Asköfjärden

1. Objectives

The present work includes the following analyses:

- An investigation into the consequences for main results of reducing the sample size presently used in monitoring this area.
- An investigation into the consequences for main results of adopting a different (optimal) sample allocation scheme across strata than the one presently used.
- An investigation into the consequences for main results of changing both the sample size and the sample allocation scheme used in monitoring this area.
- An investigation into the consequences for the trends of main indicators of sampling every two years and every three years

2. Methodological notes

2.1. Fixed stations and Stratification

The sampling design includes a set of fixed stations that are sampled annually without replacement. For simplicity, the estimates of variance developed in the present study assume the data was collected using simple random sampling with replacement.

Additionally, the present sampling design involves a stratification of the area into four depth strata (0-3m; 3-6m; 6-10m; 10-20m). To date results at area level have been computed using a simple average of the values of each indicator across all samples collected in the year. This procedure ignores the underlying stratification used in collecting the sample and leads to biased estimates when the samples are combined to produce area-level results[1]. Correcting this bias require the weight of the different strata (e.g., their area or volume) to be known and included in the estimation procedure. At the time of the analysis such weights were not available. To alleaviate the impact of previous effect on analyses and keep results comparable accross sample sizes and allocation schemes an assumption was made that the sampling effort deployed in each stratum was proportional to the size of the stratum. This assumption is likely not valid for the area analysed so results of the present study should be regarded with particular caution until the issue is definitively corrected.

2.2. Resampling strategy, power and interpretation of results

This study carries out a series of re-sampling analyses that provide insights into the consequences of sample size reductions and re-distribution of effort across strata for the

[1] Note that the strata-level estimates are not affected by this bias; and that, as long as the number of stations in each strata is maintained across years (a situation that in fact happened throughout the time series), the trends in mean values are still worth analyzing. The results of the optimizations, however, will conditional on the maintanence of the strata weights used in the original (and present) sample allocation.

precision obtained in a set of statistical indicators, namely their mean value. Albeit providing significant insight into those effects and approximating the reasoning behind a power analysis, these analyses are not *de facto* power analyses. As a consequence, the results obtained with regards to sample sizes and re-allocation of effort should not be interpreted as providing the sampling levels or strategies required for sufficient detection of particular changes in the system or the testing of hypotheses; rather they indicate sample size reductions and re-distributions of effort that, based on available data, yield approximately the same results as obtained by the current programme irrespective of the power they provide.

2.3. Resampling and re-allocation

Re-sampling of annual estimates: 5000 Bootstrap replicates of area-level and strata-level annual estimates were generated. These were done using simple random sampling with replacement and the original sample sizes per strata as stratum weight. Different sample sizes and sampling effort allocations were tested, including single indicator Neyman allocation and compromise multi-indicator Neyman allocation. In compromise allocations, the minimum number of stations accepted for each stratum was 5 with re-allocations being made across the remaining strata when expected sample sizes from Neyman allocation were below this threshold. In both single indicator- and compromise-allocation, when a strata is not presently used to calculate the average for a certain indicator its optimal sample size was considered 0.

Re-sampling of trend estimates: 1000 bootstrap replicates of regressions of mean indicator ~ year were determined. When simulating sampling every two years a random start for the series was defined, with the first sampled year being either the 1st or the 2nd year available in the time series. When simulating sampling every three years random start for the series was also defined, with the first sampled year being selected among the 1st, or 2nd, or 3rd year available in the time series. To keep the length of the time series constant and secure comparability of results a similar limitation was put on the end year used in analysis. E.g., in the case of simulations of sampling every two years involving the 1st year available, every second year was included until year (t-1), i.e., the second last year in the series; in the case simulations that involved starting in the 2nd year available, every second year was included until year (t), i.e., the last in the series. A similar reasoning was used in simulations of sampling every three years.

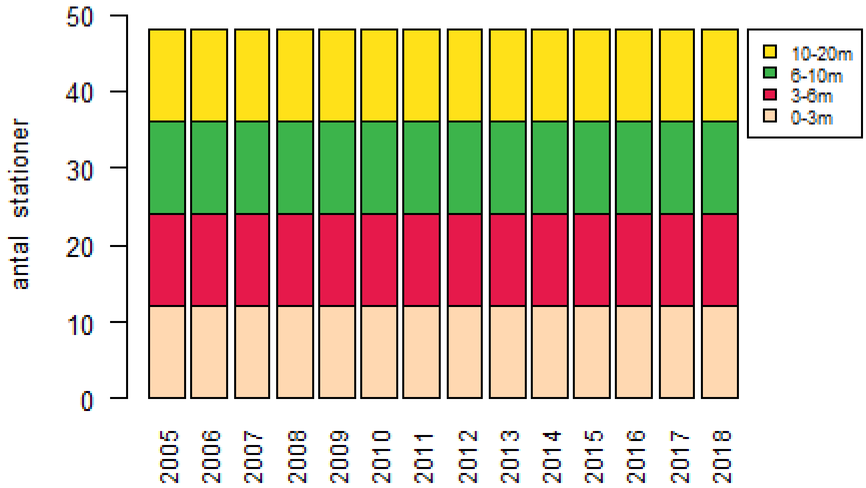
2.4. Data available

The data consisted of the numerical values for the indicators CodN, CyprinidsB, CyprinidsN, FlounderN, HerringN, PerchB, PerchN, PikeN, PikeperchN, PiscivoresN, and WhitefishN by station, **from 2005 to 2018**, as defined in the following table:

Indicator	Swedish	Definition	Strata used in calculating average
CodN	CPUE Torsk	Cod, Number per gear	"0-3m", "3-6m", "6-10m", "10-20m"
CyprinidsB	WPUE Karpfisk	Cyprinid fish, Biomass per gear	"0-3m", "3-6m", "6-10m"
CyprinidsN	CPUE Karpfisk	Cyprinid fish, Number per gear	"0-3m", "3-6m", "6-10m"
FlounderN	CPUE Skrubbskädda	Flounder, Number per gear	"0-3m", "3-6m", "6-10m", "10-20m"
HerringN	CPUE Strömming	Herring, Number per gear	"0-3m", "3-6m", "6-10m", "10-20m"
PerchB	WPUE Abborre	Perch, Biomass per gear	"0-3m", "3-6m", "6-10m"

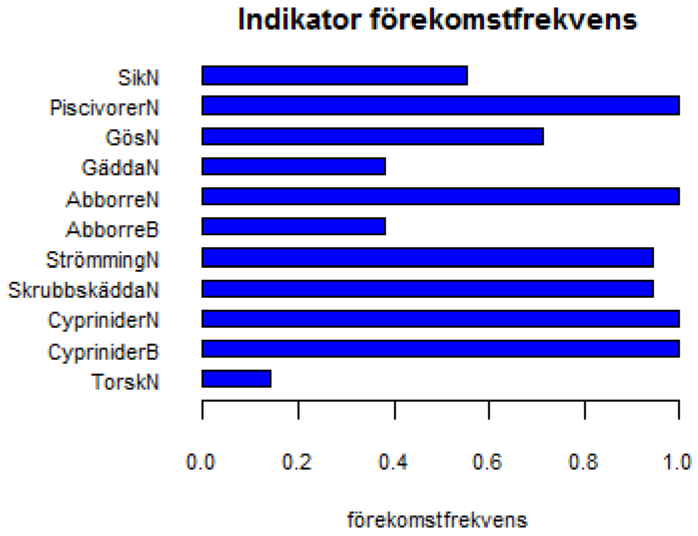
PerchN	CPUE Abborre	Perch, Number per gear	"0-3m", "3-6m", "6-10m"
PikeN	CPUE Gädda	Pike, Number per gear	"0-3m", "3-6m", "6-10m"
PikeperchN	CPUE Gös	Pikeperch, Number per gear	"0-3m", "3-6m", "6-10m", "10-20m"
PiscivoresN	CPUE Rovfisk	Piscivorous fish, Number per gear	"0-3m", "3-6m", "6-10m"
WhitefishN	CPUE Sik	Whitefish, Number per gear	"0-3m", "3-6m", "6-10m", "10-20m"

The number of stations sampled **per year (n=48),** their distribution across strata, and the methodology used during sampling were constant throughout the time series. All stations were sampled every year apart from minor departures due to occasional disturbances in the fishing area (**18 out of 672 stations sampled**).



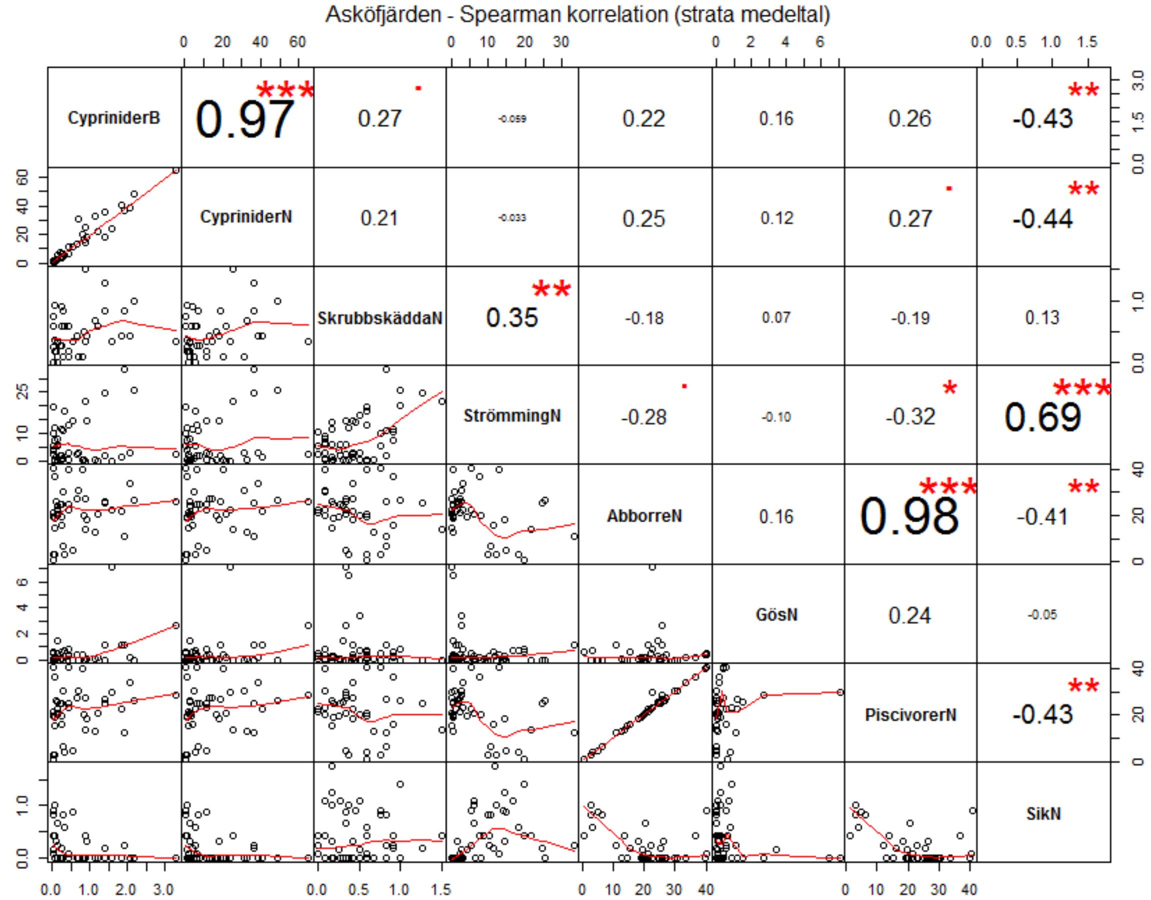
2.5. Choice of indicators

Results were obtained for all indicators in all sample size and sample allocation scenarios tested. However, only the ones derived for species that register higher frequency of occurrence in the area were considered when defining the optimum scenarios for re-allocation of stations across depth strata. This is because it is difficult to obtain precise estimates for rare and less common species that register a large number of zero-observations unless a dedicated programme is established that specifically targets the habitats (e.g., depths) where they exist. **In the case of Äsköfjärden, the most frequent indicators in the dataset (as defined by number of non-zero observations) were the Cyprinids, Herring, Perch, Flounder, Piscivores and Whitefish.**



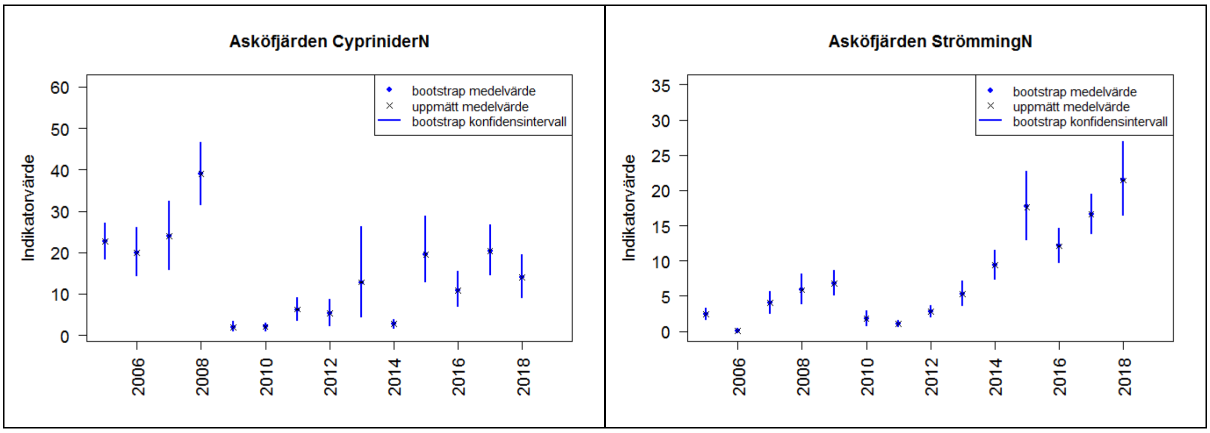
Furthermore, during initial analyses, some indicators were identified as highly positively correlated with each other (e.g., CyprinidsB and CyprinidsN). The presence in the analysis of indicators with very high and significant positive correlations is not particularly informative on the status of the system (the indicators are likely to reflect the same pattern) and has the negative effect of giving them excessive weight in the results of the allocation algorithm (thus making the results less optimal for other indicators, particularly those with contrasting distributions). It was therefore considered useful to further restrict the indicators used in studies of re-distribution of samples across depth strata to the subset not displaying such correlations.

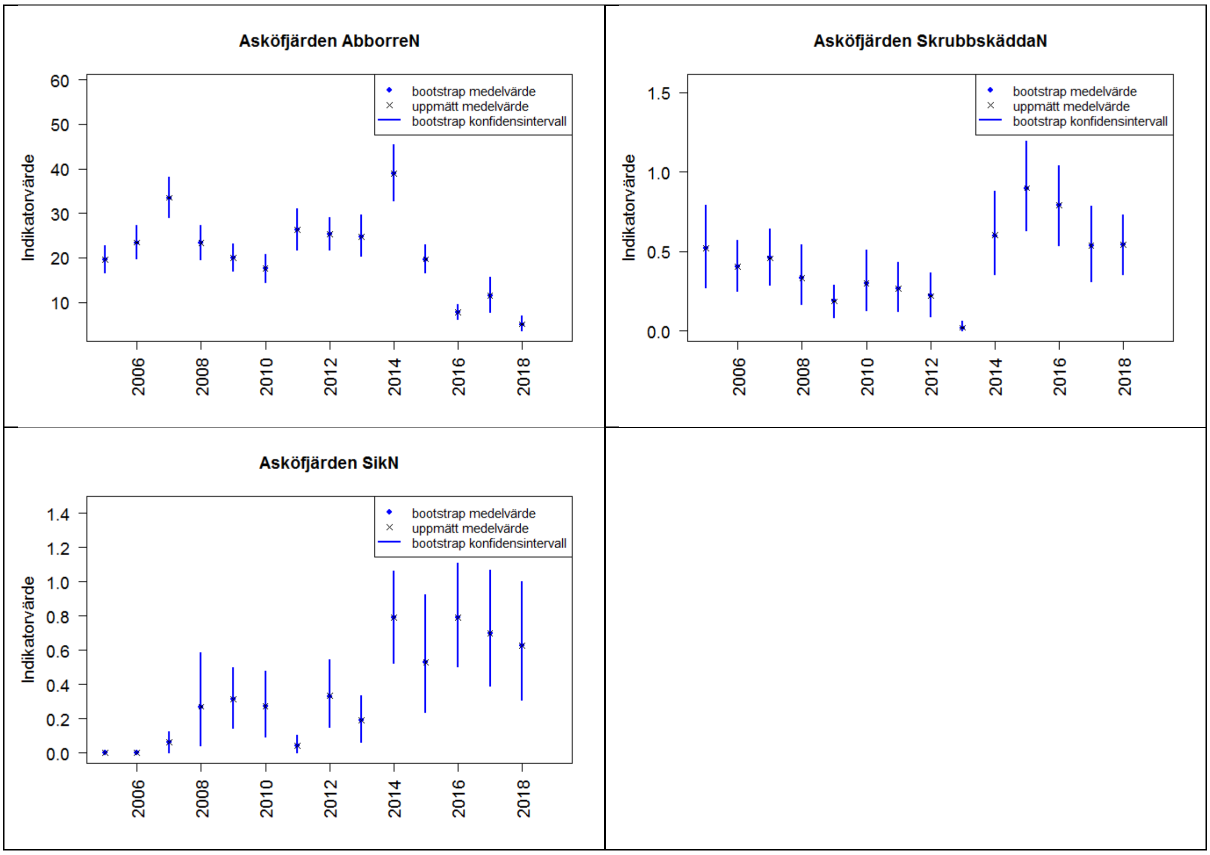
In the case of Äsköfjärden, high positive significant correlations are observed between CyprinidsN and CyprinidsB, and between PerchN, PerchB and PiscivoresN. After redundancies were eliminated, **CyprinidsN, HerringN, PerchN, FlounderN and WhitefishN** remained as the main indicators to be used in the analyses.



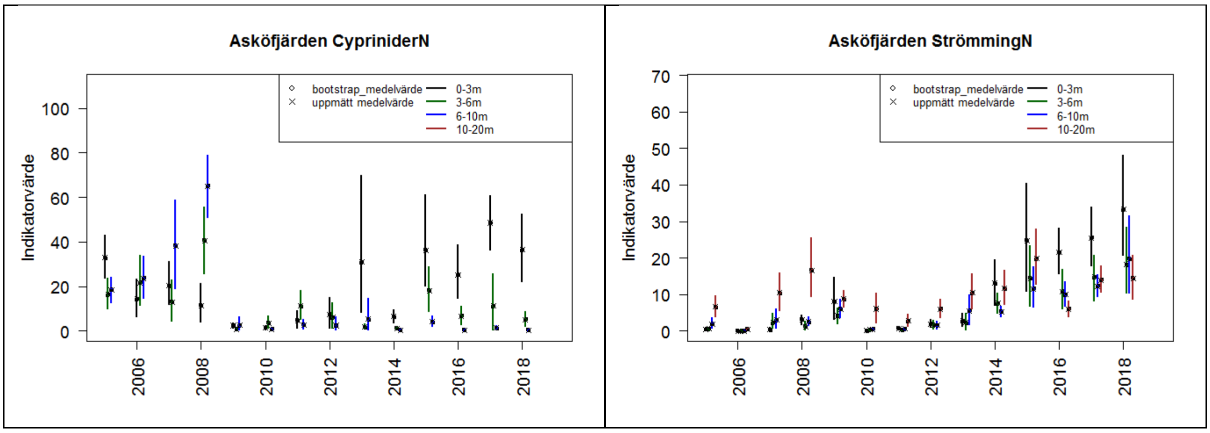
3. Results

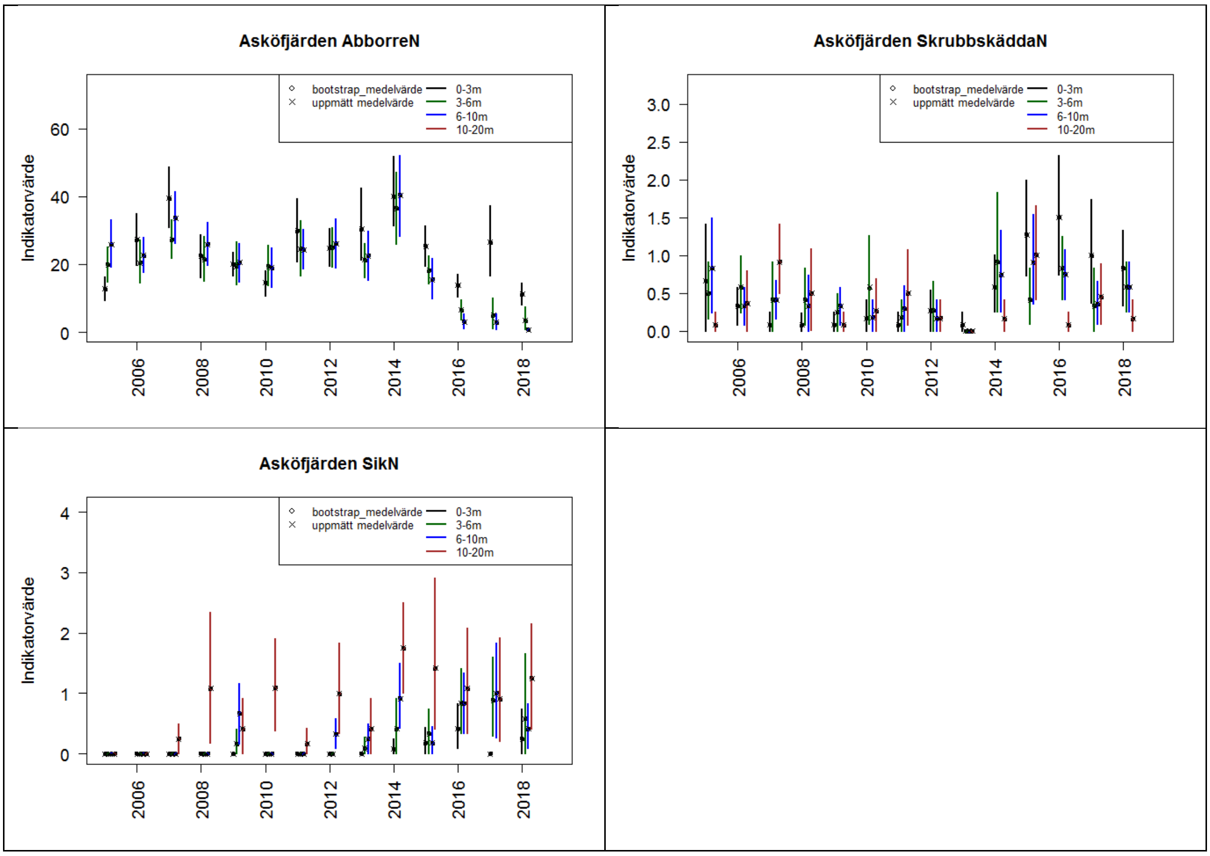
3.1. Variation in indicators over the years





3.2. Variation in indicators over the years by depth strata

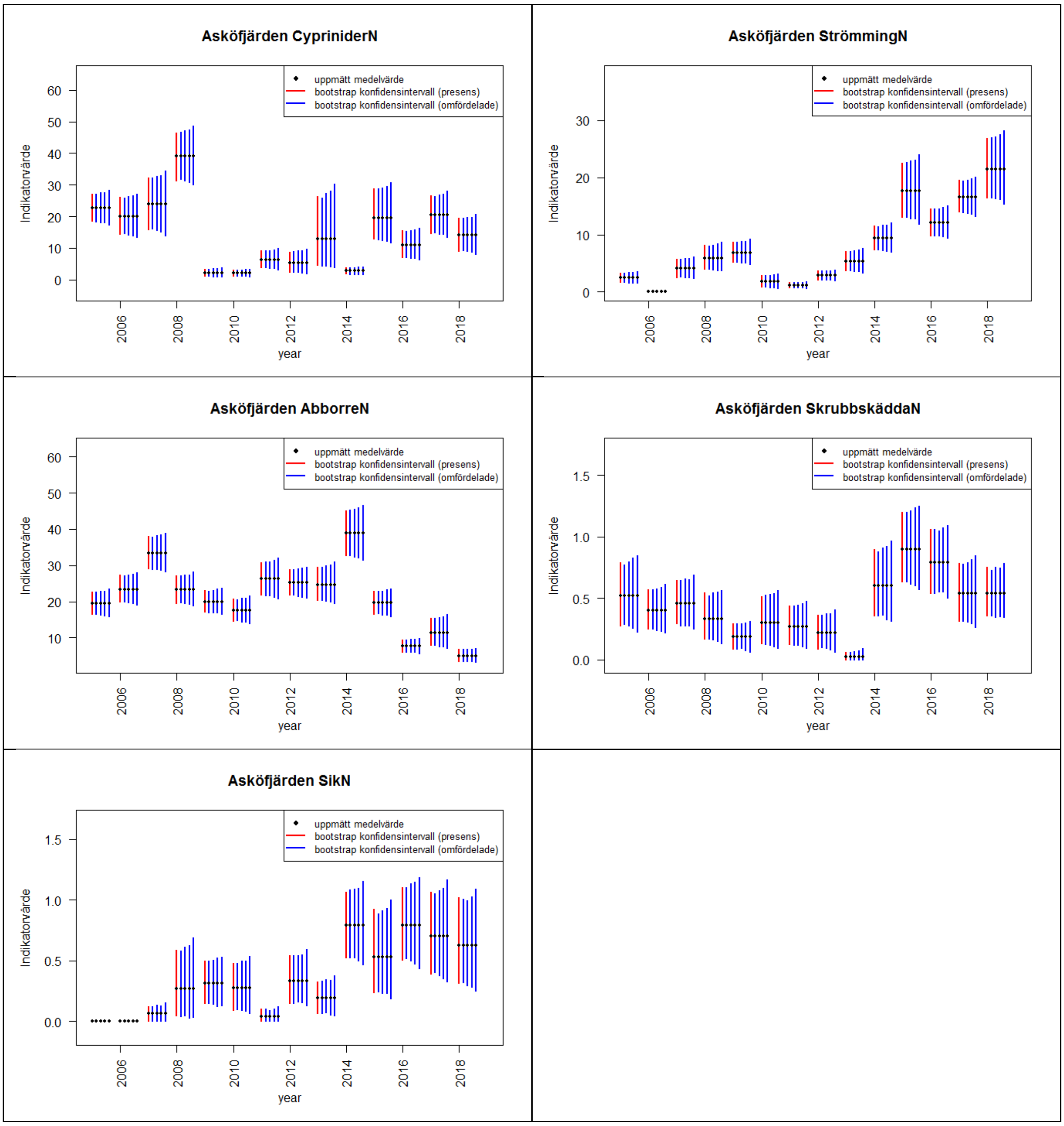




3.3. Variability in results with sample size (original allocation)

The figure displays the impacts of sample size reductions in present area-level estimates under the present sampling **effort of 48 stations** (red, first blue line in each series) and successively smaller sampling **effort of 43, 38 and 33 stations** (remainder blue lines, from left to right within each year) [2]. The simulations were quite stable as shown by the low variability in the results of the two first confidence intervals of each year (compare red and first blue line; first two rows of table). The decrease in precision that a reduction in sample size could have caused can be observed in the relative increase of the confidence intervals from left to right within each year.

[2] The variability in samples sizes tested in the different scenarios considered for this area results from the need to maintain at least 5 samples in all strata while avoiding substantial departures from the strata weights determined for each scenario.



The following table displays detailed results on the 5%, 50% (median) and 95% quantiles of the distribution of relative standard errors (RSE) of the simulated replicates. Green coloured cells are estimates that stayed within +5% of the presently obtained value. Red coloured cells contain estimates that are beyond that limit. The comparison of the first two rows provides insight into the variability brought about by the simulations themselves. The increase in RSE observed with decreasing sample size provides insight into the decrease in the precision of area-level estimates to be expected from a reduction in sample size.

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Median	95%	5%	Median	95%	5%	Median	95%	5%	Median	95%	5%	Median	95%
Present	10.0	19.8	36.5	9.6	15.5	30.9	7.0	8.3	16.9	16.2	23.8	54.6	18.7	31.3	57.2
48	9.8	19.6	36.1	9.5	15.2	30.7	7.0	8.4	16.7	15.9	23.5	55.0	18.8	31.2	57.5
43	10.5	20.5	38.6	9.8	16.1	32.1	7.4	8.6	17.5	16.9	24.7	57.6	19.6	32.8	60.0
38	10.9	21.8	39.6	10.5	17.0	34.1	7.9	9.1	18.0	17.8	25.9	60.7	20.6	33.6	63.2

33	12.4	24.1	45.0	11.6	19.2	37.7	8.6	10.1	20.2	19.6	29.1	68.5	23.2	37.8	71.1
28	13.1	25.9	47.8	12.3	20.1	41.2	9.2	10.9	22.0	21.2	31.3	72.4	24.3	41.0	75.5
23	14.0	27.9	51.9	13.4	21.9	44.3	9.9	11.8	23.6	22.8	33.5	80.2	26.9	43.7	81.9

Based on these results it is concluded that **if 43 or 38 stations** had been sampled, the relative standard error (RSE) obtained for the main indicators would most likely have stayed within a +5% interval of present value. This reduction in sampling would correspond to the following re-allocation of stations across strata (changes to weight of strata highlighted in parenthesis):

Depth strata	Present (n=48)		Reduction to n = 43		Reduction to n = 38	
0-3 m	**12**	**(0,25)**	**11**	**(0,25)**	**10**	**(0,25)**
3-6 m	**12**	**(0,25)**	**11**	**(0,25)**	**10**	**(0,25)**
6-10 m	**12**	**(0,25)**	**11**	**(0,25)**	**10**	**(0,25)**
10-20 m	**12**	**(0,25)**	**11**	**(0,25)**	**10**	**(0,25)**

3.4. Variability in results with sample size (Neyman allocation)

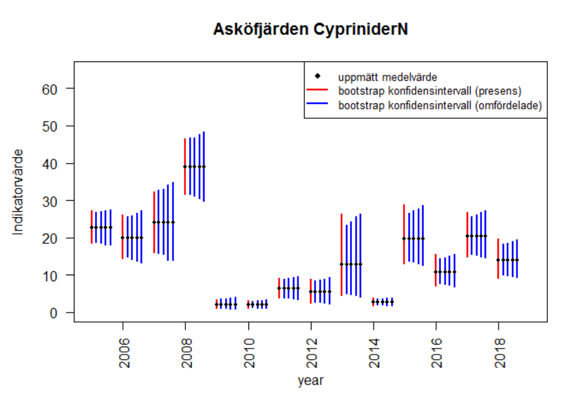
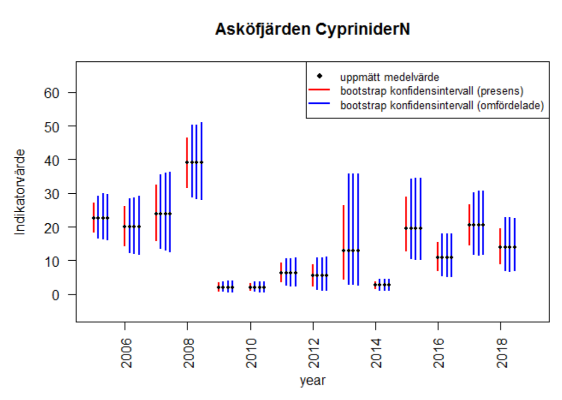
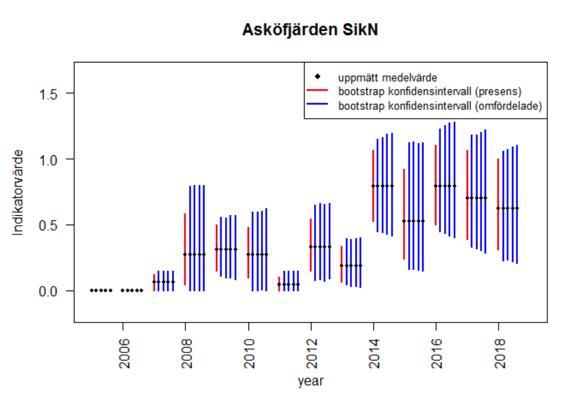
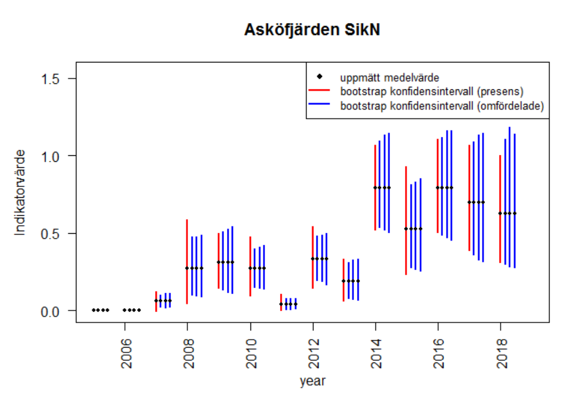
3.4.1. Single Indicator Neyman allocation

The redistribution of sampling effort across strata as indicated by Neyman allocation focused on improving area-level estimates of each of the main indicators is displayed in the following table

Depth strata	Present	CyprinidsN	HerringN	PerchN	FlounderN	WhitefishN
0-3 m	**12**	22	11	18	14	2
3-6 m	**12**	14	8	16	13	7
6-10 m	**12**	11	8	15	11	8
10-20 m	**12**	0	21	0	10	31

The following graphs display the evolution of the simulated confidence intervals of two contrasting indicators (rows) under two contrasting allocation scenarios (columns). Each graph displays the confidence interval of the original series (red line) and confidence intervals obtained with successively smaller sample sizes (blue lines). Full results for all scenarios and indicators are displayed in the table that follows. In this table values are expressed in terms of relative standard error (RSE) as calculated from bootstrap. To facilitate interpretation a colour code is used in the cells – Yellow when values are lower than those presently obtained (first row); Green when RSE are within +5% of present values; and red when RSE values are beyond that 5% of the present value.

	Reallocation Scenario

	CyprinidsN	WhitefishN
CyprinidsN		
WhitefishN		

The results show that the adoption of a scheme focused on the optimal allocation of one indicator results in more precise estimates for that indicator but frequently generates a negative side-effect on other indicators, which precision significantly degrades relative to its original values. These effects largely motivated the need to consider compromise multi-indicator allocations such as the ones proposed in section 3.4.2.

Reallocation Scenario: focus on CyprinidsN

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.6	15.5	31.0	7.1	8.3	16.9	16.1	23.9	54.7	18.7	31.4	57.3
48	9.6	16.8	34.5	9.0	20.4	48.2	6.8	8.1	14.2	16.2	25.1	52.6	24.6	46.1	89.8
43	9.8	17.3	36.4	9.3	20.9	47.9	7.1	8.4	14.8	16.7	25.4	53.9	25.4	47.0	90.6
38	11.0	18.9	41.2	10.2	21.5	48.4	7.9	9.6	16.5	18.3	27.7	58.4	26.3	46.7	90.0
33	11.7	20.5	44.1	10.9	21.8	47.9	8.4	10.1	17.8	19.3	29.1	60.4	26.9	46.9	90.0
28	13.2	22.5	48.0	11.9	23.2	49.2	9.5	11.3	19.5	21.2	31.8	65.1	27.9	47.0	89.9

Reallocation Scenario: focus on HerringN

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.6	15.5	31.0	7.1	8.3	16.9	16.1	23.9	54.7	18.7	31.4	57.3
48	11.8	21.1	42.1	10.5	14.6	23.5	8.2	9.8	18.6	17.2	28.0	59.3	18.8	28.4	43.9
43	12.5	22.4	44.2	11.2	15.5	25.0	8.8	10.4	19.9	18.2	29.1	63.3	20.1	30.4	46.1
38	13.1	23.0	44.8	11.8	16.4	26.1	9.0	10.8	21.3	19.1	30.6	67.4	21.0	32.5	48.2

33	14.2	25.2	47.9	12.8	17.7	29.0	9.9	11.8	22.9	20.6	33.2	72.6	22.5	34.8	52.7
28	15.2	28.0	54.1	14.0	19.6	31.0	10.6	12.6	25.0	22.8	35.3	79.8	24.1	37.0	58.6

Reallocation Scenario: focus on PerchN

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.5	15.5	31.1	7.1	8.2	17.0	16.1	23.7	54.5	18.7	31.3	57.1
48	9.0	17.1	33.6	9.1	19.9	48.1	6.6	7.7	14.8	16.3	24.4	54.9	24.2	45.8	89.7
43	9.6	18.4	35.1	9.5	20.6	47.8	6.8	8.0	15.6	16.9	24.9	57.2	25.0	46.4	90.7
38	10.4	19.8	38.4	10.2	21.0	48.0	7.6	8.8	17.1	18.1	26.5	62.0	25.1	46.5	90.5
33	11.3	21.9	41.4	11.0	21.5	48.2	8.0	9.4	19.1	19.6	27.6	64.0	25.8	46.9	89.2
28	12.5	24.3	46.8	11.9	21.8	48.3	8.8	10.6	20.7	21.0	29.9	71.2	26.5	47.9	88.9

Reallocation Scenario: focus on FlounderN

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.6	15.5	31.0	7.1	8.3	16.9	16.1	23.9	54.7	18.7	31.4	57.3
48	9.6	18.2	35.7	9.1	16.0	33.9	6.9	8.2	15.5	15.9	23.2	52.4	19.6	33.8	63.3
43	10.3	19.1	37.8	9.6	17.3	35.9	7.4	8.7	16.8	16.8	24.9	55.1	21.1	35.8	66.6
38	11.2	20.6	41.6	10.4	18.6	37.6	8.0	9.5	18.0	18.4	27.1	60.4	22.5	38.1	70.7
33	11.8	22.0	43.5	11.1	19.6	40.7	8.5	10.1	19.0	19.0	28.8	63.8	23.9	40.2	76.4
28	12.9	24.5	48.0	12.1	21.4	44.5	9.3	11.1	21.1	21.2	32.0	70.5	26.3	44.1	82.2

Reallocation Scenario: focus on WhitefishN

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.6	15.5	31.0	7.1	8.3	16.9	16.1	23.9	54.7	18.7	31.4	57.3
48	14.3	29.9	54.5	12.9	17.4	20.4	9.8	11.7	25.0	21.3	30.9	79.4	19.4	29.3	37.7
43	14.8	30.3	55.1	13.8	18.4	22.0	10.3	12.4	26.3	22.2	33.1	81.3	21.0	31.8	41.0
38	15.1	30.4	55.8	14.2	18.8	23.1	10.6	12.6	26.1	23.1	33.4	81.3	21.9	33.0	42.5
33	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

3.4.2. Multi-Indicator compromise Neyman allocation

To circunvent the negative consequences of single-indicator optimization for the the remainder of indicators, multi-indicator compromise Neyman allocations were considered. The redistributions of sampling effort across strata obtained by this methodology are displayed in the following table with strata weights highligthed in parenthesis

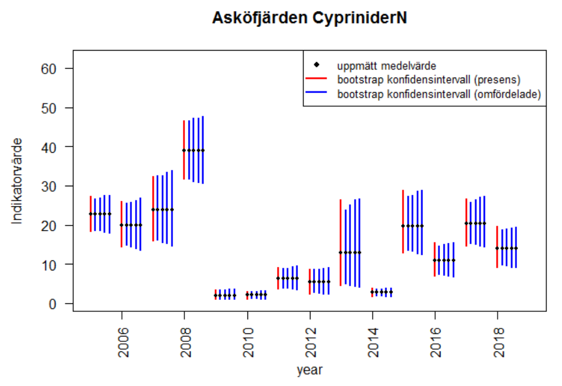
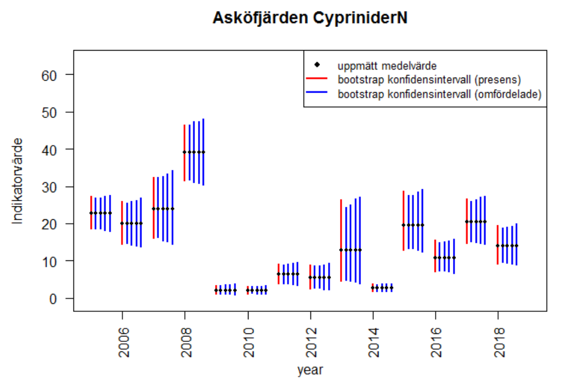
Depth strata	Present		Compromise0		Compromise1		Compromise2	
0-3 m	**12**	(0,25)	17	(0,35)	16	(0,33)	13	(0,27)
3-6 m	**12**	(0,25)	13	(0,27)	13	(0,27)	12	(0,25)

6-10 m	**12**	(0,25)	11	(0,23)	11	(0,23)	11	(0,23)
10-20 m	**12**	(0,25)	7	(0,15)	8	(0,17)	12	(0,25)

Where:

Compromise0 = AllocScenarioCypNHerNPerN
Compromise1 = AllocScenarioCypNHerNPerNFloN
Compromise2 = AllocScenarioCypNHerNPerNFloNWhiN

The following graphs display the evolution of the simulated confidence intervals of two contrasting indicators (rows) under the two compromise solutions (columns). Each graph displays the confidence interval of the original series (red line) and confidence intervals obtained with successively smaller sample sizes (blue lines). Full results for all scenarios and indicators are displayed in the table that follows. In this table values are expressed in terms of relative standard error (RSE) as calculated from bootstrap. To facilitate interpretation a colour code is used in the cells – Yellow when values are lower than those presently obtained (first row); Green when RSE are within +5% of present values; and red when RSE values are beyond that 5% of the present value.

<table>
<tr><th></th><th colspan="2">Reallocation Scenario</th></tr>
<tr><th></th><th>Compromise0
[CypN + HerN + PerN]</th><th>Compromise1
[CypN + HerN + PerN + FloN]</th></tr>
<tr><td>CyprinidsN</td><td>
</td><td>
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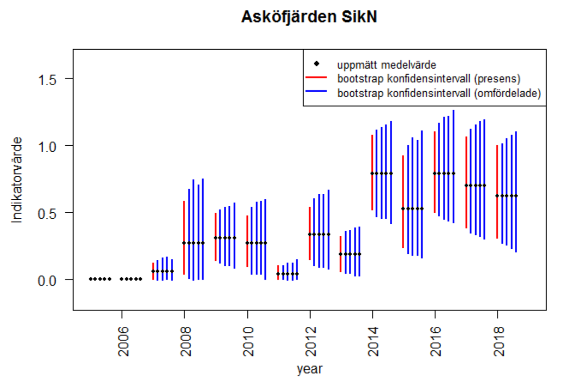
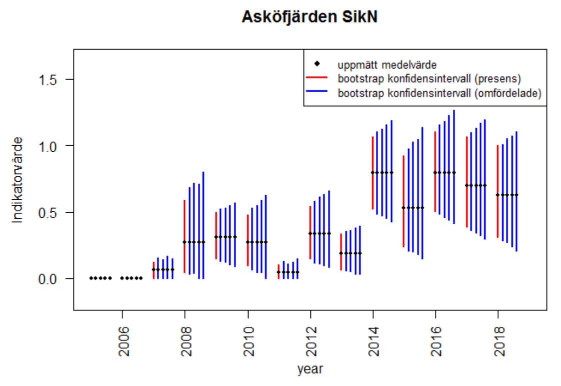
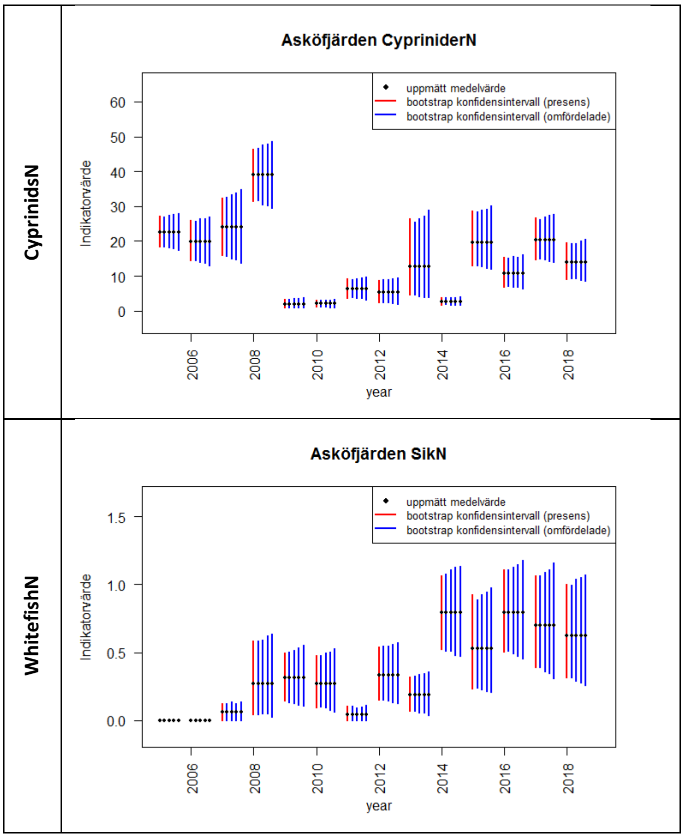
<tr><td>WhitefishN</td><td>
</td><td>
</td></tr>
</table>

	Reallocation Scenario
	Compromise2 **[CypN + HerN + PerN + FloN + WhiN]**



The graphs and table show that a reallocation of effort is **likely to improve the precision of results of most indicators (compromise2). Under that allocation, a sample size reduction to 43 would still provide approximately the same results as obtained with the present sample allocation scheme and sample size (n =48)**. Under such effort reallocation and sample size reduction scenario, detrimental effects in the precision of the main indicators would have been minor relative to the values originally obtained.

Compromise0 **[CypN + HerN + PerN]**

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.4	9.6	15.4	30.8	7.1	8.4	17.0	16.0	23.8	54.6	18.9	31.4	57.5
48	9.5	17.4	34.3	8.9	17.9	40.5	6.8	8.0	14.8	16.1	23.5	51.3	21.9	39.7	75.7
43	10.1	18.4	36.6	9.5	19.6	44.2	7.1	8.5	15.7	17.0	24.3	54.7	23.8	43.0	82.3
38	10.8	19.8	38.8	10.2	19.8	43.9	7.6	9.0	16.8	18.0	26.4	58.4	24.2	42.0	80.9
33	11.2	20.6	41.1	10.8	21.4	48.2	8.0	9.6	18.1	19.3	27.9	61.6	26.2	46.9	88.6
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Compromise1 **[CypN + HerN + PerN + FloN]**

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.9	36.5	9.6	15.5	31.0	7.1	8.3	16.9	16.1	23.9	54.7	18.7	31.4	57.3

48	9.5	17.6	34.8	9.0	17.1	37.8	6.8	8.1	15.1	16.2	23.2	51.2	20.9	37.5	71.0
43	10.3	18.5	36.7	9.6	18.4	40.8	7.2	8.6	16.1	17.1	24.3	53.7	22.8	39.8	75.7
38	10.8	19.6	38.8	10.2	19.7	43.8	7.6	9.0	16.8	18.0	26.2	58.4	24.2	42.0	81.2
33	11.4	21.1	41.7	11.0	21.2	47.9	8.1	9.6	18.8	19.3	28.0	62.1	26.4	46.5	90.0
28	12.9	23.8	47.7	12.1	22.7	48.0	9.3	11.0	20.5	21.3	31.4	67.9	27.8	47.5	90.3

Compromise2 **[CypN + HerN + PerN + FloN + WhiN]**

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Med.	95%	5%	Med	95%	5%	Med	95%	5%	Med.	95%	5%	Med.	95%
Present	10.0	19.8	36.5	9.5	15.4	31.0	7.0	8.3	16.9	16.1	23.9	54.8	18.8	31.3	57.3
48	9.8	19.0	36.1	9.4	15.4	31.0	7.0	8.4	16.2	15.9	23.6	53.9	18.9	31.2	57.3
43	10.9	20.3	39.4	9.9	16.6	32.3	7.7	9.1	17.6	17.0	25.8	57.3	20.2	33.1	60.3
38	11.4	20.7	41.5	10.5	17.6	33.9	8.1	9.6	18.6	17.8	27.2	59.0	21.4	35.0	63.7
33	12.2	22.8	44.9	11.3	18.8	35.8	8.8	10.4	19.9	19.1	29.3	65.6	22.6	37.0	68.1
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

It is worth noticing that the results obtained at area-level under the present sample size of 48 stations, a sample size of 43 stations with the present allocation (section 3.3) and a sample size of 43 with the allocation suggested under compromise2 (this section) were generally favourable to the original allocation even if differences are within what might be expected from the variability of simulations themselves (within less of a few percent points). These results are displayed in the following table where the most precise allocation for each indicator is highlighted in yellow.

	CyprinidsN			HerringN			PerchN			FlounderN			WhitefishN		
	5%	Median	95%	5%	Median	95%	5%	Median	95%	5%	Median	95%	5%	Median	95%
48 (present)	10.0	19.8	36.5	9.6	15.5	30.9	7.0	8.3	16.9	16.2	23.8	54.6	18.7	31.3	57.2
43 (original)	10.5	20.5	38.6	9.8	16.1	32.1	7.4	8.6	17.5	16.9	24.7	57.6	19.6	32.8	60.0
43 (comp2)	10.9	20.3	39.4	9.9	16.6	32.3	7.7	9.1	17.6	17.0	25.8	57.3	20.2	33.1	60.3

3.5. Variability of trends with different allocation and sample size

The following slopes and results of slope significance test (H_0: slope=0, $p<0.05$) were determined for the present estimates at area-level

Indicator	Slope	Significance?
CyprinidsN	-0,71698	FALSE
HerringN	1,338899	TRUE
PerchN	-1,01336	FALSE
FlounderN	0,02178	FALSE
WhitefishN	0,058511	TRUE

The next tables show the the number of replicates (out of 1000) that registered slope with same sign and the same outcome of slope significance test (as originally determined from present estimates) for different varying sample size and allocations. **In agreement with previous analysis, it is noticeable that if the samples had been re-allocated and sample size reduced the general perception of the trends in the main indicators would not have differed.**

Original

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	1000	969	1000	912	1000
48	1000	974	1000	917	998
43	999	964	1000	912	999
38	1000	959	1000	898	997
33	997	943	1000	895	995

Compromise1 **[CypN + HerN + PerN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	1000	968	1000	917	998
48	1000	972	1000	916	994
43	1000	961	1000	904	992
38	999	953	1000	893	985
33	999	948	1000	887	973

Compromise1 **[CypN + HerN + PerN + FloN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	1000	957	1000	911	997
48	1000	972	1000	898	995
43	1000	956	1000	919	993
38	999	952	1000	909	983
33	1000	957	1000	871	978

Compromise2 **[CypN + HerN + PerN + FloN + WhiN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	1000	970	1000	919	999
48	1000	967	1000	901	1000
43	1000	963	1000	908	999
38	999	939	1000	878	998
33	999	957	1000	880	996

3.6. Variability of trends with different allocation and sample size **(sampling every second year)**

The following tables show similar results when a change in sampling periodicity from annual to once every two years is simulated. It is clear the different results that would have been obtained, **particularly for CyprinidsN and WhitefishN.**

Original

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	812	913	906	997	777
48	810	920	914	1000	783
43	797	899	894	1000	774
38	800	896	876	1000	745
33	810	868	860	996	662

Compromise0 **[CypN + HerN + PerN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	816	907	887	1000	800
48	831	897	867	1000	694
43	812	899	876	1000	659
38	818	899	876	999	643
33	787	891	846	998	611

Compromise1 **[CypN + HerN + PerN + FloN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	816	914	877	999	800
48	812	901	896	1000	696
43	813	904	871	999	686
38	814	891	856	997	653
33	804	879	848	999	601

Compromise2 **[CypN + HerN + PerN + FloN + WhiN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	804	914	911	1000	772
48	797	886	907	999	777
43	808	909	874	999	733
38	793	901	863	998	721
33	820	883	864	997	686

3.7. Variability of trends with different allocation and sample size **(sampling every third year)**

The following tables show similar results when a change in sampling periodicity from annual to once every three years is simulated. It is clear the different results that would have been obtained, **particularly for HerringN and WhitefishN.**

Original

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN

Present	795	838	0	626	102
48	824	848	0	591	106
43	796	823	0	586	103
38	796	835	2	587	101
33	813	798	2	555	88

Compromise0 **[CypN + HerN + PerN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	801	858	0	586	107
48	826	823	0	581	103
43	810	851	2	572	96
38	803	834	1	573	84
33	808	831	3	583	90

Compromise1 **[CypN + HerN + PerN + FloN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	812	828	0	585	105
48	805	819	0	596	89
43	802	822	0	573	99
38	832	836	1	564	95
33	782	831	0	580	76

Compromise2 **[CypN + HerN + PerN + FloN + WhiN]**

SampSize	CyprinidsN	FlounderN	HerringN	PerchN	WhitefishN
Present	802	833	1	617	110
48	827	849	0	592	99
43	819	826	0	591	117
38	803	853	0	572	106
33	821	813	0	569	89