

Draft – Methods for sharing FSC sockeye when the FSC Total Allowable Catch is less than the combined FSC needs – Internal, for discussion purposes only

Introduction

Fisheries and Oceans Canada is responsible for the conservation and protection of Canada's marine resources, including Fraser River sockeye salmon. Under the Wild Salmon Policy, this responsibility mandates the government to maintain healthy salmon populations and their habitats while managing fisheries for sustainable benefits. To achieve these objectives, DFO places the highest priority for the use of wild salmon on conservation, followed by ensuring that First Nations receive sufficient opportunity to meet their food, social, and ceremonial (FSC) needs.

Every year, prior to the sockeye season, FSC communal licence harvest targets ("FSC targets") for Fraser sockeye are included in the South Coast Salmon IFMP for marine and Fraser River First Nations. In most years, fisheries are managed in-season to provide opportunities for all First Nations to achieve communal licence harvest targets. However, if in-season assessments of sockeye run-size are lower than forecast pre-season, the situation could arise where the number of harvestable sockeye is insufficient to meet FSC needs. In this circumstance, DFO must still manage to achieve escapement objectives, and consequently, must reduce the harvestable surplus available for FSC fisheries. The issue that must then be resolved is how to equitably share any reduction to FSC catch targets among individual First Nations, especially for groups with differential access to the resource.

This document outlines some approaches to sharing a limited sockeye surplus among First Nations in the specific circumstance where the First Nations FSC targets cannot be met due to a lack of abundance of sockeye in-season.

Groups currently under treaty will be managed separately and will not be included in this document.

In-season Calculation of First Nations FSC Shares

Harvestable surpluses of Fraser River sockeye stocks are determined by DFO staff and the Fraser River Panel based on in-season information on abundance, test fishing catches, environmental conditions and escapement targets provided by Canada. Under the Pacific Salmon Treaty, the Total Allowable Catch (TAC) for sharing with the United States is equal to the total run size less the escapement target, management adjustment, test fishing catch and the Fraser River Aboriginal Fishery Exemption. The United States is entitled to 16.5% of the TAC, and the remaining 83.5% goes to Canada. The amount of sockeye harvestable in Canada is equal to the Canadian TAC plus the Fraser River Aboriginal Exemption. The Aboriginal Exemption is an amount of 400,000 sockeye negotiated under the Treaty to provide priority harvest to both in-river and marine area First Nations. However, the total pre-season FSC target for all First Nations typically exceeds the amount provided for Aboriginal Exemption under the Treaty. Any FSC target amount in excess of 400,000 is therefore taken from the Canadian TAC prior to sharing the remainder between the commercial and recreational sectors. The Aboriginal Exemption is apportioned among the four run-timing groups according to the Treaty with a maximum of 80,000 fish for Early Stuart and the remaining amount spread over the Early Summer, Summer and Late run timing groups according to the average Fraser River FN harvest

on the three previous cycle lines. For planning purposes, the remaining FSC target in excess of the Fraser River Aboriginal Exemption is spread across each run-timing group based on their relative abundance while taking into consideration conservation concerns and First Nations' preferences for certain stocks or run-timing groups. An example of these calculations is shown in Table 1.

Table 1. Example of TAC Calculations Used to Apportion FSC Harvest Across Run-Timing Groups

	Early Stuart	Summer	Summer	Lates (incl. BK)	Total
Run Size	35,000	349,000	1,810,000	705,000	2,899,000
Total Deductions	59,400	290,900	1,062,800	462,100	1,875,200
Escapement Target	35,000	145,400	724,000	431,600	1,336,000
Management Adjustments	24,200	36,200	36,200	-	96,600
F.R. Aboriginal Fish. Exemption	-	100,400	276,700	22,900	400,000
PSC test fishing	200	8,900	25,900	7,600	42,600
TAC for U.S. - Canada share allocation	-	58,100	747,200	242,900	1,048,200
U.S. share of TAC	-	9,600	123,300	40,100	173,000
Canadian share of TAC	-	148,900	900,600	225,700	1,275,200
FSC Target for all FNs					
Fraser River Aboriginal Exemption	-	100,400	276,700	22,900	400,000
FSC portion of TAC	-	24,000	484,900	100,100	609,000
Remaining Canadian TAC (Comm'l + Rec)	0	24,500	139,000	102,700	266,200

These calculations are updated throughout the in-season management process by the Fraser River Panel and DFO staff as information on abundance, timing, management adjustments, and escapement targets is updated. When the Canadian TAC plus the Fraser River Aboriginal Exemption exceeds the pre-season FSC target, FSC fisheries are opened as planned. In this situation, the in-season estimate of the total FSC target for all First Nations is equal to the pre-season FSC target. However, if the in-season estimate of the Canadian TAC plus the Fraser River Aboriginal Exemption is less than the total pre-season FSC target for all First Nations, then the limited available harvest must be shared among First Nations groups. This is the only situation in which the in-season FSC target would be less than the pre-season FSC target, and this scenario is the subject of this paper.

Principles of Sharing Arrangements

1. All planned harvest will remain within conservation constraints.
2. The run-timing group which has an allowable TAC above the harvest rate floor* will be fully harvested within conservation constraints.
3. Run-timing groups whose allowable TACs are generated as a result of harvest rate floors implemented to allow harvest of more abundant, co-migrating stocks will only be harvested to the extent required to access the more abundant group.

* A harvest rate floor is a minimum harvest rate applied to run-timing groups that would otherwise have no allowable fishing mortality based on the size of their return. A harvest rate floor is implemented to allow some harvest of stronger stocks while keeping the impact on weaker stocks at an acceptable level. For instance, a 20% harvest rate floor was applied to the Late-run timing group in 2008 and 2009.

Sharing Methods

With the exception of Early Stuart sockeye, there is currently no arrangement to apportion the pre-season FSC targets among individual First Nations for each run-timing group. In other words, although the total FSC target is split into the four run-timing groups for planning purposes, there are no allocation agreements in place to apportion fish from a specific run-timing group among individual First Nations groups. Such an arrangement was developed in 2005 with Fraser First Nations for the Early Stuart sockeye, which will form the basis for sharing the total FSC target for this run-timing group.

Early Stuarts

The Early Stuarts are the only run-timing group for which a sharing arrangement among Fraser First Nations has been developed. The arrangement is based on assigning priority access to these fish to those terminal First Nations groups who have limited or no access to other sockeye. As is the case for the overall FSC target, the Early Stuart sharing arrangement requires that a harvestable amount of Early Stuarts be identified. In other words, there must be available Early Stuart sockeye in excess of the spawning escapement goal (including any management adjustments) for there to be an FSC harvest. This calculation is done by DFO staff based on in-season information from the Fraser River Panel. In years of large Early Stuart returns FSC harvest does occur in some marine areas but in most years is negligible.

Based on the sharing plan developed for the 2005 season, if the identified FSC target for Early Stuarts is less than 24,500 fish, the first 5,000 harvestable fish are allocated to the Carrier-Sekani Tribal Council, and the remaining portion of the FSC target of Early Stuarts is allocated among other First Nation groups according to the top portion of Table 2. If the identified Early Stuart FSC target is greater than 24,500, sockeye are shared according to the bottom portion of Table 2. Any in-season changes to the FSC target for Early Stuart sockeye will be allocated according to this sharing plan. Even in years with no identified TAC, some amount of terminal harvest does occur.

Table 2. 2005 First Nation Sharing Plan for Early Stuart Sockeye**FSC Allocation <24,500***Share equals FSC Target minus 1st priority allocation * X%*

First Nations Groups	Share	Example
FSC Target		20,000
<u>1st priority allocation</u>		
Carrier-Sekani Tribal Council (CSTC)	5,000	5,000
<u>Remaining allocation</u>		
Carrier-Sekani Tribal Council (CSTC)	0.00%	0
Lheit-lit'en (LTN)	1.54%	231
Carrier-Chilcotin (CCTC)	0.51%	77
CTC/TNG/ESK	15.38%	2,308
Shuswap Fisheries Commission (SFC)	0.51%	77
Stl'atl'imx Nation (STA)	25.64%	3,846
NNTC/NTA	25.64%	3,846
Lower Fraser FNs Above Port Mann	25.64%	3,846
Lower Fraser FNs Below Port Mann	5.13%	769

FSC Allocation >24,500*Share equals min. target plus X% of FSC Target >24,500*

First Nations Groups	min. target	Share	Example
FSC Target			30,000
<u>1st priority allocation</u>			
Carrier-Sekani Tribal Council (CSTC)	5,000	5,000	5,000
<u>Remaining allocation</u>			
Carrier-Sekani Tribal Council (CSTC)	0	5.00%	275
Lheit-lit'en (LTN)	300	1.00%	355
Carrier-Chilcotin (CCTC)	100	1.00%	155
CTC/TNG/ESK	3,000	13.00%	3,715
Shuswap Fisheries Commission (SFC)	100	1.00%	155
Stl'atl'imx Nation (STA)	5,000	13.00%	5,715
NNTC/NTA	5,000	13.00%	5,715
Lower Fraser FNs Above Port Mann	5,000	40.00%	7,200
Lower Fraser FNs Below Port Mann	1,000	13.00%	1,715

Note: Harvest of Early Stuart sockeye is minimal but does occur in marine areas in many years and is expected to occur in the future.

Early Summers, Summers, Lates

If there is an in-season reduction to the overall FSC target (including Early Stuart, Early Summer, Summer, and Late Run sockeye), FSC targets for individual First Nations groups will be adjusted to reflect the proportional reduction of the total pre-season FSC target to the total in-season FSC target. For example, if the total pre-season FSC target is 1,009,000 sockeye, and the in-season FSC TAC is only 756,750 this represents a 25% reduction in the total FSC TAC. This 25% reduction would then be applied to all individual First Nations FSC communal licence harvest targets to determine the adjusted harvest target. An example of this arrangement is shown in Table 3.

Table 3. Adjusted harvest targets based on in-season reductions to the Total FSC target

First Nations Group	FSC Target	% of Total Target	Adjusted FSC Target	% of Total Target
Total	1,009,000	100%	756,750	100%
Marine	260,000	25.7681%	195,000	25.7681%
Lower Fraser	449,000	44.4995%	336,750	44.4995%
BC Interior	300,000	29.7324%	225,000	29.7324%

However, if there is an in-season reduction in the total FSC target (across all run-timing groups) in a year where there is also an identified FSC target for Early Stuart sockeye, any Early Stuart FSC target must then be subtracted from each First Nation's FSC target for *all* run-timing groups.

An additional complication arises when it is not the overall TAC which is reduced, but rather access to part of the TAC (usually Summer-run stocks) is restricted due to allowable impact limits on other stocks (usually either just Late-run stocks [Tables 5, 6, 8, 10, 13] or both Early Summers and Lates [Tables 7, 9, 11, 12]). Because the access to each stock is different in each area, sharing the available TAC equitably is not straight forward.

There are two basic types of strategies. The first type shares the constraint, with the total catch available dependent on the stock-composition and availability in each area (**Total catch to date [Alt. 1]** and **Pre-season percentages [Alt. 2]**). The second type (**Total catch balance [Alt. 3]**), takes the stock-composition into account and attempts to meet an objective (balance the burden of conservation) based on the overall catch rather than the catch of the constraining stock.

Once the constraints are allocated, any constraints not required to achieve the adjusted share in an area can be reallocated by either sharing [**Alt.1.b, Alt.2.b**], or trading [**Alt.1.c, Alt.2.c**]. Trying to balance the total catch [**Alt.3**] requires more assumptions and the TACs will change dramatically based on changes in the estimated stock composition. The total catch balance strategy may be most useful in situations where there is only a small amount of TAC which is expected to be caught within a few days. It would probably not work well for longer term plans because it is quite sensitive to the frequent in-season changes to the stock composition estimates.

Table 4. Sharing strategies

Type One - sharing constraints
Initial Allocation
Alt 1. Total catch to date
Alt 2. Pre-season percentages
Re-Allocation
a. None
b. Sharing
c. Trading
Type Two - sharing total catch
Allocation
Alt 3. Total catch balance

Details of the FSC sharing strategies:

The far right portion of each table shows the number of sockeye that can be caught in each area while staying within the constraints, based on the percentage of the constraining group present. All of the TACs within constraints are dependent on the current stock composition estimates and will change as they do.

Type One

Total catch to date [Alt.1]

Constraints allocated based on the concept that the group furthest behind from “adjusted FSC target” (Table 3.) needs more of the constraint to catch up. To determine how much of the remaining impact goes to each region, we take the total balance yet to be caught and apply the proportion of the balance from each region to the allowable impact. Any unneeded constraint can be reallocated to the other areas based on the same percentages (Table 6. and Table 7.).

Table 5. Total catch to date [Alt 1.a]; only one constraining run-timing group (Lates), the table on the right shows the total number of sockeye currently available based on the most recent stock-composition estimates. In this case, the Marine area could plan a fishery for 48,920 sockeye and remain within their Late constraint.

First Nations Group	FSC Target	Catch to Date	Balance Remaining	% of Balance Remaining	Late Constraint Allocation	% Lates in each area	TAC
Total	1,009,000	614,000	395,000	100%	45,000		
Marine	260,000	114,000	146,000	36.962%	16,633	34%	48,920
Lower Fraser	449,000	400,000	49,000	12.405%	5,582	32%	17,445
BC Interior	300,000	100,000	200,000	50.633%	22,785	2%	200,000
Total							266,365

$\% \text{ of Balance Remaining}_{\text{area}} = \text{Balance}_{\text{area}} / \text{Balance}_{\text{total}}$
 $\text{Constraint}_{\text{area}} = \% \text{ of Balance Remaining}_{\text{area}} * \text{Constraint}_{\text{available}}$
 $\text{TAC within constraint}_{\text{area}} = \text{Constraint allocation}_{\text{area}} / \% \text{ Lates}_{\text{area}}$

Table 6. Total catch to date, sharing [Alt 1.b]; any unneeded constraint is reallocated In this case, BCI only needs 4,500 Lates to achieve their catch target, so the remainder is distributed to Marine and Lower Fraser based on their balance remaining percentages.

First Nations Group	FSC Target	Catch to Date	Balance Remaining	% of Balance Remaining	Constraint Allocation	% Lates in each area	TAC within constraint
Total	1,009,000	614,000	395,000	100%	45,000		
Marine	260,000	114,000	146,000	74.8718%	30,323	34%	89,186
Lower Fraser	449,000	400,000	49,000	25.1282%	10,177	32%	31,803
BC Interior	300,000	100,000	200,000	NA	4,500	2%	200,000
Total							320,988

$\text{Constraint}_{\text{area}} = [\text{Balance}_{\text{area}} / (\text{Balance}_{\text{Marine}} + \text{Balance}_{\text{Lower Fraser}})] * (\text{Constraint}_{\text{available}} - \text{Constraint}_{\text{BCI}})$

Table 7. Total catch to date, sharing [Alt 1.b]; two constraining run-timing groups, in this scenario we are not sure how many E Sum are needed by each group (the TAC within each constraint is completely dependent on the most recent stock composition estimates), but we do know that BCI only needs 4,500 Lates so the rest are reallocated

First Nations Group	FSC Target	Catch to Date	Balance Remaining	% of Balance Remaining	E Sum Constraint	Late Constraint	% ESum in each area	TAC within ESum const	% Lates in each area	TAC within Late const	TAC within both const
Total	1,009,000	614,000	395,000	100%	175,000	45,000					
Marine	260,000	114,000	146,000	36.962%	64,684	30,323	20%	146,000	34%	89,186	89,186
Lower Fraser	449,000	400,000	49,000	12.405%	21,709	10,177	35%	49,000	32%	31,803	31,803
BC Interior	300,000	100,000	200,000	50.633%	88,608	4,500	50%	177,215	2%	200,000	177,215
Total								372,215		320,988	298,204

Scenario – Constraining run-timing group is present in areas which have fallen behind in achieving their targets.

Pros – attempts to get groups as close to their target catches as possible, uses the allocation of the constraints to attempt to share the “burden of conservation” evenly between the three regions

Cons – difficult to explain, the amount available to each group is dependent on the catch in other areas, additional constraint allocation may not help an area achieve their target (i.e. more E. Sum will not help Marine groups get their target if the E. Sum have already moved into the river), constraint shares shift every time there is a fishery because the % of the balance remaining will change.

Pre-season percentages [Alt.2]

Constraints allocated based on each Area’s % of full FSC amounts (i.e. marine = 26%; LFr = 44%; BCI = 30%)

Table 8. Pre-season percentages [Alt 2.a]; one constraint

First Nations Group	FSC Target	% of Total	Late Constraint	% Lates in each area	TAC within constraint
Total	1,009,000	100%	45,000		
Marine	260,000	25.7681%	11,596	34%	34,105
Lower Fraser	449,000	44.4995%	20,025	32%	62,577
BC Interior	300,000	29.7324%	13,380	2%	300,000
Total					396,682

$$\text{Constraint}_{\text{area}} = (\text{FSC Target}_{\text{area}} / \text{FSC Target}_{\text{total}}) * \text{Constraint}_{\text{available}}$$

Table 9. Pre-season percentages [Alt 2.a]; two constraints

First Nations Group	FSC Target	% of Total	E Sum Constraint	Late Constraint	% E Sum in each area	TAC within ESum const	% Lates in each area	within Late const	TAC within both constraints
Total	1,009,000	100%	175,000	45,000					
Marine	260,000	25.7681%	45,094	11,596	20%	225,471	34%	34,105	34,105
Lower Fraser	449,000	44.4995%	77,874	20,025	35%	222,498	32%	62,577	62,577
BC Interior	300,000	29.73%	52,032	13,380	50%	104,063	2%	300,000	104,063
Total									200,746

Scenario – Knowledge of constraints

Pros – straightforward to calc & explain, TAC in each area is independent of the actions of any other group

Cons – majority of Lates do not reach BCI (or anywhere upstream of Harrison confluence) in some years, so the % of the constraint caught in each area is not proportional to pre-season targets, if groups in one area are unable to catch their allocation it may not be caught.

Pre-season percentages, sharing [Alt. 2.b]

Constraints allocated based on each Area's % of full FSC amounts (i.e. marine = 26%; LFr = 44%; BCI = 30%) and constraints not required to meet adjusted harvest targets are reallocated.

Table 10. Pre-season percentages, sharing; one constraint, the difference between this table and Table 6 is that the unneeded Lates are redistributed based on the pre-season percentages rather than the balance remaining percentages.

First Nations Group	FSC Target	% of Total	Late Constraint	% Lates in each area	TAC
Total	1,009,000	100%	45,000		
Marine	260,000	25.7681%	14,852	34%	43,682
Lower Fraser	449,000	44.4995%	25,648	32%	80,150
BC Interior	300,000	29.7324%	4,500	NA	300,000
Total					423,832

Table 11. Pre-season percentages, sharing; two constraints, the difference between this table and Table 7 is that the unneeded BCI Lates are redistributed based on the pre-season percentages rather than the balance remaining percentages.

First Nations Group	FSC Target	% of Total	E Sum Constraint	Late Constraint	% E Sum in each area	TAC within E Sum const	% Late in each area	within Late const	TAC within both constraints
Total	1,009,000	100%	175,000	45,000					
Marine	260,000	25.7681%	45,094	14,852	20%	225,471	34%	43,682	43,682
Lower Fraser	449,000	44.4995%	77,874	25,648	35%	222,498	32%	80,150	80,150
BC Interior	300,000	29.73%	52,032	4,500	50%	104,063	NA	300,000	104,063
Total									227,896

Scenario - Prior knowledge that some portion of a constraint allocated to an area will not be required to achieve the adjusted FSC target in an area.

Pros – straightforward to calculate and explain, makes efficient use of the constraints (i.e. E Summers that are no longer in the Marine area can be moved into the river to allow other groups to continue trying to meet their FSC targets)

Cons – The % of the TAC, and % of constraint caught in each area is not proportional to pre-season targets. If we are wrong about the constraint required, we will either constrain a group unfairly or fish into escapement. It could be particularly problematic if we reallocate E Summers from the Marine area into the river after we think they have passed and they show up in the Marine test fisheries unexpectedly. Marine groups are less likely to accept an unexpected restriction if it appears that their E Summers were given away.

Pre-season percentages, trading [Alt 2.c]

Based on the option above, but the reduction in BCI's share of Lates is replaced with an equal increase in Early Summers (an additional option would be to trade constraint equivalencies, i.e. if there are 20,000 E Sum and 10,000 Lates, then 2 E Summers would be worth 1 Late).

Table 12. Pre-season percentages, trading; one Late = one E Summer

First Nations Group	FSC Target	% of Total	E Sum Constraint	Late Constraint	Trading BCI Lates for Marine and LFA E Summers (1:1)	Revised E Sum Constraint	Revised Late Constraint	% of E Sum in each area	TAC within Esum const	% Lates in each area	TAC within Late const	TAC within both Const
Total	1,009,000	100%	175,000	45,000		175,000	45,000					
Marine	260,000	25.7681%	45,094	11,596	% of Late Mar+LFA Share	41,796	14,894	20%	208,980	34%	43,805	43,805
Lower Fraser	449,000	44.4995%	77,874	20,025	63% 5,581	72,293	25,606	35%	206,551	32%	80,019	80,019
BC Interior	300,000	29.7324%	52,032	13,380	Needed Available	60,911	4,500	50%	121,823	NA	300,000	121,823
												Total
												245,647

Available = BCI's Late constraint allocation – BCI's Late constraint requirements

Marine share of the unneeded BCI lates (3,298) = the number available (8,880) multiplied by 37% (Marine pre-season TAC/Marine and Lower Fraser preseason TACs)

Scenario - Knowledge of constraints, some co-ordination between areas, and some amount of a constraint that can be more efficiently used elsewhere.

Pros – takes access to stocks in each area into account, if constraints are traded rather than freely shared, areas may be more willing to accept constraints caused by unexpected return patterns (i.e. if Marine traded some E Sum for Lates, they might be more likely to accept having to wait if E Sum show up unexpectedly in Marine areas after we thought that they had passed)

Cons – reduced FSC disproportionate to full FSC amounts, trading implies ownership of the constraint and if constraints are owned and can be traded at will, it could greatly complicate the in-season management, also if the entire amount of unneeded constraint is not exchanged some may not be harvested (could be reduced if constraint equivalencies are traded rather than straight fish).

Note: full amount of Lates is not accessible to ~40% of LFrA effort in some years (groups that fish above the Harrison) – this is not taken into account in this alternative

Type Two

Total catch balance [Alt. 3] – new for 2009

Principle is that the constraint gets moved around so that the reduced shares for each area are all the same % of the full FSC amounts. This is similar to the method used to balance the catch in commercial fisheries between gear types.

Table 13. Total catch balance;

First Nations Group	FSC Target	% of Total	% Lates in each area	Late Constraint Allocation	Catch Target	Catch %
Total	1,009,000	100%		45,000		
Marine	260,000	25.7681%	34%	16,714	49,160	26%
Lower Fraser	449,000	44.4995%	32%	27,152	84,851	44%
BC Interior	300,000	29.7324%	2%	1,133	56,668	30%
Total				45,000	190,679	

Scenario – There is a very small amount of TAC available that could be caught within a day or two (before the stock-composition estimates and therefore the catch targets can change).

Pros – concept is easy to explain (even if the actual calculations aren't!); all areas share equally in the “burden of conservation”

Cons – total reduced FSC is less than the other options (note that this is the same problem that we see in planning CDN Commercial fisheries – trade-off between harvesting full CDN Share or keeping to area-gear shares); shares are highly sensitive to stock composition

Summary

Two basic types of strategies have been developed, either sharing the constraint or sharing the total catch. Sharing the constraint can be based either on using constraint allocation to get groups as close to their FSC targets as possible or simply on their share of the pre-season catch target. Total catch available would then depend on what proportion of the constraining stock is present in each area. Sharing the total catch would be very difficult in-season for any extended period; because the catch targets would be very sensitive to the current stock-composition estimates that change daily (a 10% change in the stock-composition could result in a 50% change in the catch target for an area).

Within each of the constraint sharing options, there are a number of ways to deal with allocated constraints that cannot be accessed by each group due to migration patterns (i.e. Most of BCI does not have access to Lates in some years, and once E Summers move into the river they are no longer vulnerable to Marine effort). Constraints can be allocated once only, with inaccessible sockeye escaping. Constraints not required to meet adjusted targets can be reallocated based on the initial sharing rules (requires us to predict how much of a constraint each area will need). Or, inaccessible constraints can be traded to other groups which can make better use of them (i.e. BCI could trade Lates that are not required to meet their adjusted FSC target for E Summers which are constraining their fisheries). Trading constraints would also require us to assume how many each area will need.

Questions Remaining

1. Which strategy should be used in which situation?
2. How do we decide how many sockeye from a constraining stock are not required to meet adjusted catch targets?
3. Once we decide on a number, how many do we reallocate?
 - a. All of them?
 - b. Some percentage to safeguard against unexpected migration patterns?