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Context of the Sharing Agreement ("Grazing Fee") for Atlantic Salmon Fisheries in the North Atlantic

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Cartoon in a Faroese newspaper back in late last century (courtesy: Jan Arge Jacobsen, June 6, 2023)

Title (english): **"Grazing fee"**

"I only use the cow as the Norwegians use the salmon"

- meaning that Norwegians (and others) are milking the cow back home while it has fed in Faroese waters.

INTRODUCTION

Managing transboundary migratory species that spawn in one jurisdiction and migrate to feeding areas in another jurisdiction where they may be fished during the feeding aggregations, requires discussion and agreement on what could be an "equitable" share of a common (in terms of its distribution) resource. The difficulty is that one jurisdiction manages the spawning and future potential recruitment of the resource while the other jurisdiction may benefit from the resource migrating to the jurisdiction to feed.

The jurisdictions usually recognize the shared responsibility (one for spawning, one for feeding) for the resource that may provide benefits to each. The decision on how the resource is to be shared is a fisheries management / socio-economic decision, which could be informed by the relative consequences of each jurisdiction's fisheries on resource conservation principles.

Biologically, the interest is in ensuring that total losses from all fisheries are at a level that does not exceed the level of replacement of the stock and that the resource is not driven to extinction by over-exploitation or insufficient management of spawning areas and spawners.

The sharing context for Atlantic Salmon arises in the management of the fisheries at West Greenland on feeding aggregations of NAC (North American Commission) and NEAC (Northeast Atlantic Commission) origin salmon during their second summer at sea, and for the management of the Faroese fishery on feeding aggregations of the majority NEAC salmon (with some minor component of NAC origin salmon) during the first winter and second winter at sea.

HISTORY OF SHARING AGREEMENT DISCUSSIONS FOR WEST GREENLAND

ICES (1993) considered the issue of sharing of the potential surplus to spawning requirements of NAC origin salmon at West Greenland between Greenlandic interests and homewater fisheries in NAC. Catch advice for the NAC complex considered the probability density function (pdf) of a forecasted prefishery abundance and illustrated potential catch options for West Greenland and in NAC for different shares of the surplus, after accounting for the spawning escapement reserve (219,132 fish) for NAC (2SW spawning requirements for NAC (193,306 fish) adjusted for natural mortality (11 months at 1% per month) between the date of the fishery at West Greenland and the spawners in home rivers). In illustrating the advice, ICES provided a table of catch options at West Greenland and in NAC for different allocations of the potential surplus to West Greenland (Table 1).

Similar advice was provided in ICES (1994 in Table 5.6.2.1) with a fuller table that summarized the catch option at West Greenland based on the proportion of the surplus allocated to Greenland for different predicted abundances of NAC origin salmon, the uncertainty of the forecast was presented as the cumulative distribution of the forecast value (Table 2). Up to that point in time, a formal sharing agreement had not been agreed among the parties to NASCO.

In 1995, ICES provided catch advice for the West Greenland at which time reference is made to a 40:60 Greenland:NAC sharing agreement had been used in the management decision of the fishery.

> "Greenland quota levels for the forecast over a range of pre-fishery abundance values between interquartile limits of each probability density function are presented in Table 9.1.6.1. For the point estimate level (i.e. 50% level) and the stochastic regression estimate using N1, the quota options ranged from 0 to 192 t, depending on the proportion allocated to West Greenland (Fna). For the Fna level of 0.4 used in recent management measures for the West Greenland Commission, the value is 77 t." (ICES 1995,p. 42).

Similar advice was also provided in ICES (1996), again referencing the 40% allocation of the potential surplus to Greenland (Table 3).

> "Greenland quota levels for both the H123 and H2-SNLQ forecasts of pre-fishery abundance were computed. The quota values based on the H123 forecast between interquartile limits of the probability density function are presented in Table 9.2.3.1. For the point estimate level (i.e. 50% level) and the stochastic regression estimate using NNI, the quota options ranged from 0 to 1,094 t, depending on the proportion allocated to West Greenland (Fna). For the Fna level used in recent management measures for the West Greenland Commission (0.4), the quota is 271 t at the 50% risk level. The lower pre-fishery abundance forecast realised with the H2-SNLQ model resulted in a set of lower quota levels (Table 9.2.3.2). The range of quota values was 0 to 275 t and the quota based upon an Fna value of 0.4 also at the 50% risk level would be zero. Considering the improved model diagnostics and the incorporation of the stock size variable, the Working Group advocates the use of the H2- SNLQ model for the 1996 1SW and 1997 2SW fisheries." (ICES 1996, p. 54).

ICES (2012) confirmed the origin of the 40% share to West Greenland as being the proportion of the total harvest of 2SW North American fish that was taken at West Greenland during 1986 to 1990; although the reason for the choice of those years was not given. The use of a sharing agreement factor in the provision of catch advice for West Greenland has been a feature of the PFA forecast and risk analysis framework for West Greenland into 2021 (ICES 2012).

As the risk analysis framework was being developed for the Faores fishery, ICES (2010) proposed using the same approach and baseline period as West Greenland to establish the share allocation for the Faroes fishery. This gave a potential share allocation of 0.075 to Faroes, being the proportion of the total harvest of European fish that was taken at Faroes between 1986 and 1990. Following discussion within NASCO, an alternative baseline period of 1984 to 1988 was proposed, which gave a share allocation of 0.084 to Faroes, and in the absence of further advice from NASCO, ICES subsequently used that value in the risk framework for the Faroes fishery (ICES 2012, 2013).

> "The Faroes 'sharing allocation' establishes the proportion of any harvestable surplus within the NEAC area that could be made available to the Faroes fishery through the TAC. Thus, for any TAC option being evaluated for the Faroes, the risk assessment is based on the total harvest (Faroes plus homewater fisheries) combined being equal to the TAC divided by the Faroes share. This approach assumes that home water countries then have the option to manage exploitation of individual river stocks on the basis of their status. The share allocation has to be determined before the catch advice is developed so that the cur-rent risk framework can be run. ICES (2013) has proposed that the share allocation could be derived using the same approach as for West Greenland, where the allocation is based on the proportion of the total harvest of North American fish that was taken at West Greenland between 1986 and 1990 (0.4). There is no biological basis for this choice, and European stocks/fisheries were not taken into account in setting this share agreement, although the status of European stocks is taken into account in the catch advice." (ICES WGNAS 2015, p. 73).

The incorporation of the sharing agreement in the risk analysis framework at the point of the West Greenland fishery or the Faroes fishery makes the assumption that for any catch option considered for the feeding aggregation fishery, a larger number of recruits will be removed in the homewater fisheries.

- For West Greenland, for every fish harvested at West Greenland as a catch option, 1.5 fish will be harvested in homewaters, for a total loss of 2.5 fish.
- For Faroes, for every fish harvested at Faroes, 10.9 fish will be harvested in homewater, for a total loss of 11.9 fish.

In the PFA forecast and catch advice model for West Greenland, the share of the catch option allocated to NAC is distributed among the six stock units of NAC based on the proportion of the predicted PFA in each stock unit to the total PFA for NAC. The catch ($Catch_{y,su}$) for each stock unit, accounting for the sharing agreement, is calculated as:

$$NA\_t_y = \frac{WG\_tac_y}{Share_{propWG}}$$

$$NA\_n_y = \frac{NA\_t_y}{u\_wt\_fish_y}$$

$$Catch\_n_y^{NAC} = NA\_n_y * p\_NAC_y$$

$$Catch_{y,su} = Catch\_n_y^{NAC} * {PFA_{y,su}}/{\sum_{su} PFA_{y,su}}$$

A similar approach is done for the Faroes risk framework.

WHY HAVE THERE NOT BEEN ANY ALTERNATIVES PROPOSED TO THE SHARING AGREEMENT?

The sharing agreement is intended to ensure that restrictive homewater management intended for conservation benefits to the spawners are not compromised if the foregone homewater catch is taken at Greenland. Parties responsible for managing spawners in rivers should decide to what extent they wish to take or forego their share of the surplus and manage exploitation of individual river stocks (ICES 2015).

Estimated exploitation rates on large salmon in homewaters have generally been < 10% since 2015, and a fraction of that rate for Scotia-Fundy, Gulf, and Newfoundland stock units (ICES 2023). Meanwhile estimated exploitation rates at West Greenland on NAC origin salmon have ranged between 5% and 15% since 1996.

ICES (1997) provided an example of catch advice options for West Greenland, based exclusively on catch options for West Greenland and no subsequent fisheries in NAC, and if exploitation rates in NAC on fish surviving the fishery at West Greenland were set at recent years levels. The example in ICES (1997; Figure 1) introduces two concepts:

- the analysis of attainment of spawner objectives in the stock units rather than just an overall NAC spawner objective
- consideration of analysis of catch options based on management approaches in home waters.

The example in ICES (1997) was not used in the catch advice nor in subsequent years. However, the example of the analysis of failing to meet the spawning requirement in at least one stock unit was the first step of the risk advice framework for NAC that considered the risk to simultaneous attainment of management objectives in the NAC stock units.

One of the reasons why the development of catch options based on previous year exploitation rates in homewaters was not pursued is that restrictive homewater management would possibly not provide any conservation benefits to the spawners if the foregone catch in homewaters is taken at Greenland. With a sharing agreement, parties agree on the share of any potential surplus that would be taken by the parties, and it is up to the parties to decide to what extent they wish to take or forego their share of the surplus. To date, only a few parties to the fisheries that exploit salmon that aggregate at Greenland to feed has entirely foregone their catch, with exception to USA which closed all directed retention fisheries on salmon in June 1995 and for the Scotia-Fundy region of Canada where directed salmon fisheries on 2SW salmon closed in the late 1990s.

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Table 1. ICES (1993; page 35) summary of catch options(number of fish) for the West Greenland fishery and the fishery on 2SW salmon in NAC for different percentages of the allocation of the surplus to West Greenland.

	Allocation to Greenland (%)					
	0	20	40	60	80	100
	Allocation in number of fish					
Greenland	0	7,739	15,478	23,218	30,957	38,696
North America	38,696	30,957	23,218	15,478	7,739	0

Table 2. Quota options table for the 1994 fishery at West Greenland relative to different proportions of the total catch of NAC origin salmon at Greenland in 1994 and in NAC in 1995 relative to the uncertainties in the forecasted surplus (ICES 1994).

Table 5.2.6.1 Quota options (in tonnes) for 1994 at West Greenland based on regression forecasts of fishery abundance. Proportion at West Greenland refers to the fraction of harvestable surplus allocated to the West Greenland fishery. The probability level refers to the pre-fishery abundance levels derived from the probability density function.

Model 1:

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	-18	-36	-54	-73	-91	-109	-127	-145	-163	-181
30	0	-7	-13	-20	-27	-34	-40	-47	-54	-61	-67
35	0	5	9	14	19	23	28	33	38	42	47
40	0	14	28	41	55	69	83	97	111	124	138
45	0	25	50	76	101	126	151	177	202	227	252
50	0	34	69	103	137	172	206	241	275	309	344
55	0	43	87	130	174	217	261	304	348	391	435
60	0	55	110	165	220	275	329	384	439	494	549
65	0	64	128	192	256	320	384	448	512	576	640
70	0	75	151	226	302	377	453	528	604	679	754
75	0	87	174	261	347	434	521	608	695	782	869

Model 2:

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	114	228	343	457	571	685	800	914	1,028	1,142
30	0	123	247	370	494	617	740	864	987	1,110	1,234
35	0	130	260	391	521	651	781	912	1,042	1,172	1,302
40	0	139	279	418	557	697	836	975	1,115	1,254	1,394
45	0	148	297	445	594	742	891	1,039	1,188	1,336	1,485
50	0	155	311	466	621	777	932	1,087	1,243	1,398	1,553
55	0	164	329	493	658	822	987	1,151	1,316	1,480	1,645
60	0	171	343	514	685	856	1,028	1,199	1,370	1,542	1,713
65	0	180	361	541	722	902	1,083	1,263	1,444	1,624	1,804
70	0	190	379	569	758	948	1,137	1,327	1,517	1,706	1,896
75	0	199	397	596	795	994	1,192	1,391	1,590	1,788	1,987

Sp.Res =	216,270
Prop NA =	0.540
WT1SWNA =	2.525
WT1SWE =	2.660
ACF =	1.121

Table 3. Quota options table for the 1996 fishery at West Greenland relative to different proportions of the total catch of NAC origin salmon at Greenland in 1996 and in NAC in 1997 relative to the uncertainties in the forecasted surplus (ICES 1996).

Table 9.2.3.1 Quota options (in tonnes) for 1996 at West Greenland based on H123 regression forecasts of fishery abundance. Proportion at West Greenland refers to the fraction of harvestable surplus allocated to the West Greenland fishery. The probability level refers to the pre-fishery abundance levels derived from the probability density function.

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	26	52	78	104	130	157	183	209	235	261
30	0	35	69	104	139	174	208	243	278	312	347
35	0	43	87	130	173	217	260	303	347	390	433
40	0	52	104	156	208	260	312	364	415	467	519
45	0	59	118	177	236	296	355	414	473	532	591
50	0	68	135	203	271	339	406	474	542	610	677
55	0	75	150	225	300	375	449	524	599	674	749
60	0	84	167	251	334	418	501	585	668	752	835
65	0	91	181	272	363	453	544	635	726	816	907
70	0	99	199	298	397	497	596	695	794	894	993
75	0	109	219	328	437	547	656	766	875	984	1,094

Sp. res =	201,483
Prop NA =	0.59224
WT1SWNA =	2.42
WT1SWE =	2.62
ACF =	1.133

Table 9.2.3.2 Quota options (in tonnes) for 1996 at West Greenland based on H2-SNLQ regression forecasts of fishery abundance. Proportion at West Greenland refers to the fraction of harvestable surplus allocated to the West Greenland fishery. The probability level refers to the pre-fishery abundance levels derived from the probability density function.

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	1	1	1	1	2	2	2	2
60	0	7	15	22	30	37	45	52	59	67	74
65	0	13	26	40	53	66	79	92	105	119	132
70	0	20	41	61	81	102	122	142	163	183	203
75	0	28	55	83	110	138	165	193	220	248	275

Sp. res =	201,483
Prop NA =	0.59224
WT1SWNA =	2.42
WT1SWE =	2.62
ACF =	1.133

Figure 1. Risk analysis plots of catch options for West Greenland only, and for Greenland and North American fisheries (set at the exploitation rate range of the previous year in homewaters) for different catch options at West Greenland. The risk is shown as the probability that the spawning requirement will not be met in at least one of the six stock units (upper panel) or the risk of severe under-escapement (spawners < 50% of requirement) in at least one stock unit in NAC. The figure is from ICES (1997).

Figure 5.2.4.5. Risk analysis for catch options on the prefishery 1SW non-maturing component in 1997. Risk is expressed relative to catch options at Greenland for 1997 and cumulatively with the exploitation rates of 0.15 to 0.28 on 2SW salmon returning to North America in 1998. Exploitation rates in North America are based on the 1996 values (Section 4.1.4). The upper panel describes the risk of not meeting the spawning requirement in at least one of the six stock areas in North America. The lower panel describes the risk of a severe underescapement (50% of spawner requirement) in at least one of the six stock areas.