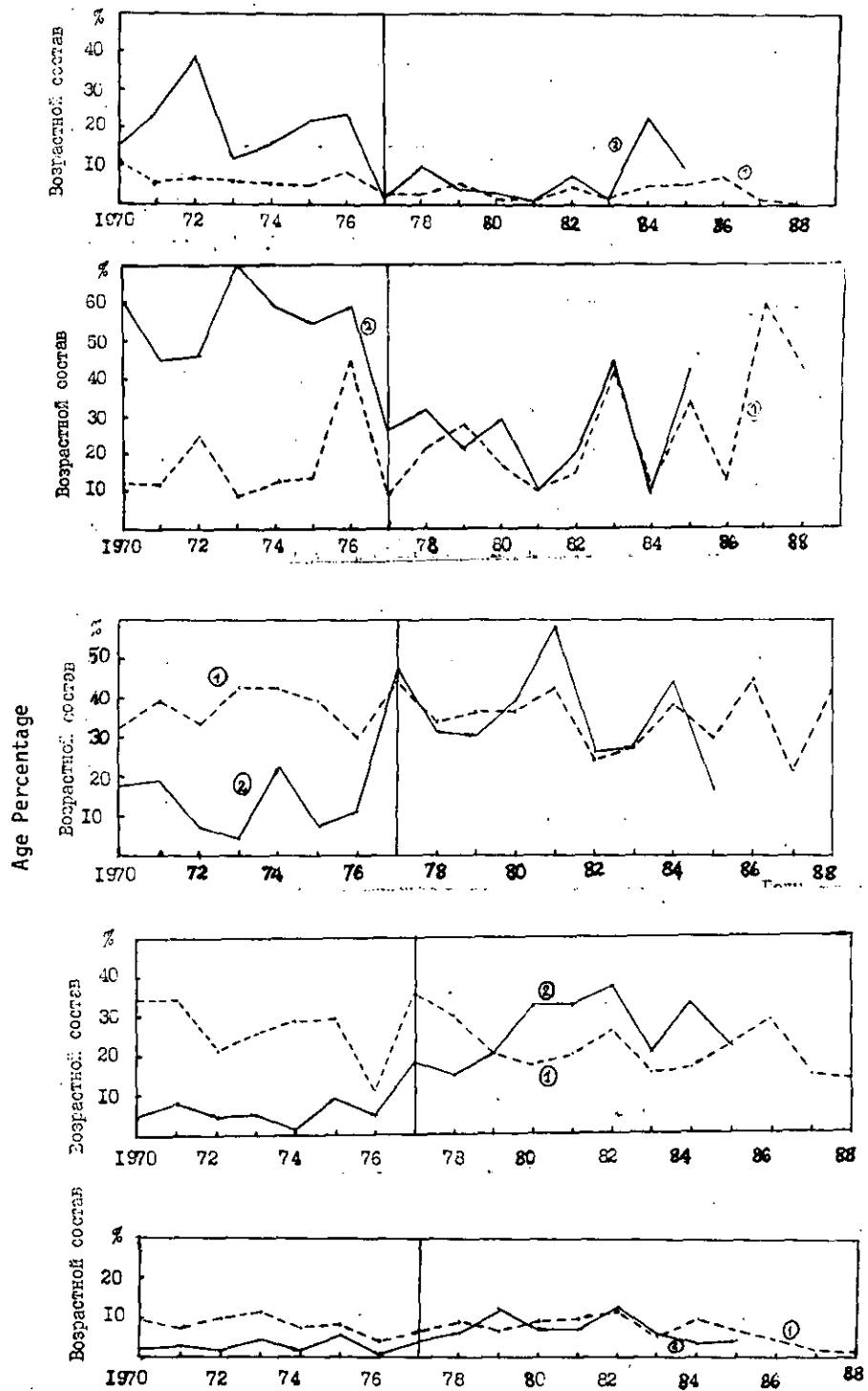
Fig.1.Change of age composition of catches by year.

A,B,C,D,E correspond to ages 1,2,3,4 and 5.

1.Soviet data

2.Canadian data
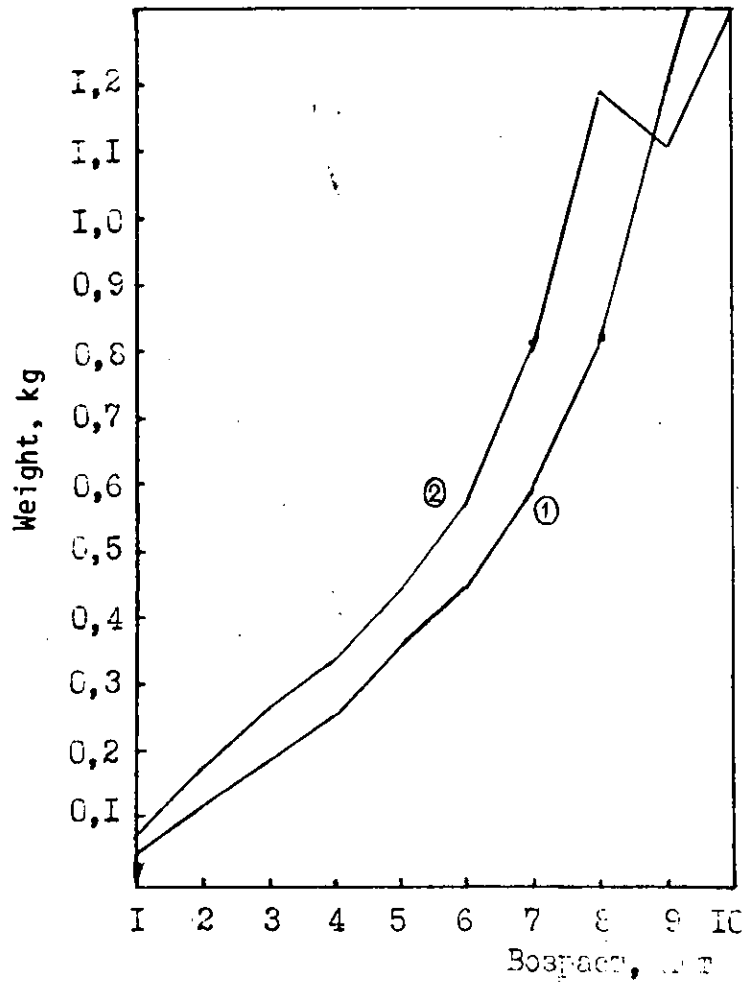
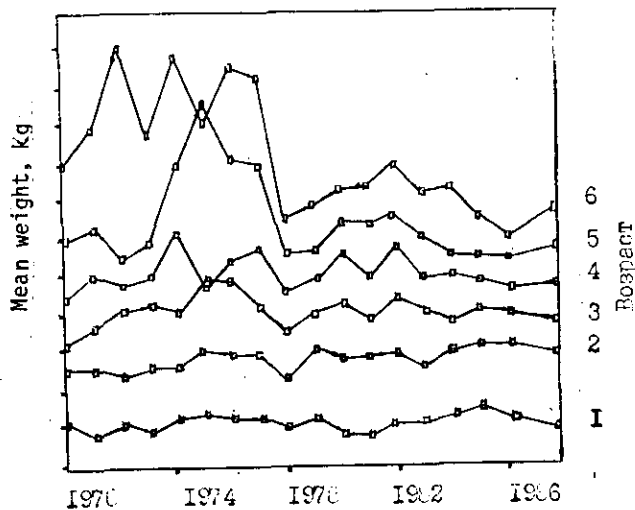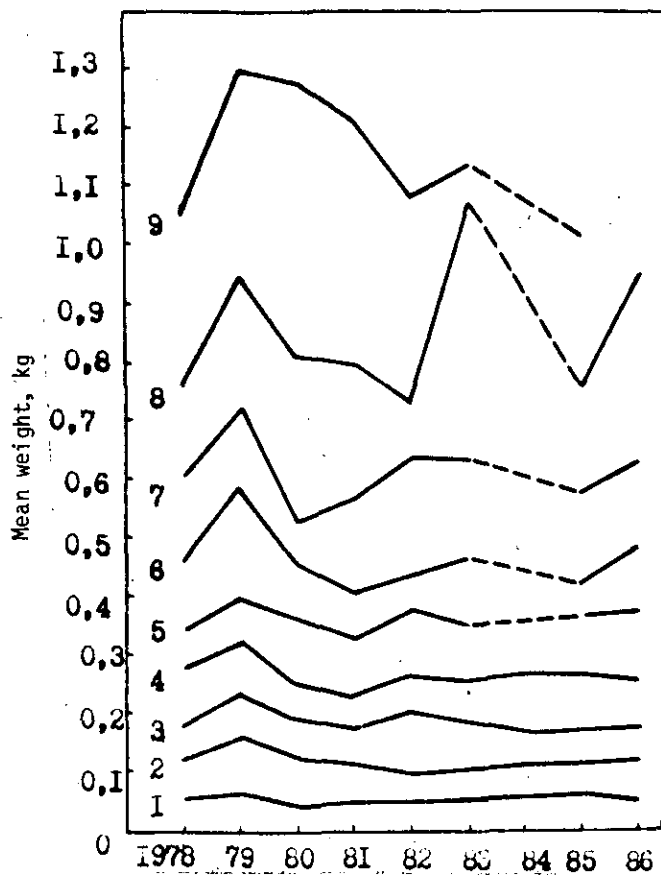Fig.2.Diagram of growth of mean weight by age.

1.Soviet data

2.Canadian data

Fig.3.Dynamics of mean weight data by year.

A.Soviet data

B.Canadian data