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Change in weight of Atlantic salmon from the  
West Greenland to home waters fisheries\*

by

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Abstract

Significant differences have been found between the average weights of Atlantic salmon of North American and European origin caught at West Greenland. Thus, the North American origin salmon were analyzed separately to demonstrate the increase in weight representing growth between the times of the West Greenland fishery and homewater fisheries. North American salmon if not caught at West Greenland as one sea-winter salmon would have returned to home waters as 2-sea-winter salmon and increased in weight by 58%; if the fishing season was earlier at West Greenland the change in weight increased to 78%. For other North American stock components at West Greenland the 1-sea-winter salmon returning as 3-sea-winter salmon would have increased in weight by 161%; the 2-sea-winter salmon returning as 3-sea-winter salmon would have increased in weight by 24%; the previous spawners would have increased in weight by 52% for grilse spawners and by 92% for 2-sea-winter spawners.

Introduction

To assess the effects of the West Greenland salmon fishery on homewaters fisheries and stocks, the 1974 ICES/ICNAF Joint Working Party on North Atlantic salmon estimated the weight that the quantity of salmon caught at West Greenland would constitute on its return to home waters had it not been caught there. Parameters included best available estimates of growth in weight, and the natural mortality rate between West Greenland and homewaters and on the exploitation rate in the home waters fisheries. In this earlier assessment, the average weights of salmon of North American and European origin in the West Greenland stock were assumed to be the same, and a value of 50% (Anon. 1979) was used for the increase in mean weight of salmon between their occurrence in the West Greenland fishery and their return to home waters in both North America and Europe. Information presented to the 1979 ICES Working Group on North Atlantic Salmon on the results of analyzes of scale characteristics showed a significant difference between the 2.96 kg mean weight of North American and 3.50 kg mean weight of one-sea-winter European origin at West

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Greenland (Reddin and Burfitt 1979). This difference may be attributed to the different time that the two groups of fish have spent at sea before appearing in the fishery at West Greenland (Anon 1979). The mean weights of two-sea-winter salmon in the homewaters fisheries in North America in 1979 and Europe in the years 1973-77 were 4.71 kg and 5.32 kg respectively (Anon 1979). This indicated that a figure of 60% for the increase in weight for salmon returning to North America would be more appropriate and corroborated the 50% increase in weight for salmon returning to Europe.

The difference in weight between North American and European origin salmon has been shown to exist in other years; 1969 (Nyman, May and Meister 1971) and 1970 (May 1971). This paper presents weights for salmon at West Greenland and in the homewaters of North America between 1969 and 1976 and examines the change in weight between the times of the West Greenland fishery and those in homewaters in the following year.

#### Materials and Methods

The whole weights of North American and European salmon originated from samples taken aboard research vessels at West Greenland from 1969-78 and by commercial sampling in the homewater fisheries in Newfoundland and Labrador from 1969-78. The data sources are listed in Table 1. All comparisons are direct, i.e. North American 1-sea-winter salmon at West Greenland are compared to 2-sea-winter salmon caught in the Newfoundland and Labrador fisheries in the following year. All samples were measured in the fresh round state of 1/10 th of a kilogram.

#### Results and Discussion

Comparison of mean weights of North American and European origin salmon caught at West Greenland in 1969-76 demonstrated that European salmon were always significantly heavier than North American salmon ( $t > 1.96$ ,  $p < .05$ ) for all years. Therefore, the changes in weight of North American origin salmon between West Greenland and homewater fisheries were analyzed separately from European origin salmon. The sea age composition of the salmon stocks has changed with time (Reddin and Burfitt 1979) and so for this analysis the 1978 stock composition is used to reflect the current status of the exploited stock at West Greenland. The sea age-classes were separated because of the different mean weights of each sea age-class.

The comparison of 1-sea-winter salmon of North American origin caught at West Greenland and in the Canadian homewater fisheries in the following year showed that these stocks of fish increased in weight by 58% between the times of the fisheries at West Greenland and in homewaters (Table 2a). One-sea-winter salmon made up 98% of the salmon exploited in the salmon fishery at West Greenland in 1978 (Reddin and Burfitt 1979).

Many of the samples used to calculate the mean weights of salmon at West Greenland were caught later in the year than the fishery now operates and salmon caught later in the season are heavier than those caught earlier (Munro and Swain 1979) minimizing the differences between the mean weights at West Greenland and homewaters. Exclusion of all one-sea-winter salmon taken after September 7 in each year demonstrates an increase in weight of 78% for North American salmon (Table 2b).

About 1% of the salmon population at West Greenland are 2-sea-winter fish that if not caught there would have returned to homewaters as 3-sea-winter fish. The increase in weight for the North American origin stocks is 24% between the times of the West Greenland and homewater fisheries (Table 3); but because of the small sample size it was impossible to adjust this to the current situation of the West Greenland fishery and thus 24% is a minimum estimate.

Recoveries of 1-sea-winter salmon tagged at West Greenland in 1972 and subsequently captured in homewaters as 3-sea-winter salmon suggested that the contribution of these salmon to the exploited stock in homewaters fisheries must be very small (J. Møller Jensen 1979). Comparison of 1-sea-winter salmon of North American origin caught at West Greenland and as 3-sea-winter salmon in the Canadian homewater fisheries two years later showed an increase in weight of 161% (Table 4). This is a minimum estimate as no attempt has been made to correct for the current times of the West Greenland salmon fishery.

One percent of the salmon stocks at West Greenland were composed of previous spawners in 1978 (Reddin and Burfitt 1979). Within this group the North American origin salmon are either salmon that spawned as grilse or 2-sea-winter spawners that returned to West Greenland as 2-sea-winter and 3-sea-winter salmon. The comparison of North American origin salmon that spawned originally as grilse and were caught at West Greenland as 2-sea-winter salmon and 3-sea-winter salmon in the Canadian homewater fisheries in the following year showed increases in weight of 52% between the times of the fisheries at West Greenland and in homewaters (Table 5). The comparison of the North American origin salmon that spawned originally as 2-sea-winter salmon and were caught at West Greenland as 3-sea-winter salmon and as 4-sea-winter salmon in the Canadian homewater fisheries in the following year showed that these stocks of fish increased in weight by 92% between the times of the fisheries at West Greenland and in homewaters (Table 5).

### Conclusions

Past assessments of the effects of the West Greenland salmon fishery on homewaters fisheries and stocks have not recognized that North American and European salmon stocks at West Greenland are each composed of different sea ages with different mean weights at both West Greenland and homewaters. Thus previous assessments by not considering these differences underestimated the weight change for North American origin fish by 8%. If the present fishing season is considered as many of the samples used were taken after the current fishing dates at West Greenland then the weight change for North American origin salmon is underestimated by 28%.

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Table 1. The sources of material for this paper.

Year	West Greenland	Area Newfoundland-Labrador
1969	May 1971	Lear and May, 1972
1970	Nyman, May and Meister, 1971	Lear and May, 1972
1971	Lear and Sandeman, 1974	Lear, 1973
1972	Lear and Sandeman, 1974	Lear, Burfitt and Batten 1974
1973	Lear and Sandeman, 1974	Lear, Batten and Burfitt, 1976
1974	Lear and Payne, 1975	Lear, unpublished data
1975	Lear, Payne and Møller Jensen, 1976	Lear, unpublished data
1976	Lear, unpublished data	Reddin, unpublished data
1977	No data available	Reddin, unpublished data
1978	Reddin and Burfitt 1979	Reddin, unpublished data

Table 2a. The changes in weight (kg) of Atlantic salmon from the West Greenland to North American home water fisheries. These fish had they not been caught as ISW fish at West Greenland would have returned to home waters as 2SW salmon.

Year(N)	North American		% growth
	Mean weight of salmon caught at WG in year N ISW	Mean weight of salmon caught in home waters in year N+1 2SW	
1978	2.96 (213)*	-	-
1977	-	-	-
1976	2.55 (167)	4.71 (1721)	85
1975	2.58 (225)	4.70 (357)	82
1974	3.12 (333)	4.35 (610)	39
1973	3.28 (40)	4.80 (302)	46
1972	2.96 (280)	4.70 (335)	59
1971	2.65 (84)	4.62 (392)	74
1970	2.85 (41)	4.03 (2145)	41
1969	3.12 (101)	4.35 (1697)	39
Mean 1969-76	2.89	4.53	58**

\* (Sample size)

\*\* Mean of percent growth 1969-76.

Table 2b. The changes in weight (kg) of Atlantic salmon from the West Greenland to North American home water fisheries excluding all fish caught after September 7. These fish had they not been caught as 1SW fish at West Greenland would have returned to home waters as 2SW fish.

Year(N)	North American		% growth
	Mean weight of salmon caught at WG 1SW	Mean weight salmon caught in home waters 2SW	
1978	2.96 (213)**		
1977	-	-	
1976	2.39 (121)	4.71 (1721)	97
1975	2.58 (225)	4.70 (357)	82
1974	2.76 (130)	4.35 (610)	58
1973	2.67 (9)	4.80 (302)	80
1972	2.74 (219)	4.70 (335)	72
Mean 1972-76	2.63	4.65	78*

\* Mean of percent growth 1972-76.

\*\* (sample size).

Table 3. The changes in weight (kg) of Atlantic salmon from the West Greenland to North American home water fisheries. These fish if they had not been caught at West Greenland as 2SW would have returned to home waters as 3SW.

Year (N)	North American		% growth
	Mean weight of salmon caught in WG in year N 2SW	Mean weight of salmon caught in home waters in year N+1 3SW	
1978	7.00 (5) <sup>***</sup>	-	-
1977	-	-	-
1976	6.16 (9)	6.45 (11)	5
1975	6.12 (5)	8.43 (6)	38
1974	7.06 (8)	8.51 (32)	21
1973	9.47 (4)	7.64 (14)	-
1972	5.85 (31)	7.17 (17)	23
1971	4.30 (1)	7.94 (12)	85
1970	5.65 (2)	7.46 (109)	32
1969	5.48 (6)	7.42 (135)	35
*weighted mean 1969-78	6.08 (67)	7.54 (336)	24 <sup>**</sup>

\* 1973 excluded from analysis as an outlier

\*\* calculated from weighted means due to the small numbers of fish sampled in some years.

\*\*\* (sample size).



Table 4. The changes in weight (kg) of Atlantic Salmon from West Greenland to North American home water fisheries. These are fish of North American origin that would have returned as 3SW had they not been caught as 1SW fish at West Greenland.

Year (N)	North American		% growth
	Mean weight of salmon caught at WG in year N 1SW	Mean weight of salmon caught at WG in year N + 2 3SW	
1978	2.96 (213)**	-	
1977	-	-	
1976	2.55 (167)	-	
1975	2.58 (225)	6.45 (11)	150
1974	3.12 (333)	8.43 (6)	170
1973	3.28 (40)	8.51 (32)	159
1972	2.96 (280)	7.64 (14)	158
1971	2.65 (84)	7.17 (17)	171
1970	2.85 (41)	7.94 (12)	179
1969	3.12 (101)	7.46 (109)	139
Mean 1969-75	2.94	7.66	161*

\* Mean of percent growth  
 \*\* (sample size).

Table 5. The changes in weight (kg) from West Greenland to the North American home water fisheries of Atlantic salmon that had previously spawned.

Year (N)	North American				% growth 2SW	% growth 3SW
	Mean Weight of salmon caught at WG in year N		Mean Weight of salmon caught in home waters in year N + 1			
	2SW	3SW	3SW	4SW		
1978	3.03 (4)**					
1977						
1976	2.10 (1)	4.04 (3)	4.82 (133)	6.82 (5)	130	69
1975	2.60 (1)		4.59 (22)		77	
1974	3.42 (5)		4.87 (26)	8.60 (6)	42	
1973			3.68 (17)	6.84 (9)		
1972	2.48 (4)		4.02 (4)		62	
1971	3.10 (1)		4.42 (22)		43	
1970	3.40 (1)		4.23 (79)	7.57 (18)	24	
1969			4.34 (69)	8.79 (11)		
Mean 1969-78	2.96 (17)	4.04 (3)	4.51 (372)	7.76 (49)	52*	92*

\* calculated from weighted means due to the small number of fish sampled in some years.

\*\* (sample size).