



ABUNDANCE INDICES FOR NORWEGIAN COASTAL COD NORTH OF 62°N

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Title (English and Norwegian):

Abundance indices for norwegian coastal cod north of 62°N
Mengdeindekser for kysttorsk nord for 62°N

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Summary (English):

In connection with the benchmark processes within ICES on Norwegian Coastal Cod north of 62°N during autumn 2020-spring 2021, new abundance index series based on bottom trawl stations and acoustics at the autumn coastal survey were made. The acoustic index covers the period 1995-2019 while the trawl index covers the period 2003-2019. This report describes the methods used and briefly presents the results.

Summary (Norwegian):

I forbindelse med metoderevisjonsarbeidet i ICES på kysttorsk nord for 62°N høsten 2020-våren 2021, ble det utarbeidet nye mengdeindeks-serier basert på faste trålstasjoner og akustikk under kysttoktet om høsten. Akustikkserien dekker perioden 1995-2019, mens trålindeksen dekker perioden 2003-2019. Denne rapporten beskriver metodikken brukt og presenterer kort resultatene i form av tabeller og grafer.

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1 - Introduction

New abundance index series for Norwegian coastal cod north of 62° were produced using the software StoX (Johnsen et al. 2019). Indices were calculated by applying trawl swept area and acoustic methods, using data collected during the Norwegian annual coastal survey in autumn NOcoast-Aco-4Q.

Time series of indices for the period 1995 to 2019 in numbers and biomass (2003-2019 for the swept-area index), their coefficient of variation, length- and weight-at-age are tabulated for three subareas and the total area in Appendix A (acoustic indices) and Appendix B (swept-area trawl indices).

2 - Biology, stock structure, and management of coastal cod

Coastal cod occurs in fjords and coastal areas along the entire coast of Norway. The management area for this species is divided into two areas south and north of 62 ° N. Genetic studies indicate a genetic cline along the coast from eastern Finnmark to inner Skagerrak (Dahle et al., 2018). Coastal cod north of 62 ° N is somewhat related to Northeast Arctic (NEA) cod, while coastal cod south of 62 ° N showing some similarities to North Sea and Skagerrak cod.

Compared to NEA cod the immature coastal cod has faster individual growth and earlier age of maturation (Berg and Albert, 2003). Since individual growth is reduced after the age of first maturation, the weight at age for old fish is somewhat lower for coastal cod than for Northeast Arctic cod at the same age.

Spawning areas for coastal cod have been mapped by egg sampling and classified according to their relative value (Gytefelt Torsk MB at www.fiskeridirektoratet.no). See also Figures 18-23 in Aglen et al. (2020). Some of these coastal cod spawning areas are close to spawning areas for NEA cod. Probably due to rather small-scale differences in currents and egg buoyancy, the coastal cod eggs and larvae tend to be retained near the spawning areas, while NEA cod eggs and larvae are transported by currents northward into the Barents Sea.

Annual total allowable catches (TAC) were set for coastal cod at 40 kt in the years 1987-2003, 20 kt in 2004, and 21kt in later years. A large proportion of the annual landings of coastal cod is by-catches in the fishery for NEA cod. A rebuilding plan was established 2011 and several technical regulations were introduced to reduce “bycatches” of coastal cod, including gear restrictions and restrictions on vessel size, and closures of spawning areas in the spawning season (Henningsværstraumen and Inner Lofoten).

3 - The autumn coastal survey

3.1 - The history of the survey and how it has developed over the years

The Institute of Marine Research (IMR) has since 1985 conducted an annual acoustic survey of coastal areas and offshore banks north of 62°N with the objective of obtaining abundance indices of commercially important fish species (Skants, 2019). The annual coverage (in October and November) of coastal areas and fjords, as well as open ocean banks, between Stad (62°N) and Varanger (71.3 °N) has since 1995 included measurements of coastal cod (*Gadus morhua*).

The trawl gear used during the first years was a Campelen 1800 standard shrimp trawl with rock hopper gear and 35 mm mesh size in the cod end. Scanmar sensors provided information about the trawl opening (height in meters), door spread and bottom contact. Since 2003 a Campelen 1800 standard shrimp trawl with rock hopper gear, 20 mm mesh size in the cod end and 80mm (stretched) in the front part is the standard fishing gear, combined with Scanmar trawl and door sensors (Aglen et al., 2005). Additional stations were added in 2017, which was done as it was considered necessary to gather more information on deep water shrimps and redfish (Mehl et al., 2018a). Standard trawl duration is 30 minutes at a speed of 3 knots, with preferred doorspread of 49-52m and trawl opening of 3.5-4.5m. Data were collected with several vessels, which are listed in Table 1.

The survey consists of a stratified grid for acoustic measurements, with fixed bottom trawl stations and additional bottom and pelagic stations on acoustic registrations within each of the strata.

During the surveys hydrographic stations were sampled semi-regularly. CTD-measurements were taken at some of the fixed bottom trawl stations or with a set distance of 30 nautical miles between each station (Staby et al., 2020).

The surveyed area was initially divided into 23 strata, and these were grouped into three subareas: North of 67°N (Area "A"), 65°-67°N (Area "B"), and 62°-65°N (Area "C") (Figure 1). The stratum "Vestfjorden East" was, however, removed from all years, since this stratum had no acoustic coverage and no trawl hauls in most years.

Acoustic transects and bottom trawl hauls are standardized since 2003. In 2017 additional acoustic transects were added to selected strata in order to improve the accuracy of saithe biomass estimates in those strata that contributed a significantly to the total estimate. Figure 2 shows the acoustic transects and trawl hauls made during the coastal survey in 2019.

Trawl catches are sorted and weighed by species according to standard procedures (Mjanger et al., 2020). Length measurements (e.g. total length; from snout to end of the caudal fin) are done for most species, either of all sorted individuals or of a subsample from large catches. Additional information such as age and type from otoliths, sex and gonad maturity stage are collected from cod.

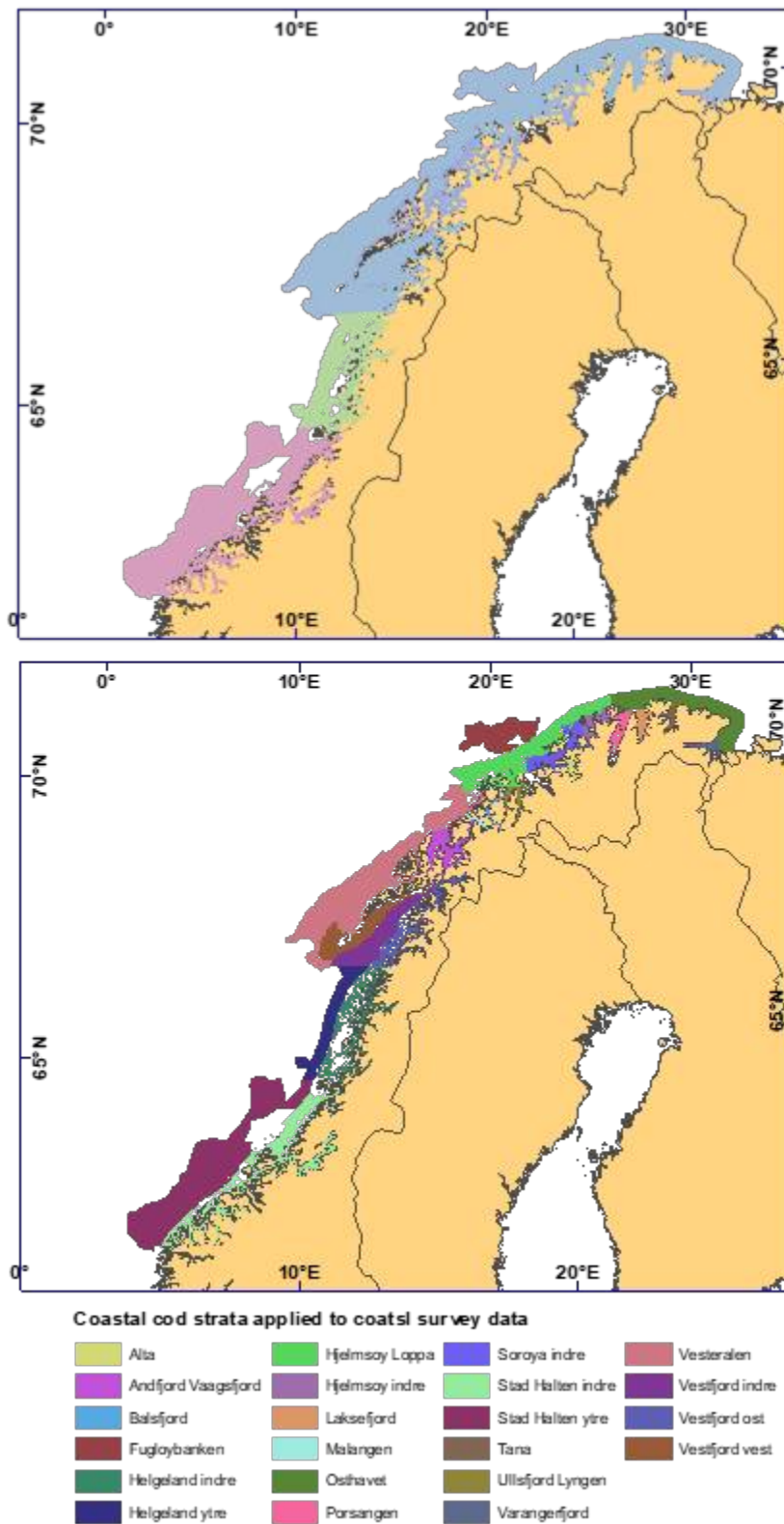
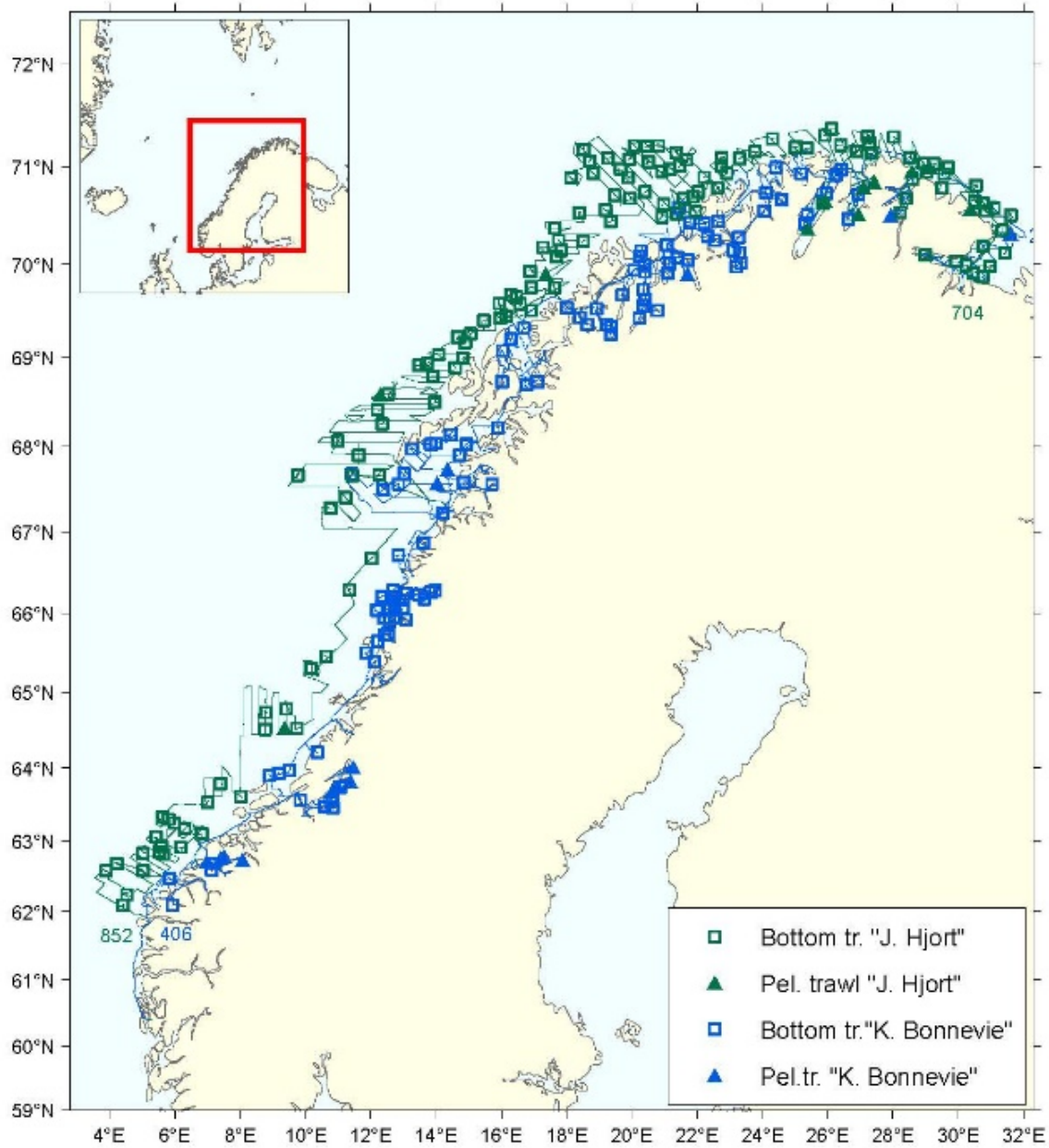


Figure 1. Map showing the 23 strata (lower panel) and the three subareas (upper panel) used for coastal cod index calculations.



Cruise no 2019210 "Johan Hjort". Trawl st.no 704–852. 5.10.–13.11.2019
Cruise no 2019629 "K. Bonnevie". Trawl st.no 287–406. 2.10.– 9.11.2019

Figure 2. Acoustic transects and trawl hauls made during the cruise in 2019. These are standard transects and trawl hauls that are made during this survey.

3.2 - Previous attempts to extract abundance indices from the survey data

As described in chapter 1.2, the autumn coastal survey has a long history and has undergone various changes over the years. It started out as an acoustic survey primarily targeting coastal cod in the Troms and Finnmark counties in the

1980s. These surveys were conducted by the former “Fiskeriforskning” marine research institute in Tromsø. IMR in Bergen started a survey at approximately the same time of the year, but targeting mainly saithe in the outer coastal areas, partly overlapping the areas of the former survey. A third survey, covering overwintering herring in the fjords was also conducted by IMR. “Fiskeriforskning” was discontinued and the department responsible for resource surveys was included in IMR. From 2003 these surveys were combined and standardized to be a combined acoustic and trawl survey mainly targeting coastal cod and saithe. When the surveys were merged and standardized in 2003, attempts were made to construct an acoustic index for coastal cod based on the original coastal cod survey and the saithe survey, covering also more southern parts of the coast north of 62 ° N. Due to partly different procedures, working protocols, and data format at the two responsible institutes, and since the surveys partly overlapped in space and time, this combination was difficult. The series was started in 1995, but for the years prior to 2003, only some of the acoustic transects, mostly those that had been standardized during the “Fiskeriforskning” survey, were used in index calculations.

3.3 - Description of the survey data

Table 1 lists the surveys from 1995-2019, which vessels took part, the number of stations taken etc.

Table 1. Description of survey data. The number of bottom trawl (BT) stations for swept area and acoustic indices differ because different data filters are applied (see sections 4.1.3 and 4.2.6).

Year	Vessel	Cruise ID	For swept area index				For acoustic index				
			N BT		N aged	N length	N BT (with cod)	N aged	N length	N miles scrutinized	
			Total	With cod						Total	With cod
1995	Michael Sars	1995111						2515	497	3869	3575
	Johan Hjort	1995211						80	1845	3952	2158
	Volstad	1995810						0	54	0	0
1996	Johan Hjort	1996214						171	2727	3285	1905
	Michael Sars	4-1996						2393	5376	6186	1552
1997	Johan Hjort	1997213						432	3656	3687	2650
	Michael Sars	4-1997						1670	4653	4180	0
1998	G.O.Sars	1998016						493	2237	3030	1808
	Jan Mayen	4-1998						2476	4060	3175	0
1999	Johan Hjort	1999215						399	1083	3813	1653
	Jan Mayen	4-1999						2780	4444	3420	0
2000	Johan Hjort	2000214						414	1202	3766	1816
	Jan Mayen	4-2000						4240	5276	3090	0
2001	Johan Hjort	2001213						267	844	4523	1229
	Jan Mayen	4-2001						3181	3815	2614	0
2002	Johan Hjort	2002214						362	1173	4655	2128
	Jan Mayen	4-2002						2048	2511	3164	0
2003	Johan Hjort	2003211	58	50	1381	2520	72	1580	2808	3695	2012
	Jan Mayen	2003706	78	68	1367	1734	109	1635	2077	4007	3130
2004	Johan Hjort	2004212	50	41	981	1714	67	1159	2010	3502	1989
	Jan Mayen	2004704	81	69	1270	1814	88	1345	1942	3469	2824
2005	Johan Hjort	2005212	42	36	759	1345	51	949	1625	3013	1768

	Jan Mayen	2005704	82	66	695	863	80	689	870	3794	3180
2006	Johan Hjort	2006213	51	42	543	821	48	677	1047	3851	2165
	Håkon Mosby	2006623	0	0	0	0	7	33	51	4479	34
	Jan Mayen	2006705	90	71	865	995	87	886	1021	4013	3260
2007	Johan Hjort	2007212	39	25	179	296	39	327	489	3550	1042
	Håkon Mosby	2007623	0	0	0	0	8	0	103	3778	0
	Jan Mayen	2007703	107	87	834	1040	85	829	1036	4670	3860
2008	Johan Hjort	2008210	86	81	1197	1773	103	1381	2012	6275	5831
	Håkon Mosby	2008623	31	16	233	329	24	308	439	1875	0
	Jan Mayen	2008705	4	4	73	127	10	73	192	214	193
2009	Johan Hjort	2009209	49	41	760	1240	46	818	1306	2860	1696
	Håkon Mosby	2009629	17	6	11	11	5	29	29	1127	180
	Jan Mayen	2009703	66	57	1263	2345	75	1299	2466	2819	2680
	Jan Mayen	2009704	4	4	140	382	14	166	544	524	524
2010	Johan Hjort	2010211	114	90	1957	3847	120	2284	4841	6175	4284
	Jan Mayen	2010704	6	6	149	489	12	168	518	380	380
2011	Johan Hjort	2011214	38	32	536	839	31	561	880	2450	1796
	Helmer Hanssen	2011722	81	71	1246	2075	80	1292	2158	4074	2875
	Helmer Hanssen	2011723	6	6	114	177	18	184	290	240	222
2012	Johan Hjort	2012210	64	55	834	1496	64	974	1701	3760	2552
	Håkon Mosby	2012620	65	51	1129	1878	50	1202	2123	2663	1402
2013	Johan Hjort	2013210	54	51	932	1638	72	1020	1836	3018	1602
	Håkon Mosby	2013623	59	50	1160	2288	65	1249	2451	2339	1227
	Helmer Hanssen	2013851	8	8	124	317	21	124	492	436	432
2014	Helmer Hanssen	2014011	8	8	209	717	21	222	736	455	449
	Johan Hjort	2014213	61	54	928	1601	81	1046	1767	4036	2680
	Håkon Mosby	2014621	74	61	1292	2555	94	1344	2623	2718	1837
2015	Johan Hjort	2015211	64	53	901	1272	65	992	1797	3880	2289
	Håkon Mosby	2015621	74	58	1180	1798	59	1183	2580	2447	1578
	Helmer Hanssen	2015854	8	7	181	566	21	229	613	395	390
2016	Johan Hjort	2016210	70	61	1451	2336	91	1545	2580	4594	4429
	Håkon Mosby	2016620	69	53	976	1463	59	1012	1522	2978	1567
2017	Johan Hjort	2017210	99	89	1616	2822	94	1656	2887	4696	2322
	Kristine Bonnevie	2017620	87	70	917	1854	97	957	1931	3760	1567
2018	Johan Hjort	2018210	110	90	1713	3282	134	1747	3316	4141	1527
	Kristine Bonnevie	2018623	86	66	1301	2365	94	1389	2523	3983	2146
2019	Johan Hjort	2019210	128	100	1516	2059	108	1598	2164	4832	2411
	Kristine Bonnevie	2019629	87	70	1191	2409	117	1196	2499	3345	2371

4 - Software used

StoX is a software developed by the Institute of Marine Research for survey analysis and index calculation. StoX is freely available (<ftp://ftp.imr.no/StoX/Download/>) and is relatively well documented (Johnsen et al., 2019). StoX is currently used for the calculation of bottom trawl indices from the Barents Sea winter survey (Mehl et al., 2018b) and from the Barents Sea ecosystem survey in the autumn (BESS) (Johannesen et al., 2019).

The data was mainly downloaded from: <https://datasetexplorer.hi.no/apps/datasetexplorer/v2/navigation> and the folder “Varanger Stad NOR coastal cruise in autumn». However, for some research vessels, especially in the early part of the period, data was lacking in the relevant folders and had to be retrieved from the original data files and reformatted to the current xml format used by StoX (<https://www.hi.no/hi/forskning/prosjekter/stox>). Steps have been taken to have these data stored in the “Varanger Stad NOR coastal cruise in autumn” folder structure and quality assure for later use.

5 - Acoustic indices

A stock abundance index series based on acoustic data from the annual autumn coastal survey (NOcoast-Aco-4Q) was calculated using the StoX software (Johnsen et al., 2019). Acoustic data covering the coastline from 62°N to the Russian border are available back to 1995, although the coverage in various parts of this area varied somewhat due to various reasons, see chapter 3.1 and 3.2 for details. For some early years in the series, acoustic data was only available from parts of the survey area. The area was split into 23 strata (see above) and the stock abundance index was calculated for each stratum separately. For various reasons, it was decided to split the total area into three subareas: The coast north of 67°N (A, consisting of 18 strata), between 65° and 67°N (B, consisting of 2 strata), and between 62°N and 65°N (C, consisting of 2 strata) (Fig 1). The spatial coverage during most of the time series is much better in subarea A than in B and C.

To estimate the uncertainty, 500 bootstrap runs were performed, and the indices are the average index from these runs.

5.1 - Acoustic indices by length

The conversion of mean nautical area scattering coefficient (NASC, $m^2 nmi^{-2}$) to fish density was carried out using a standard procedure, where trawl stations (with a catch of more than 1 cod individual) were assigned to each PSU. As a rule, all stations within a stratum were assigned to the PSUs in the same stratum. However, if less than three trawl stations were carried out in a stratum, stations in neighbouring strata were assigned to the PSUs so that at least three stations were assigned to each PSU.

The combined length distribution (d), calculated for each transect (PSU, j), is given by

$$d_{l,j} = \sum_{s=1}^n d_{l,s,j}, \text{ (eqn 1)}$$

where $d_{l,s,j}$ is fish density (number by 1 nmi tow distance) by station (s) and length group (l , cm), and n is the total number of stations.

The fish density (ρ , individuals nmi^{-2}) by length group and transect was calculated using

$$\rho_{j,l} = NASC_{j,l} / (4\pi\sigma_{bs,l}), \text{ (eqn 2)}$$

where $NASC_{j,l}$ is the mean nautical area scattering coefficient by transect and length group and $\sigma_{bs,l}$ (m^2) is the acoustic backscattering cross-section for a fish of length l .

$NASC_{j,l}$ is given by

$$NASC_{j,l} = NASC_j p_{l,j} (\sigma_{bs,l} / (\sum_l \sigma_{bs,l})), \text{ (eqn 3)}$$

where $\sigma_{bs,l}$ is the acoustic backscattering cross-section for a fish of length l multiplied by the proportion (p) of a fish of length l in $d_{l,j}$, and $NASC_j$ is the mean nautical area scattering coefficient over a given transect.

The acoustic backscattering cross-section for a fish of length l is calculated using

$$\sigma_{bs,l} = 10^{\left(\frac{TS_{l,j}}{10}\right)}, \text{ (eqn 4)}$$

where the target strength, TS (dB re 1m²), for a fish of length l is calculated using

$$TS_l = m \log_{10}(l) + a, \text{ (eqn 5)}$$

where m and a are constants, set at 20 and -68.0 respectively.

The abundance (N , inds) of cod by length group l and stratum k is given by

$$N_{k,l} = \rho_{k,l} A_k, \text{ (eqn 6)}$$

where A (nmi²) is the stratum area, and the mean density of cod by l and k is given by

$$\rho_{k,l} = (1/n_k) \sum_{j=1}^{n_k} (w_{k,j} \rho_{k,j,l}), \text{ (eqn 7)}$$

where $\rho_{k,l} = (1/n_k) \sum_{j=1}^{n_k} (w_{k,j} \rho_{k,j,l})$, is the transect weight, n_k is the total number of sample transects and $L_{k,j}$ and \bar{L}_k are the distance of each transect by stratum and the mean transect distance over each stratum respectively.

5.2 - Acoustic indices by age

Only a subsample of the length-measured individuals (j) is aged. A two-stage conversion process is used to convert the abundance of fish by length group to abundance of fish by age group.

First, the abundance ($N_{k,l}$) by l and k is distributed the length-measured individuals to generate so-called super-individuals, each representing an abundance estimated as:

$$N_{k,j,s,l} = N_{k,l} w_{k,j,s,l}, \text{ (eqn 8)}$$

where

$$w_{k,j,s,l} = \rho_{k,s,l} / \left(\sum_{s=1}^n \rho_{k,s,l} \right) \times 1/m_{k,s,l}, \text{ (eqn 9)}$$

and m is the number of length-measured individuals.

Second, in instances where a super-individual is not aged, the missing age is filled in by a random data imputation. The imputation of missing age is principally carried out at the station level, randomly selecting the value from aged super-individuals within the same length group. If no aged super-individual is available at station level, the imputation is attempted at strata level, or lastly on survey level. In instances, where no age information is available at any level for a specific length group, the abundance estimate is presented with unknown age. As the imputation of missing age values in both examples also imputes associated biological parameters, abundance can be estimated for any combination of classifications assigned to the super-individuals e.g. sex, maturity, age etc. In our case the otolith type was used to classify the super-individuals, see below.

5.3 - Length and weight at age

Length and weight at age was calculated using the weighting factors defined in eqn 8 (the “super -individuals”).

5.4 - Uncertainty of abundance indices

Uncertainty was estimated as the coefficient of variation (ratio of standard deviation to the mean, CV). StoX calculates CV using bootstrap runs by stratum, treating each trawl station as the primary sampling unit. Here we used 500 bootstrap runs.

5.5 - Extracting coastal cod from total cod

Since the discrimination of coastal cod and other cod caught at the coastal survey is based on otolith types (see above), this poses a special challenge to producing abundance index series with uncertainty for coastal cod. Running a StoX project on the acoustical and biological data to produce an acoustic index series will primarily produce indices for all cod present in these data sources. However, when running the bootstrap process in StoX, it is possible to group the superindividuals by several categories, for instance age and otolith type. There is no facility inside StoX to present those “two-dimensional” bootstrap data but using an R-script manipulating the bootstrap files generated by StoX it is possible to extract relevant data. Thus, this was done after the whole time series was made by ordinary StoX-runs, by selecting only those entries in the bootstrap data that contained superindividuals with otolith types “1” and “2”. All tables and figures in the appendices were produced with this R-script. The R-script itself is documented in appendix C. Since the growth pattern can only be distinguished with certainty in otoliths from two-year old and older fish (although an otolith type is in some cases noted also for younger fish), the indices of age 0 and age 1 were excluded from the index series suggested for use in stock assessment.

5.6 - Acoustic indices - settings in StoX

The processes included and the settings of parameters when running StoX for acoustic indices are given in Tables 2-5:

Table 2. Baseline processes:

Process	Parameters	Values
ReadProcessData		
ReadAcousticXML	FileName1, FileName2, ...	Relevant data files
FilterAcoustic	AcousticData	ReadAcousticXML
	DistanceExpr	N/A
	FreqExpr	N/A
	NASCEExpr	acocat == 31
NASC	LayerType	WaterColumn
ReadBioticXML	FileName1, FileName2, ...	Relevant file names
FilterBiotic	FishStationExpr	fs.getLengthSampleCount('TORSK')>1
	CatchExpr	species == '164712'
	SampleExpr	N/A
	IndExpr	N/A
StationLengthDist	LengthDistType	NormLengthDist
RegroupLenghDist	LengthInverval	1.0
Catchability	CatchabilityMethod	LengthDependentSweepWidth
	LengthDist	RegroupLengthDist
	ParLenfthDependentSweepWidth	SpecCat=;Alpha=5.91;Beta=0.43;LMin=15.0;LMax=62.0
RelLengthDist	LengthDist	Catchability
DefineStrata	UseProcessData	“ True”
StratumArea	AreaMethod	Accurate

DefineAcousticTransect	DefinitionMethod	UseProcessData
MeanNASC	NASC	NASC
	SampleUnitType	PSU
BioStationAssignment	BioticData	FilterBiotic
	AssignmentMethod	Stratum (first time, then UseProcessData)
	EstLayers	1~PELBOT
BioStationWeigting	WeightingMethod	SumWeightCount
TotalLengthDist	LengthDist	RelLengthDist
AcousticDensity	LengthDist	TotalLengthDist
	NASC	MeanNASC
	m	20
	a	-68
MeanDensity_Stratum	Density	AcousticDensity
	SampleUnitType	Stratum
SumDensity_Stratum	Density	MeanDensity_Stratum
Abundance	Density	SumDensity_Stratum
	PolygonArea	StratumArea
IndividualDataStations	Abundance	Abundance
IndividualData	IndividualDataStations	IndividualDataStations
SuperIndAbundance	Abundance	Abundance
	IndividualData	IndividualData
	AbundWeightMethod	StationDensity
	LengthDist	RegroupLengthDist

Table 3. Baseline report processes:

Process	Parameters	Values
FillMissingData	Superindividuals	SuperIndAbundance
	FillVariables	ImputeByAge
	Seed	1
	FillWeight	Mean
EstimateByPopulationCategory	Superindividuals	FillMissingData
	Lengthinterval	5.0
	Scale	1000
	Dim1	otolithtype
	Dim2	age
	Dim3	SpecCat

Table 4. R processes:

Process	Parameters	Values
runBootstrap	bootstrapMethod	AcousticTrawl
	acousticMethod	PSU~Stratum

	bioticMethod	PSU~Stratum
	startProcess	TotalLengtDist
	endProcess	SuperIndAbundance
	nboot	500
	seed	1
	cores	4
imputeByAge	seed	1
	cores	4
SaveProjectData		" Enabled"

Table 5 R report processes:

Process	Parameters	Values
getReports	out	all
	options	grp1="age", grp2="otolithtype"
getPlots	out	all
	options	grp1="age", grp2="otolithtype"

5.7 - Resulting time series

The annual abundance indices and biomass indices by age groups and for age group 2+, their coefficient of variation, and mean length and weight by age groups are shown in Appendix A for the total area and for the subareas A, B and C.

The abundance indices for age 2+ are depicted in Figures 3 to 6. The series for the total area (Fig 3) is characterized by high indices at the beginning of the time series, but rapidly decreasing from 1997 to a level of 10-20 million, without any clear trends. In general, the uncertainties are larger during the first part of the time series compared to more recent years.

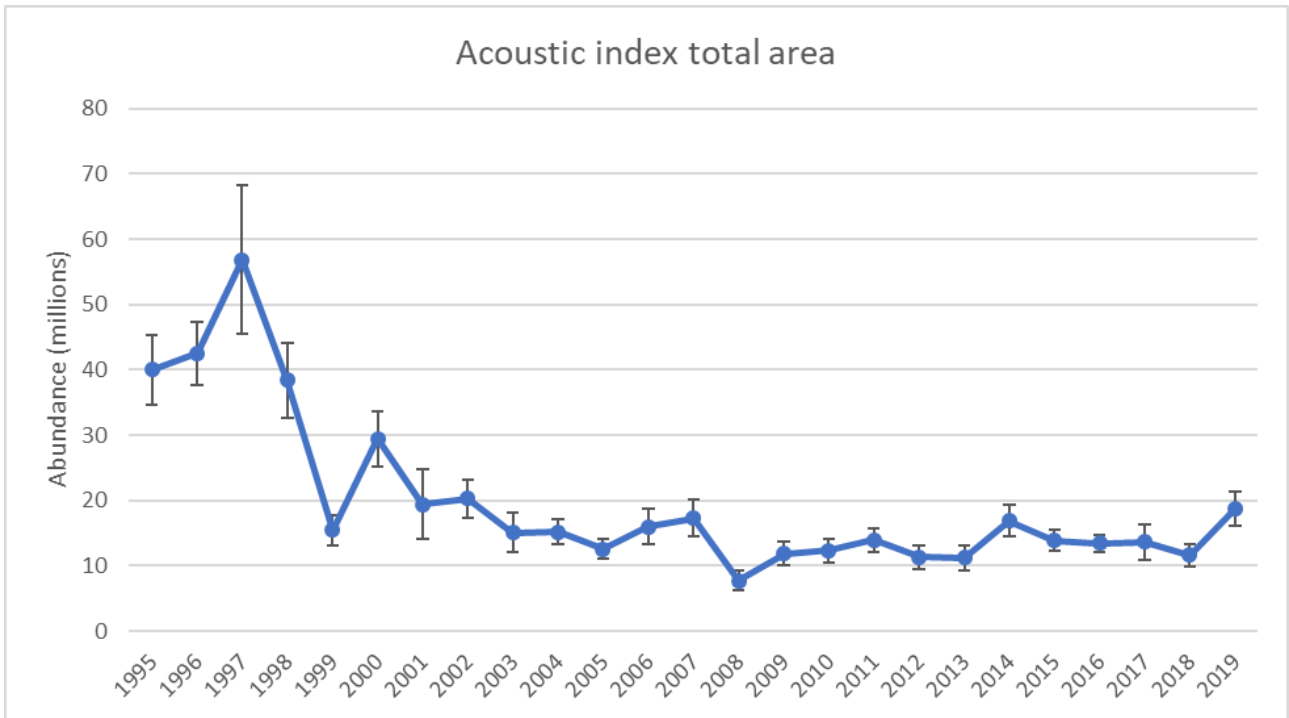


Figure 3. Acoustic index series for coastal cod age 2+ in the total area. Error bars represent +/- two standard deviations.

The series for subarea A (the northern part of the survey area, Figure 4) resembles that for the total area, because this area contains most of the coastal cod.

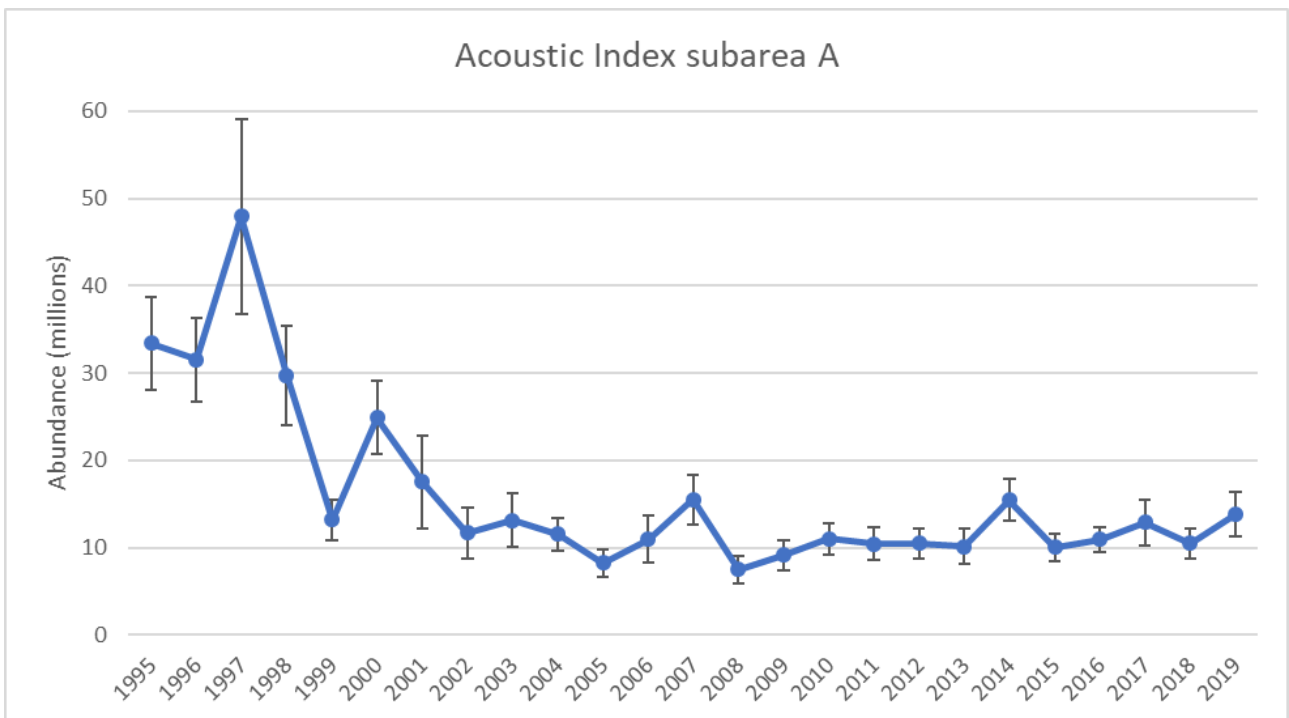


Figure 4. Acoustic index series for coastal cod age 2+ in subarea A (north of 67 ° N). Error bars represent +/- two standard deviations.

The indices for subareas B (Figure 5) and C (Figure 6) are lower than for subarea A. The uncertainties are also more variable from year to year.

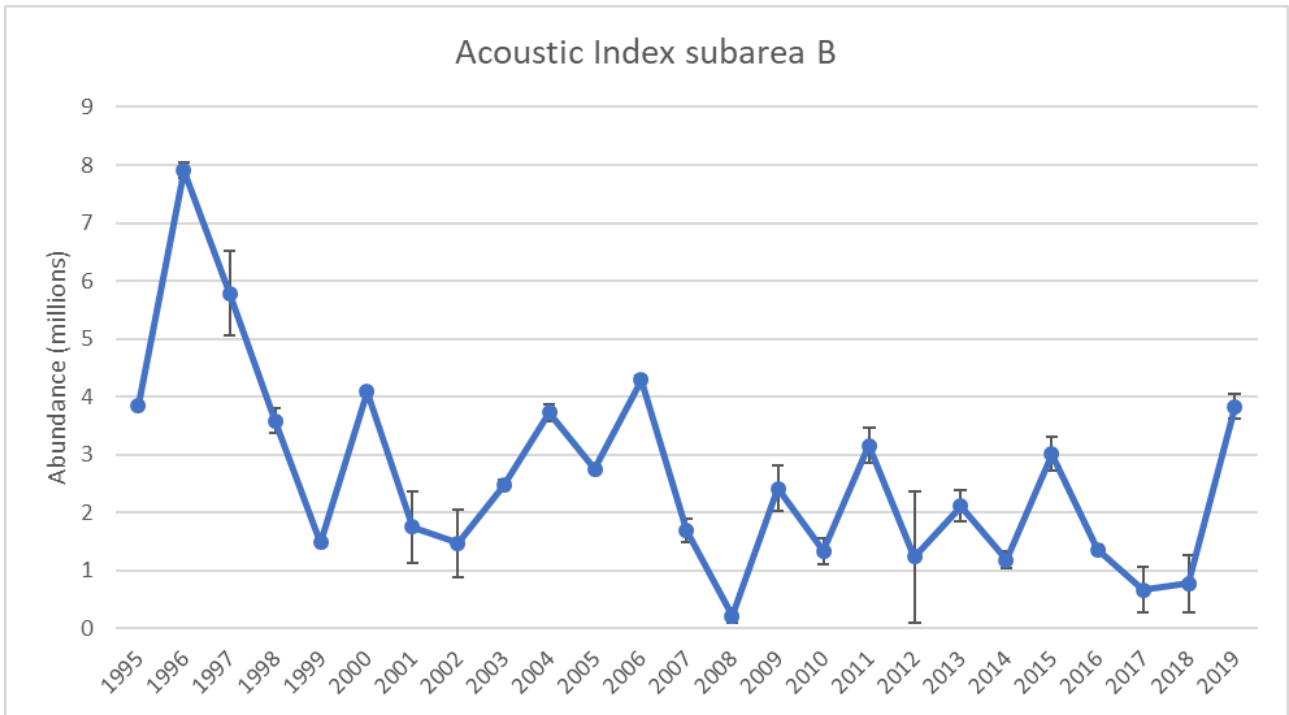


Figure 5. Acoustic index series for coastal cod age 2+ in subarea B (between 65 ° N and 67 ° N). Error bars represent +/- two standard deviations.

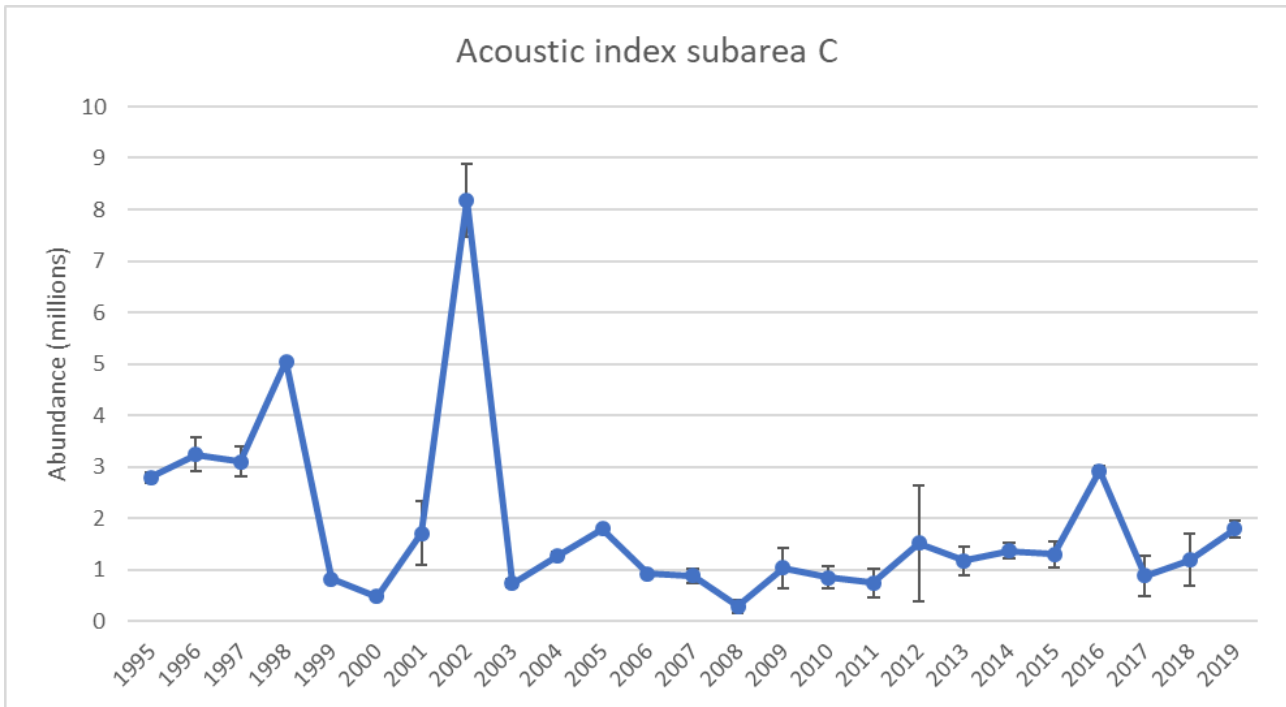


Figure 6. Acoustic index series for coastal cod age 2+ in subarea C (between 62 ° N and 65 ° N). Error bars represent +/- two standard deviations.

To assess whether the indices can describe the stock dynamics over time, plots on how year classes (cohorts) could be traced from year to year were constructed (Figure 7-10). The progression of year classes through the stock is reasonably well described for the total area and for subarea A (Figures 7-8). A year effect is visible for instance in 1998, when all age groups were recorded lower than expected. In other years, single age groups, in particular among older fish, show unexpected patterns. This seems to be a problem for age groups above 10 years. As expected, the plot for Subarea A (Figure 8) resembles that for the total area, while those for Subarea B (Figure 9) and Subarea C (Figure 10) show a much less consistent picture, where strong year effects are visible .

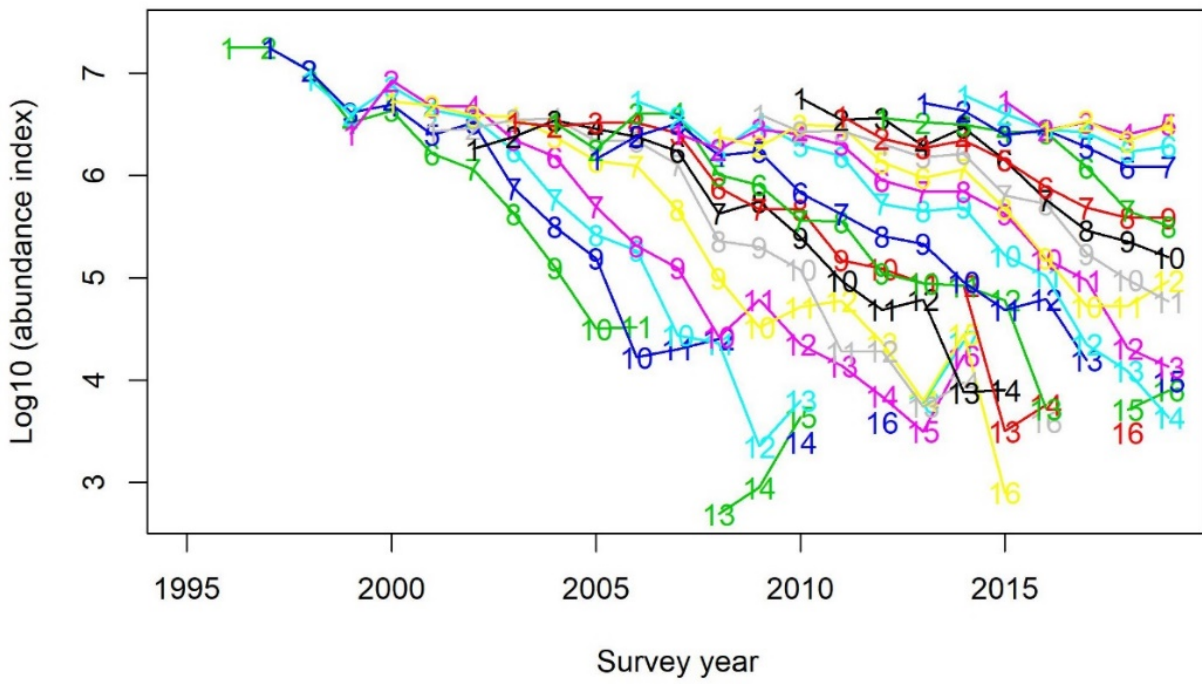


Figure 7. Abundance (log scale) over time for the year classes 1995 to 2014 for age 1 and older in the acoustic index series for the total area. The age is shown for each data point.

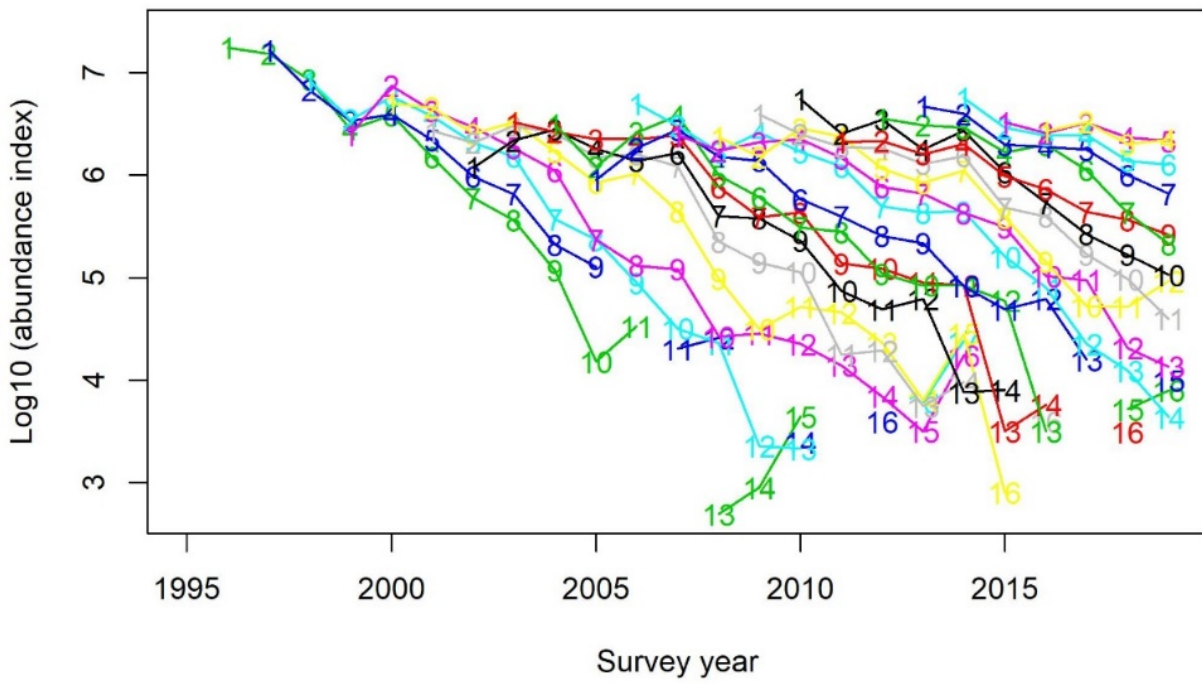


Figure 8. Abundance (log scale) over time for the year classes 1995 to 2014 for age 1 and older in the acoustic index series for Subarea A. The age is shown for each data point.

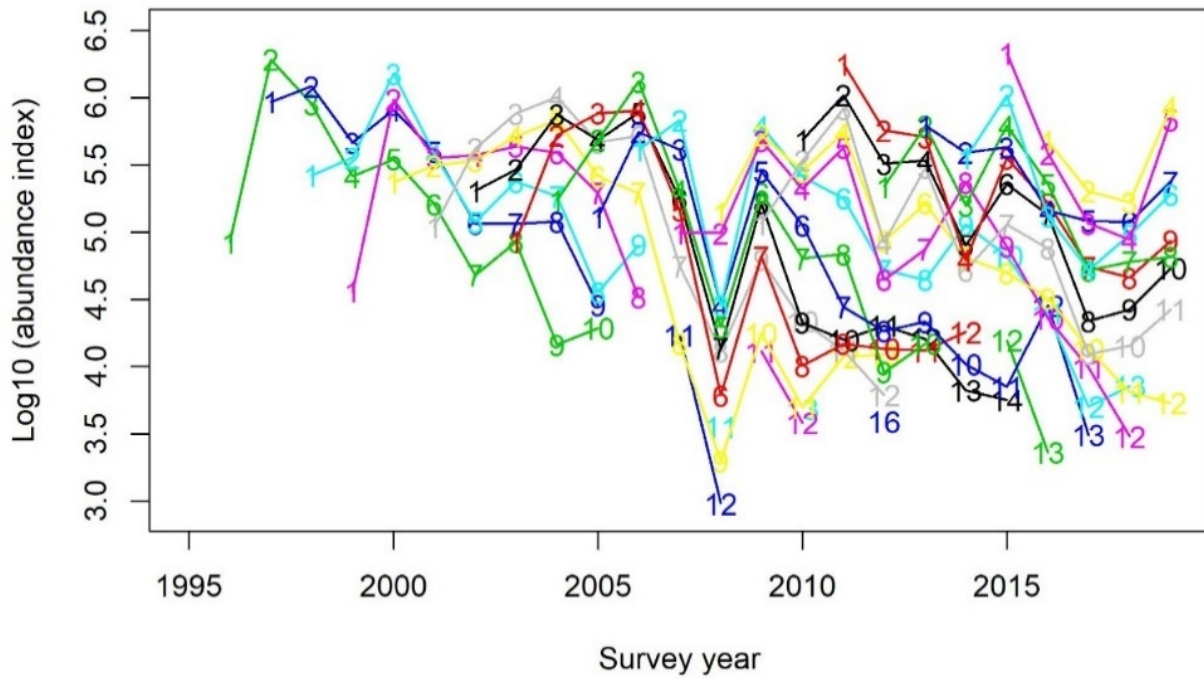


Figure 9. Abundance (log scale) over time for the year classes 1995 to 2014 for age 1 and older in the acoustic index series for Subarea B. The age is shown for each data point.

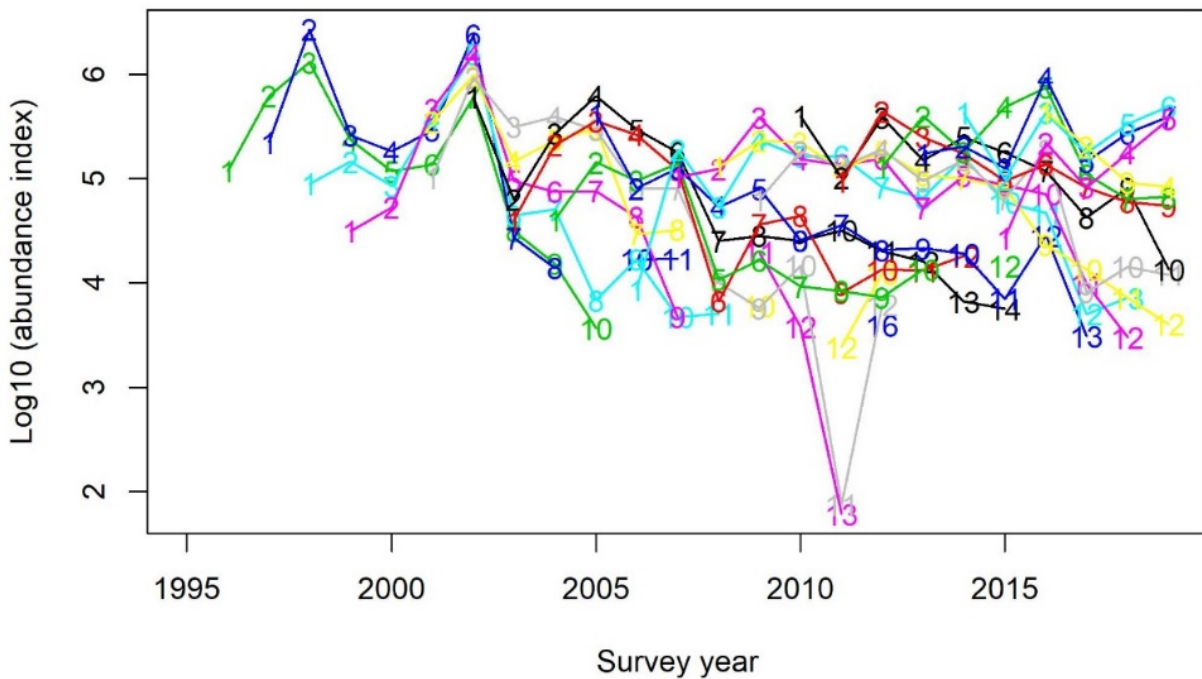


Figure 10. Abundance (log scale) over time for the year classes 1995 to 2014 for age 1 and older in the acoustic index series for Subarea C. The age is shown for each data point.

5.8 - Internal consistency in the acoustic series for subarea A

The internal consistency plots (number at age n in year n plotted versus number at age $n+1$ in year $y+1$) for age groups 1-6 are shown in Figure 11 and for age groups 7-12 in Figure 12. In most cases the fit is rather poor. Exceptions are age 1-2 and age 2-3, with rather high correlation, but the regressions are highly affected by the large indices during the first part of the period.

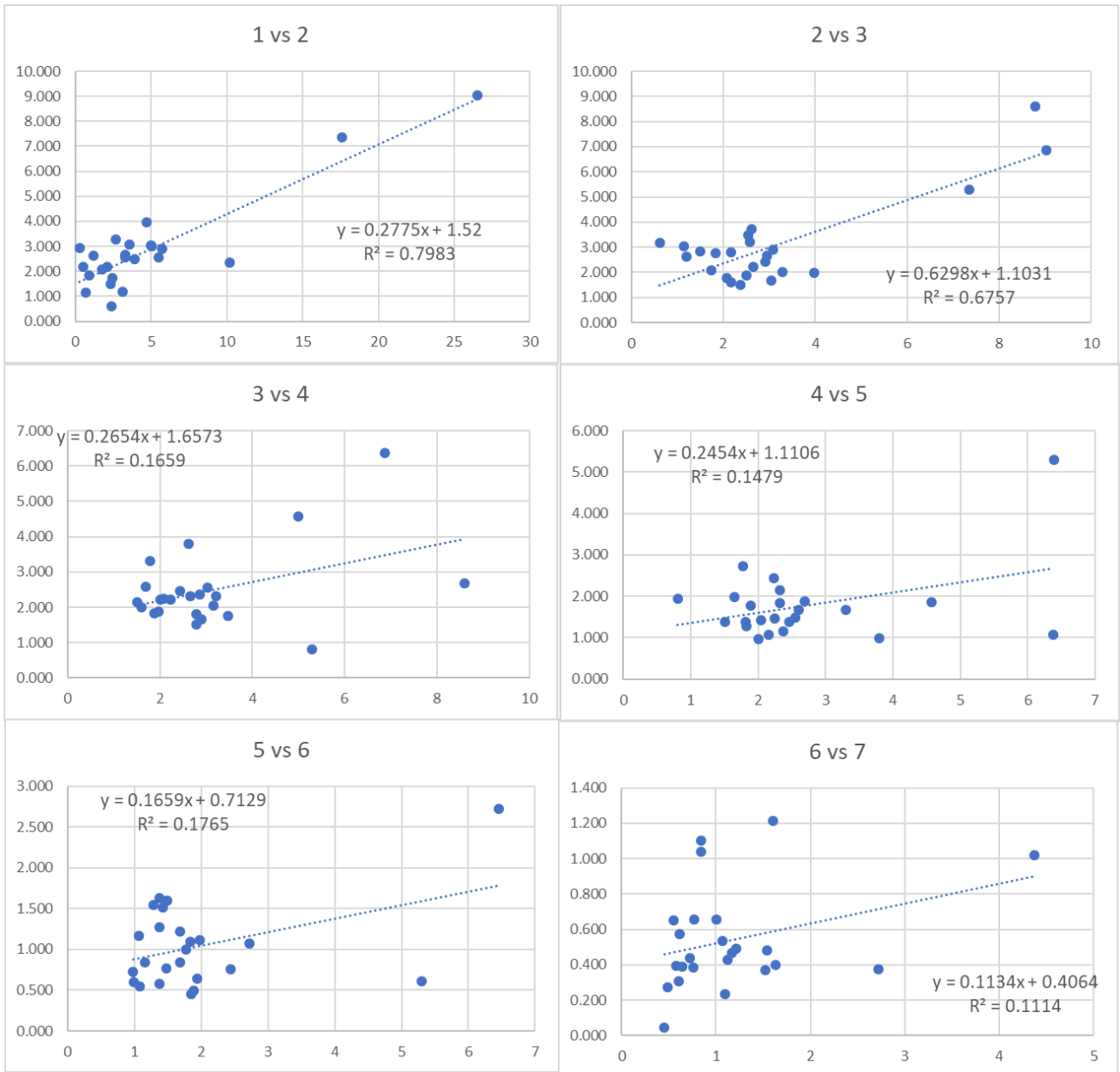


Figure 11. Consistency plots for the acoustic index for area A. Age groups 1-6.

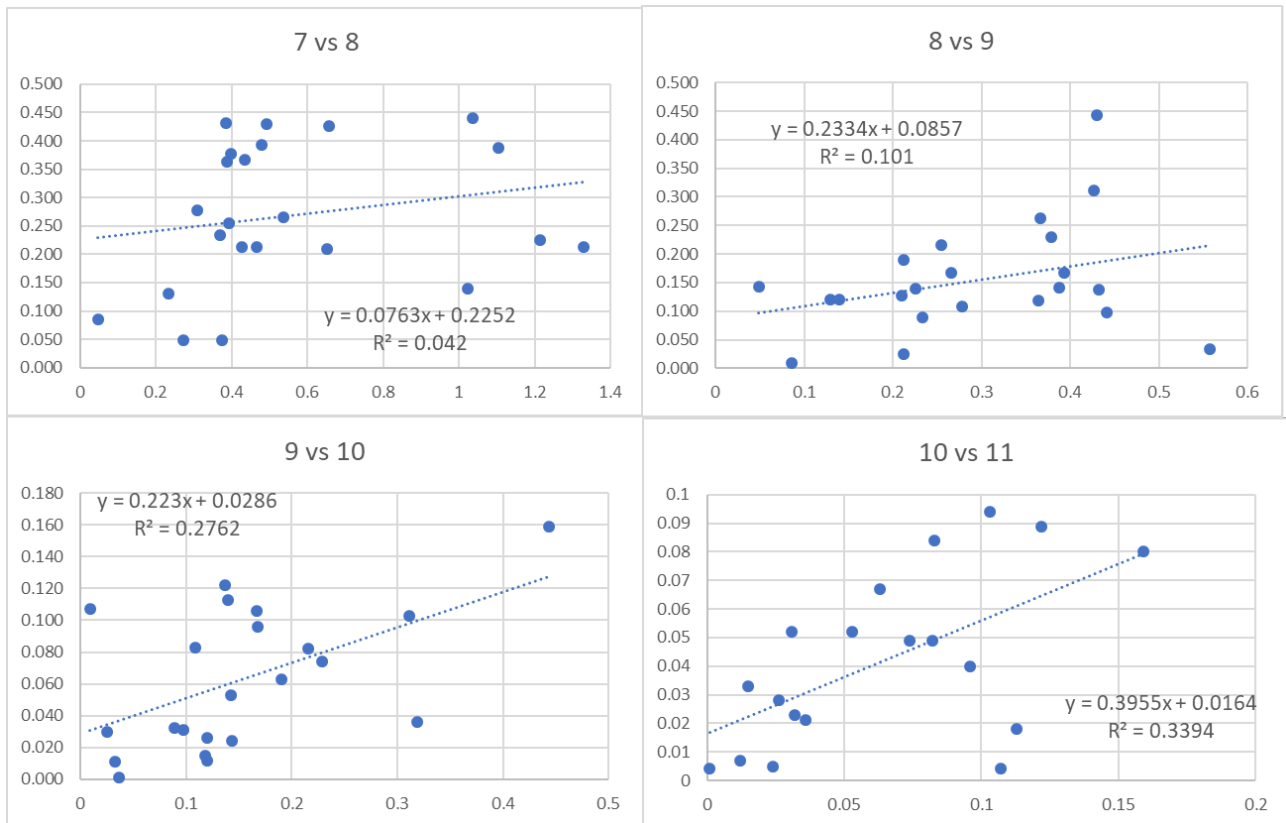


Figure 12. Consistency plots for the acoustic index for area A. Age groups 7-12.

5.9 - Comparison with acoustic index series calculated with previous methods

An acoustic index has been calculated for this stock since 1995 (see chapter 1.3). Because this approach used a somewhat more detailed strata system and a method based on the SAS software platform, it is difficult to compare that series with the new acoustic index developed in StoX. Nonetheless, a comparison made for the sum over ages 2+ (Figure 13) shows that there are large differences between the series before 2002. For the period after 2002 the indices are much more similar, with the new series estimates being somewhat lower in most years. A part of the large discrepancies found in the early years of the series can be explained by poor data quality of the acoustic data. When the series was rerun in StoX and the acoustic data checked in detail, some few enormous NASC values were detected, indicating that parts of the bottom signal had been integrated. In small strata containing few transects and few values, such erroneous values may have a big impact on the total index. For instance, in 2000, taking out a NASC value of 4718 from a small stratum (Sørøya Indre) made the index in that stratum change from 46 000 tonnes to 1400 tonnes. In 1996, 1999 and in 2000 six extremely high values were found and removed from the transects, which had profound effects on the index values from these years. It is unknown whether these erroneous values were in fact included in the old acoustic series or not. In the remaining years before 2002, no extreme values could be found and also in these years the new index is substantially lower than the old index, indicating that there are other reasons for the differences. Despite this we argue that the new indices should be accepted on the grounds that they are developed in one go, using a more quality assured software with identical settings from year to year, and with a more thorough quality assurance of the acoustic data.

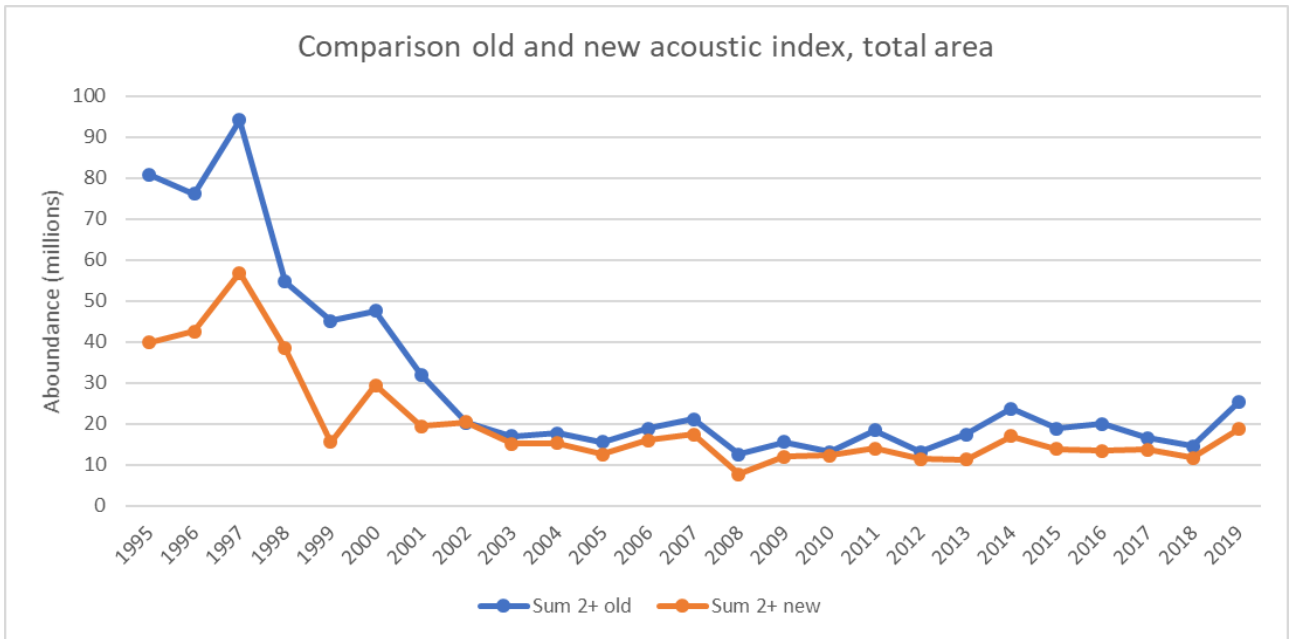


Figure 13. Comparison of the old and new acoustic abundance index series for sum over ages 2+ for the total area.

6 - Swept area indices

A stock abundance index series based on bottom trawl hauls at the annual autumn coastal survey (NOcoast-Aco-4Q) was calculated using the StoX software. Trawl data covering the coastline from 62°N to the Russian border were available back to 1995, although the coverage in various parts of this area varied somewhat due to ship availability, weather conditions etc. However, the survey was designed as an acoustic survey before 2003, and trawls were done on acoustic registrations in order to supply biological data for the acoustic observations. Consequently, we did use trawl data prior to 2003 when calculating the swept-area indices for coastal cod. The area is split into 22 strata (Figure 1) and the stock abundance index is calculated for each stratum separately. It was decided to split the total area into three subareas: The coast north of 67°N (A, consisting of 18 strata), between 65° and 67°N (B, consisting of 2 strata), and between 62°N and 65°N (C, consisting of 2 strata). The coverage during most of the time series is much better in subarea A than in B and C.

The coastal cod was split from the NEA cod using the same methods as described for the acoustic index, see above.

To estimate the uncertainty of the estimate, 500 bootstrap runs were performed, and the indices are the average index from these runs.

6.1 - Swept area indices by length

The following description is taken from Johannesen et al. (2019):

The swept area density (ρ , individuals per square nautical mile, inds nmi⁻²) by stratum (k), station (s) and length group l (1 cm), is given by

$$\rho_{k,s,l} = f_{k,s,l} / sw_l, \text{ (eqn 10)}$$

where $f_{k,s,l}$ is the number of individuals standardized over a towing distance of 1 nmi by k, s and l, and sw_l is the adjusted swept width in nmi's by length group calculated using

$$sw_l = EW_l / 1852, \text{ (eqn 11)}$$

where EW_l is the length dependent effective swept width. The length dependency of swept width is taken from (Dickson, 1993)

The abundance (N , inds) by l and k is calculated using

$$N_{k,l} = \rho_{k,l} A_{k,s}, \text{ (eqn 12)}$$

where A is stratum area (nmi²), and $\rho_{k,l}$ is the average swept area density by l and k, given by

$$\rho_{k,l} = (1/n) \sum_{s=1}^n \rho_{k,s,l}, \text{ (eqn 13)}$$

where n is number of stations.

6.2 - Swept area indices by age

The sampling protocol for the survey is to sample one individual from each 5 cm length group at each trawl station for aging and individual weights. A two-stage conversion process is used to convert the abundance of fish by length group to abundance of fish by age group.

Firstly, the abundance ($N_{k,l}$) by length group l (5 cm) and stratum k is distributed by the length-measured individuals (j) to generate so-called “Super-individuals” (super-individuals represent fractions of a total, our use corresponds to a probability based design where $W_{k,j,s,l}$ is the inverse of the inclusion probability for a single fish sample), each representing an abundance estimated as:

$$N_{k,j,s,l} = N_{k,l} W_{k,j,s,l}, \text{ (eqn 14)}$$

where

$$W_{k,j,s,l} = \frac{\rho_{k,s,l}}{\left(\sum_{s=1}^n \rho_{k,s,l} \right)} \times \frac{1}{m_{k,s,l}}, \text{ (eqn 15)}$$

and m is the number of length-measured individuals

Secondly, in instances where a super-individual is not aged, the missing age is filled in by a random data imputation. The imputation of missing age is principally carried out at the station level, randomly selecting the value from aged super-individuals within the same length group. If no aged super-individual is available at the station level, the imputation is attempted at strata level, or lastly on survey level. In instances where no age information is available at any level for a specific length group, the abundance estimate is presented with unknown age (Johnsen et al., 2019).

6.3 - Length and weight at age

Length and weight at age was calculated using the weighting factors defined in eqn 15 (the “super -individuals”).

6.4 - Uncertainty of abundance indices

Uncertainty was estimated as the coefficient of variation (ratio of standard deviation to the mean, CV). StoX calculates CV using bootstrap runs by stratum, treating each trawl station as the primary sampling unit. Here we used 500 bootstrap runs.

6.5 - Extracting coastal cod from total cod

Since the discrimination of coastal cod and other cod caught at the coastal survey is based on otolith types (see above) this poses a special challenge to producing abundance index series with uncertainty for coastal cod. Running a StoX project on the biological data to produce a swept-area index series will primarily produce indices for all cod present in this data source. However, when running the bootstrap process in StoX, it is possible to group the superindividuals by several categories, for instance age and otolith type. There is no facility inside StoX to present those “two-dimensional” bootstrap data but using an R-script manipulating the bootstrap files generated by StoX it is possible to extract relevant data. Thus, this was done after the whole time series were made by ordinary StoX-runs, by selecting only those entries in the bootstrap data that contained superindividuals with otolith types “1” and “2”. All tables and figures in the appendices to this document were produced by this R-script. The R-script itself is documented in appendix “C”.

6.6 - Swept area indices – settings in StoX

The processes included and the settings of parameters when running StoX for swept area indices are given in tables 6-9:

Table 6. Baseline processes:

Process	Parameters	Values
ReadProcessData		
ReadBioticXML	FileName1, FileName2, ...	Relevant file names
FilterBiotic	FishStationExpr*	gear =~['3270','3271'] and gearcondition < 3 and tawlquality =~['1','3'] and fishstationtype !=['2'] and CatchExpr species == '164712'
	SampleExpr	N/A
	IndExpr	N/A
DefineSweptAreaPSU	Method	Station
StationLengthDist	LengthDistType	NormLengthDist
RegroupLengthDist	LengthInterval	5.0
Catchability	CatchabilityMethod	LengthDependentSweepWidth
	LengthDist	RegroupLengthDist
	ParLenfthDependentSweepWidth	SpecCat=;Alpha=5.91;Beta=0.43;LMin=15.0;LMax=62.0
RelLengthDist	LengthDist	Catchability
DefineStrata	UseProcessData	" True"
StratumArea	AreaMethod	Accurate
TotalLengthDist	LengthDist	RegroupLengthDist
SweptAreaDensity	SweptAreaMethod	LengthDependent
	BioticData	FilterBiotic
	LengthDist	TotalLengthDist
	DistanceMethod	FullDistance
	SweepwidthMethod	Predetermined
MeanDensity_Stratum	Density	SweptAreaDensity
	SampleUnitType	Stratum
	PolygonArea	StratumArea
AbundanceByLength	Density	MeanDensity_Stratum
IndividualDataStations	Abundance	AbundanceByLength
IndividualData	IndividualDataStations	IndividualDataStations
SuperIndAbundance	Abundance	AbundanceByLength
	IndividualData	IndividualData
	AbundWeightMethod	StationDensity
	LengthDist	RegroupLengthDist

* In the period 2017-2019 this filter was changed to allow for inclusion of stations coded with StationType = C and trawlQuality = 2

Table 7. Baseline report processes:

Process	Parameters	Values
---------	------------	--------

FillMissingData	Superindividuals	SuperIndAbundance
	FillVariables	ImputeByAge
	Seed	1
	FillWeight	Mean
EstimateByPopulationCategory	Superindividuals	FillMissingData
	Lengthinterval	5.0
	Scale	1000
	Dim1	otolithtype
	Dim2	age
	Dim3	SpecCat

Table 8. R processes:

Process	Parameters	Values
runBootstrap	bootstrapMethod	AcousticTrawl
	acousticMethod	PSU~Stratum
	bioticMethod	PSU~Stratum
	startProcess	TotalLengtDist
	endProcess	SuperIndAbundance
	nboot	500
	seed	1
	cores	4
imputeByAge	seed	1
	cores	4
SaveRImage		" Enabled"

Table 9. R report processes:

Process	Parameters	Values
getReports	out	all
	options	grp1="age", grp2="otolithtype"
getPlots	out	all
	options	grp1="age", grp2="otolithtype"

6.7 - Resulting time series

Index series for the total area (Figure 14) and for the three subareas A (Figure 15), B (Figure 16) and C (Figure 17) are shown below. The abundance indices for the total area is rather flat but one year, 1997, stands out from the rest having a three times as high index and much wider confidence limits than the rest of the years in the series.

The amount of coastal cod in subarea A (Figure 15) is much higher than in the more southern subareas B and C, and the index series in subarea A therefore resembles the total index to a high degree. While the index for subarea A (and therefore also the total area) shows peaks in 2003 and in 2014-2015, the series for subareas B and C are without conspicuous trends. The relative uncertainty is much higher for the two southern subareas than for the northern (subarea A). The uncertainty in the last four years is smaller than for the earlier part of the index series, for all subareas.

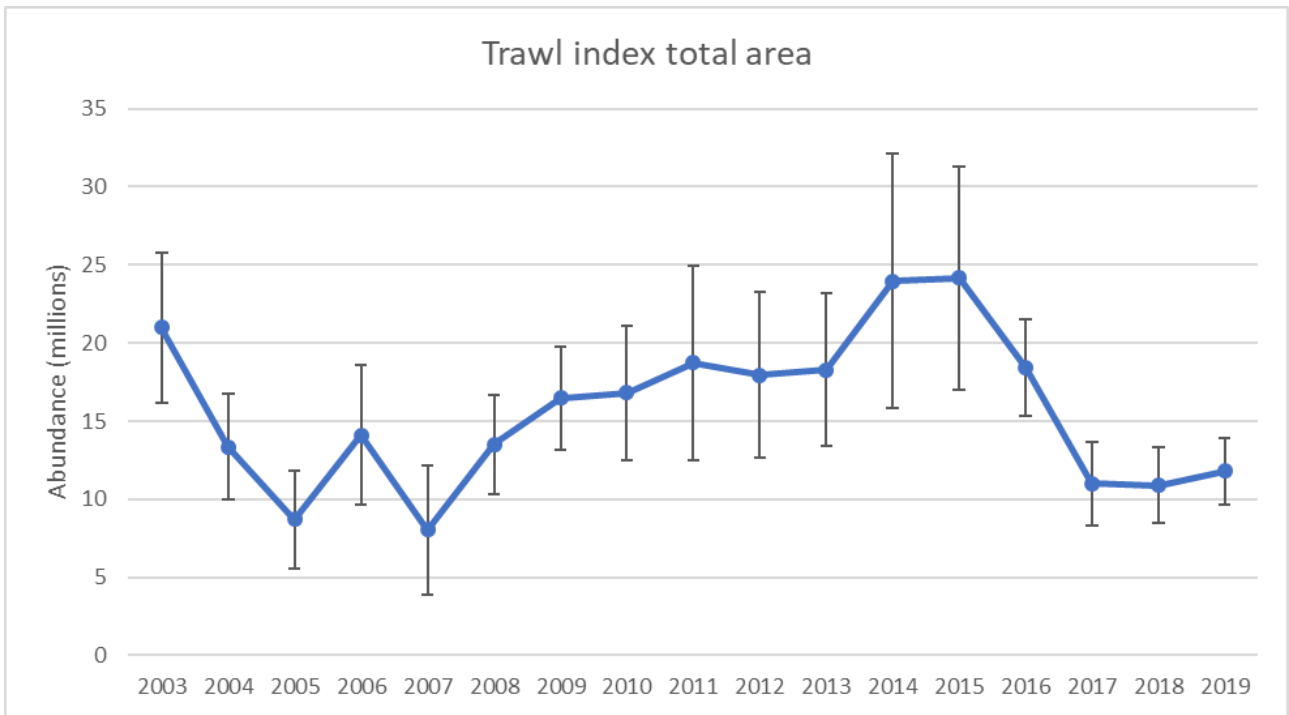


Figure 14. Trawl index series for coastal cod age 2+ in the total area. Error bars represent +/- two standard deviations.

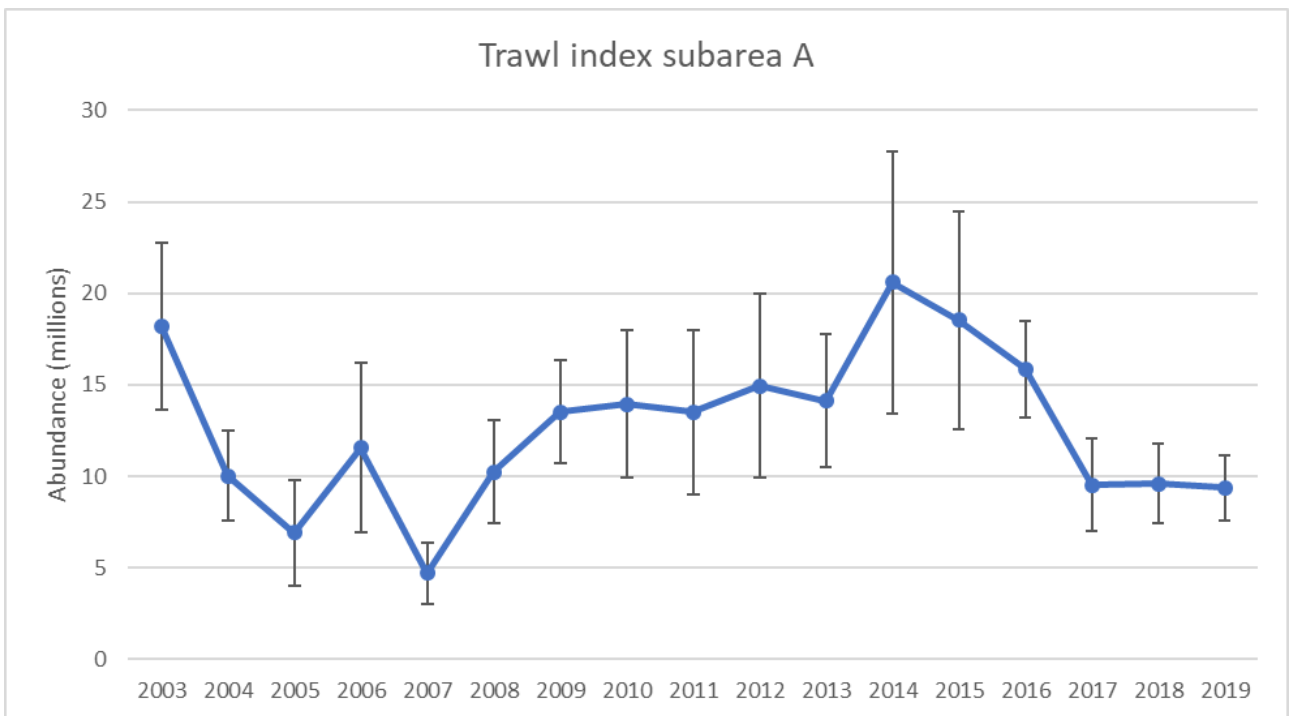


Figure 15. Trawl index series for coastal cod age 2+ in subarea A (north of 67 ° N). Error bars represent +/- two standard deviations.

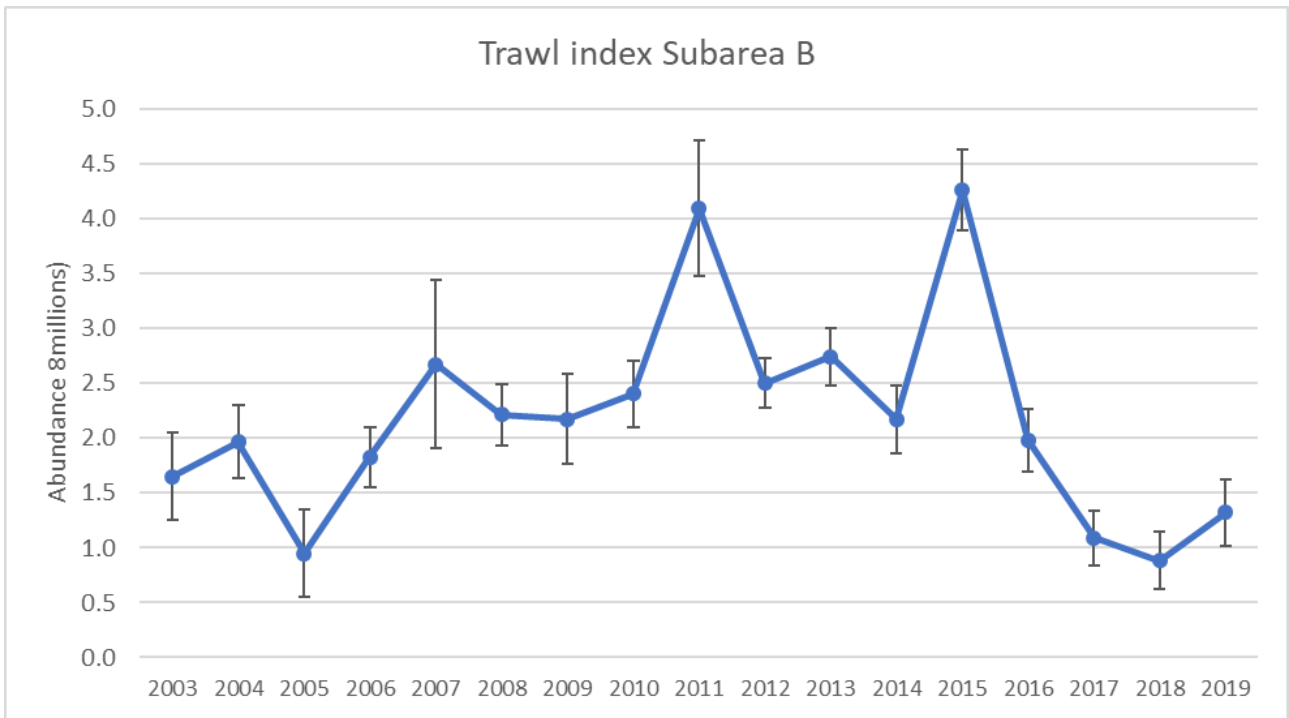


Figure 16. Trawl index series for coastal cod age 2+ in subarea B, (between 65 ° N and 67 ° N). Error bars represent +/- two standard deviations.

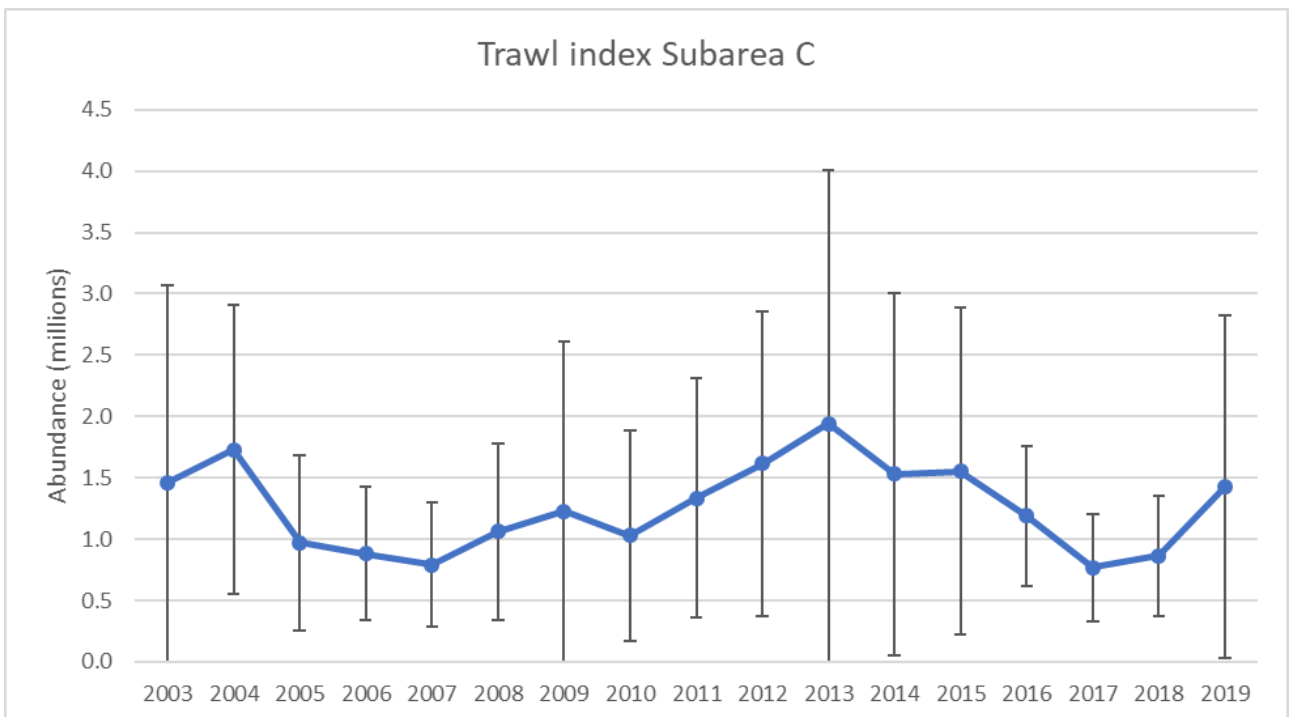


Figure 17. Trawl index series for coastal cod age 2+ in subarea C, (between 62 ° N and 65 ° N). Error bars represent +/- two standard deviations.

Consistency among cohorts are illustrated on Figures 18-21. The cohorts can be followed in subarea A (and in the total area) without conspicuous year effects, except in 2005 and 2007. For the two subareas B (Figure 20) and C (Figure 21) it is not possible to follow the year classes except for short periods, indicating that the indices for these subareas do not reflect the total abundance of coastal cod during the period 2002 to 2019.

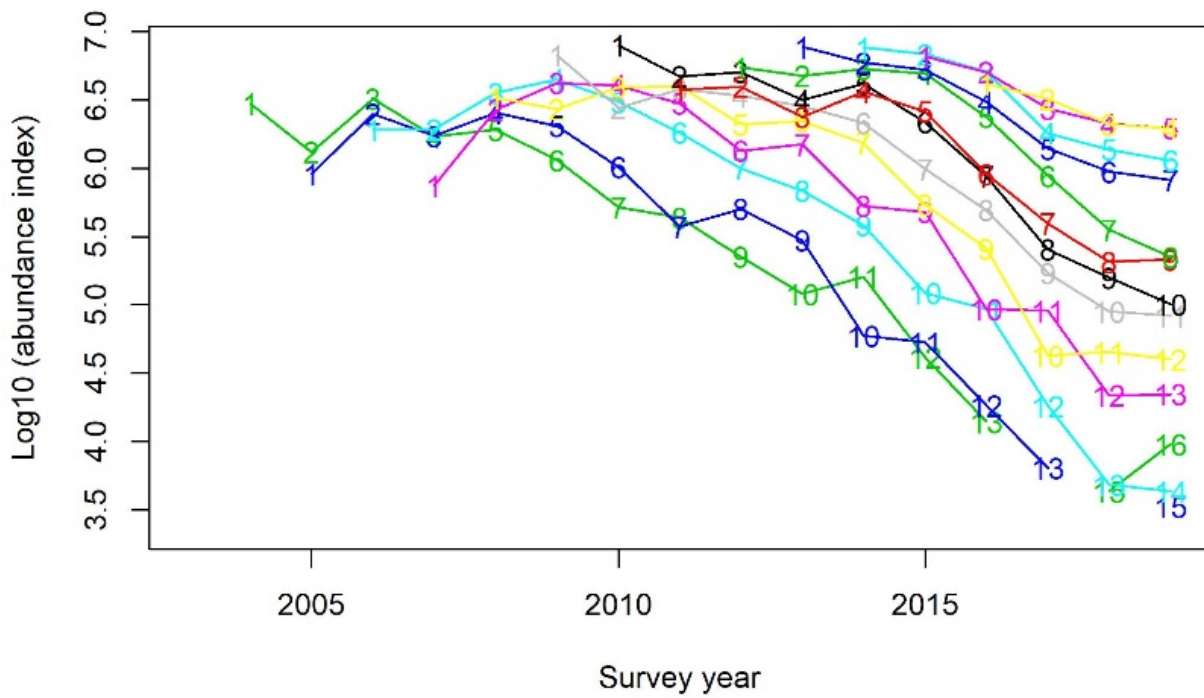


Figure 18. Abundance (log scale) over time for the year classes 2002 to 2014 for age 1 and older in the trawl index series for the total area. The age is shown for each data point.

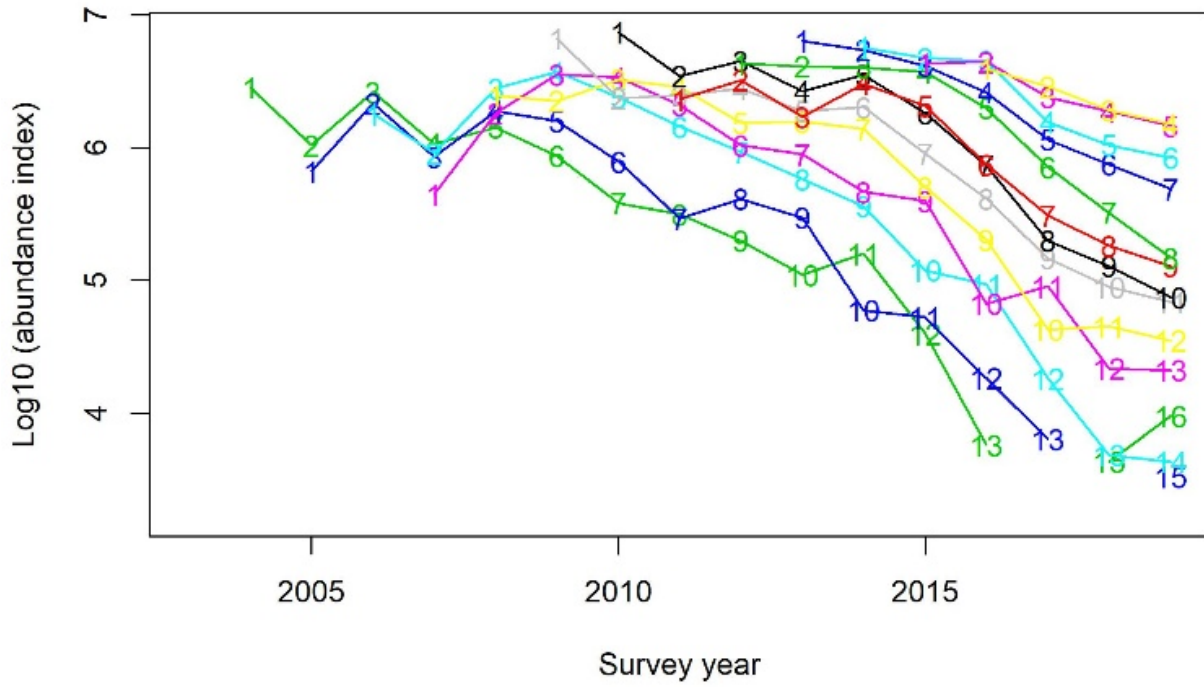


Figure 19. Abundance (log scale) over time for the year classes 2002 to 2014 for age 1 and older in the trawl index series for Subarea A. The age is shown for each data point.

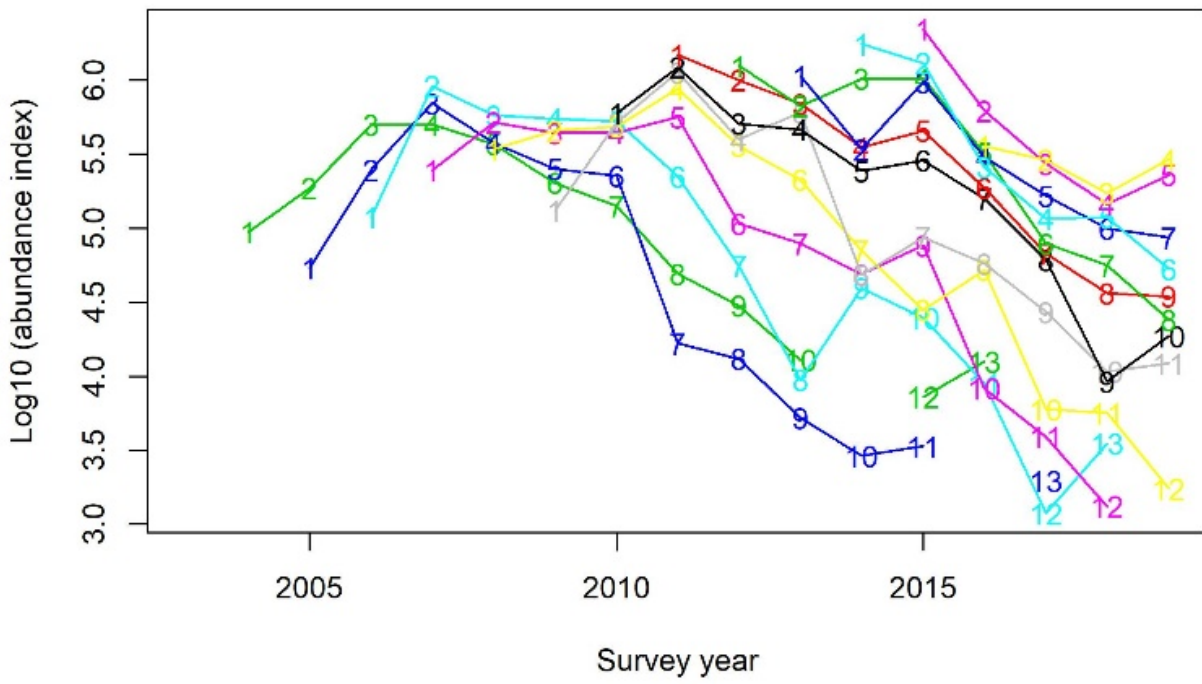


Figure 20. Abundance (log scale) over time for the year classes 1995 to 2014 for age 1 and older in the trawl index series for Subarea B. The age is shown for each data point.

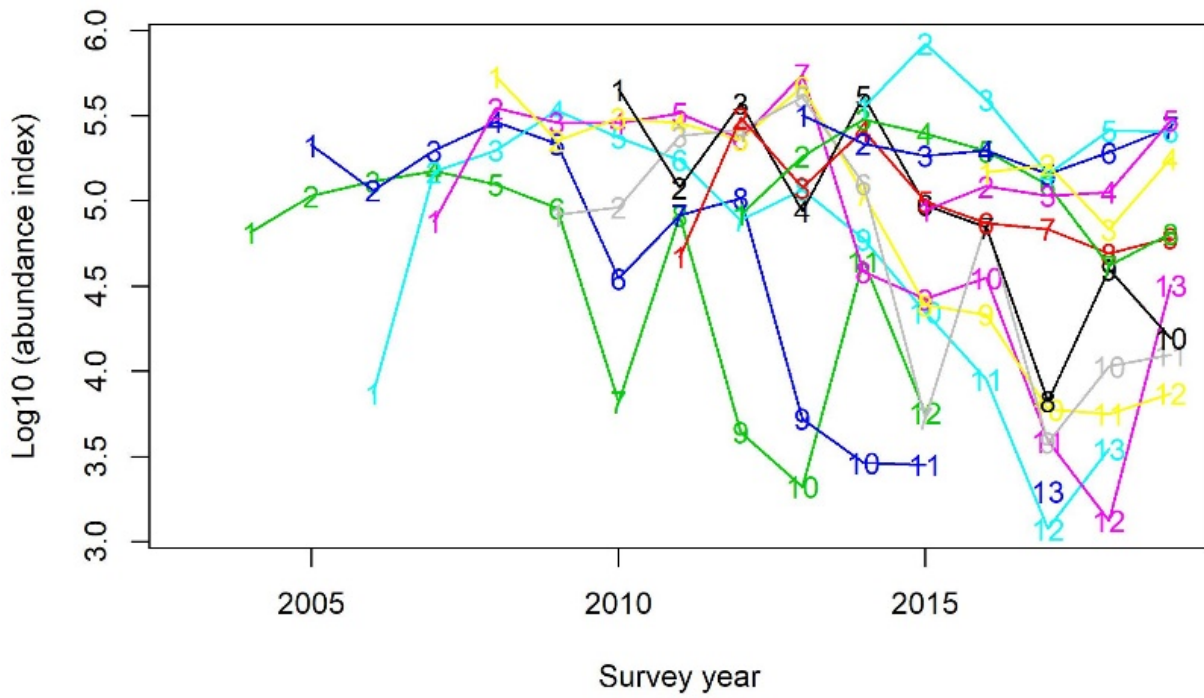


Figure 21. Abundance (log scale) over time for the year classes 2002 to 2014 for age 1 and older in the trawl index series for Subarea C. The age is shown for each data point.

6.8 - Consistency within the trawl index series for area A

The internal consistency plots (number at age n in year n plotted versus number at age $n+1$ in year $y+1$) for age groups 1-6 are shown in Figure 22 and for age groups 7-12 in Figure 23. In most cases the fit is poor.

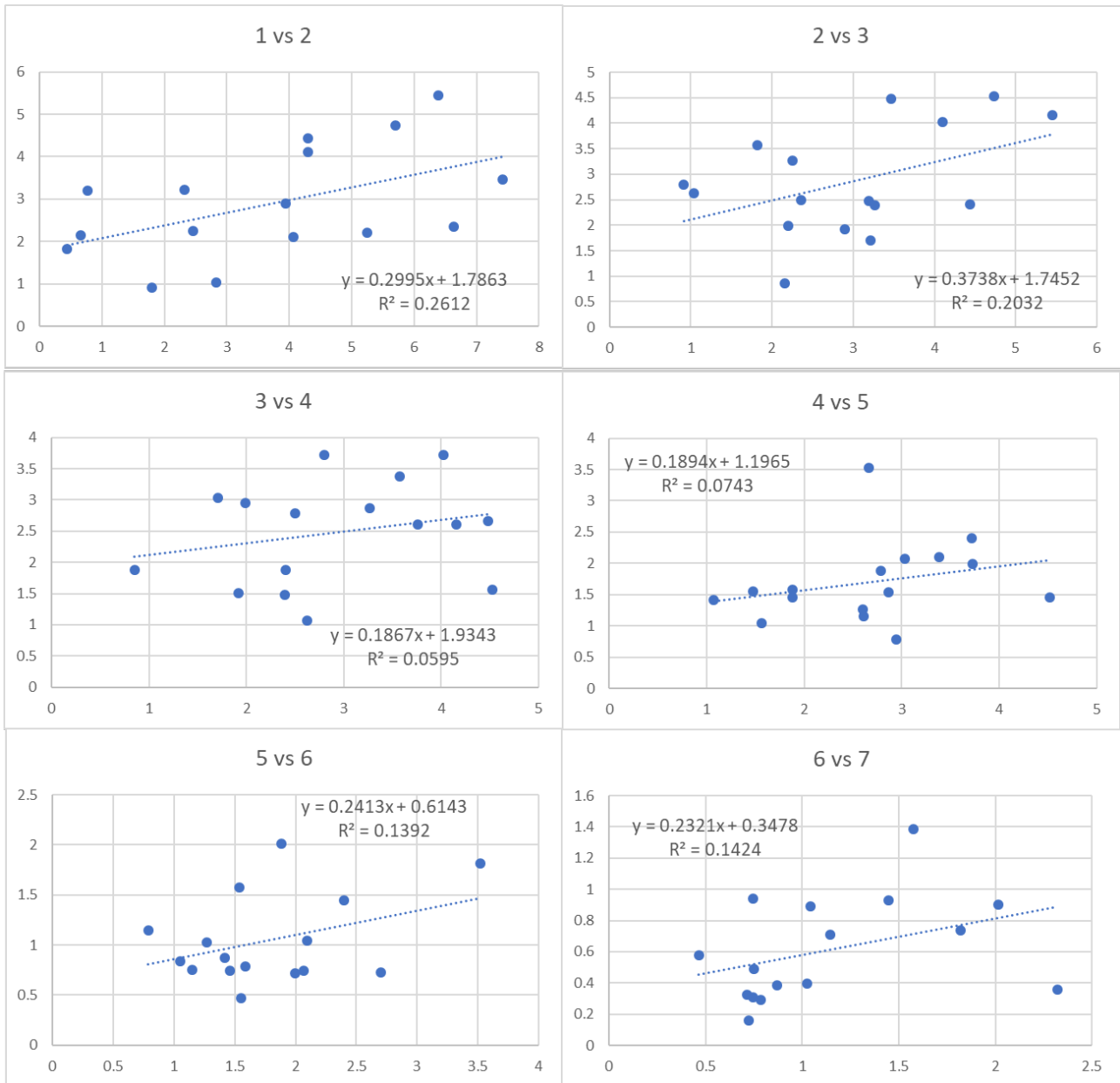


Figure 22. Consistency plots of the trawl index for area A. Age groups 1-6.

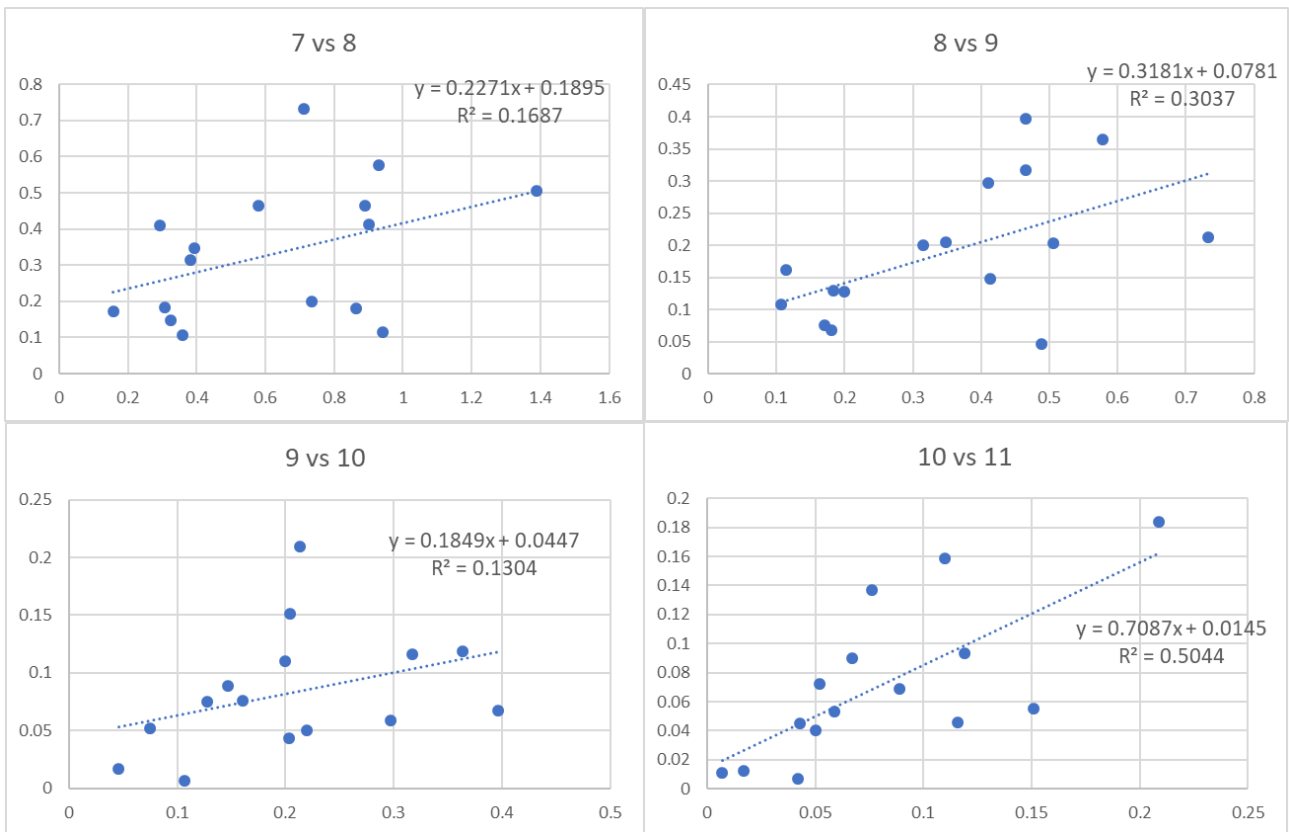


Figure 23. Consistency plots of the trawl index for area A. Age groups 7-11.

7 - Comparison of the trawl and acoustic index series

The acoustic index series and the trawl index series give a partly independent view of the stock situation over time. They are not totally independent, since the length information used to translate the acoustic backscatter into fish abundance comes by and large from the same trawl hauls that are used for calculation of swept area indices, and the age information used to break the acoustic index down to age groups partly comes from the same trawl hauls that are used to calculate the swept area indices. However, the total backscatter, mainly determining the acoustic index, is totally independent of the catch rates in the trawl hauls, so in this respect the two series give independent information about the amount of fish. There are numerous reasons that these indices differ. Trawling on the bottom is only possible where the bottom is trawlable, that is soft and smooth and not too steep. In many areas of the coast it is not possible to trawl, and consequently the trawl hauls may not be representative of areas with hard and/or steep bottom. On the other hand, even though the acoustic method will cover all navigable waters, the acoustic backscatter signal is difficult to interpret where the bottom is steep, and in all areas the dead zone near the bottom will not be covered. Also, the allocation of acoustic backscattering by species can be challenging, and in particular in areas where it is not possible to trawl.

In Figure 24 the new acoustic index series and the swept-area series are compared, and also the landings statistics are included on the figure for comparison.

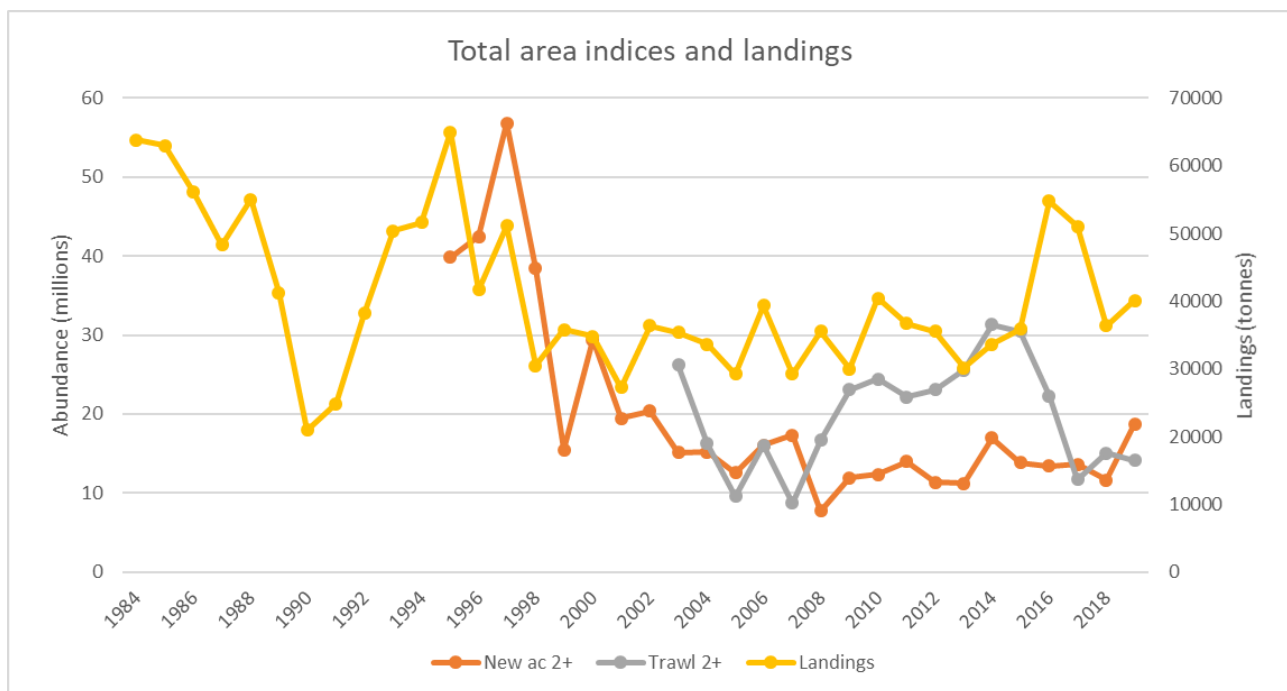


Figure 24. New acoustic series (2+), trawl index series (2+) and landings (taken from table 2.1a in ICES (2020)).

The acoustic series, going back to 1995, shows a decrease in the last part of the 1990s with a simultaneous decrease in catches during that period, from a record high catch in 1995 to a level at about half of that total during the next decades. The acoustic index and the trawl index fluctuate without clear trends after 2003, in some years the acoustic index is higher than the trawl index and vice versa. These index series are compared on age-group basis in figure 25 and 26. The consistency is quite good for many of the age groups, with r^2 in the range 0.2-0.6. However, for some age groups (mainly 3-6) the fit is poorer, with r^2 in the range 0.0-0.1.

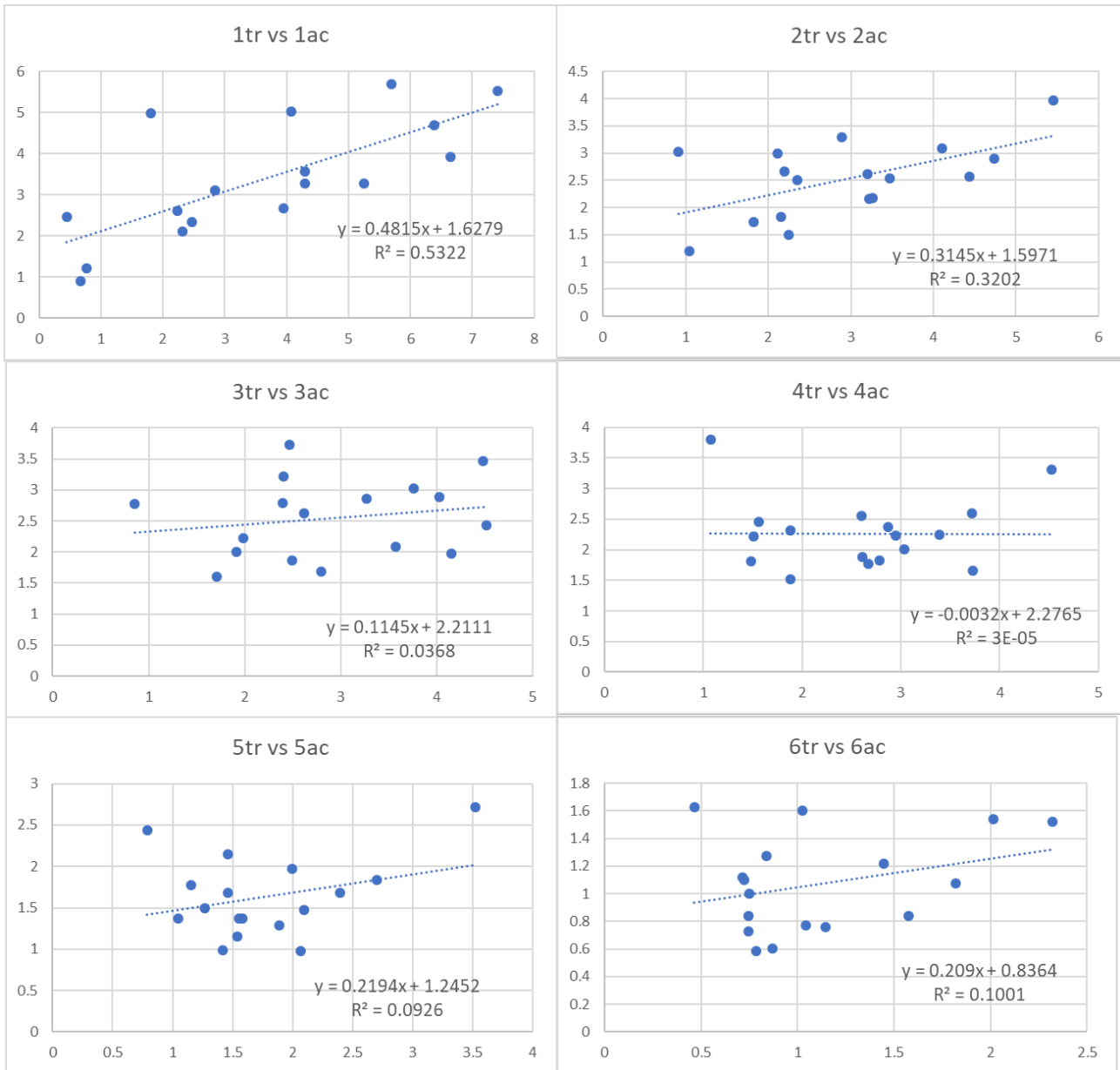


Figure 25. Comparison of acoustic index and trawl index for area A in the period 2003 to 2009, age groups 1-6.

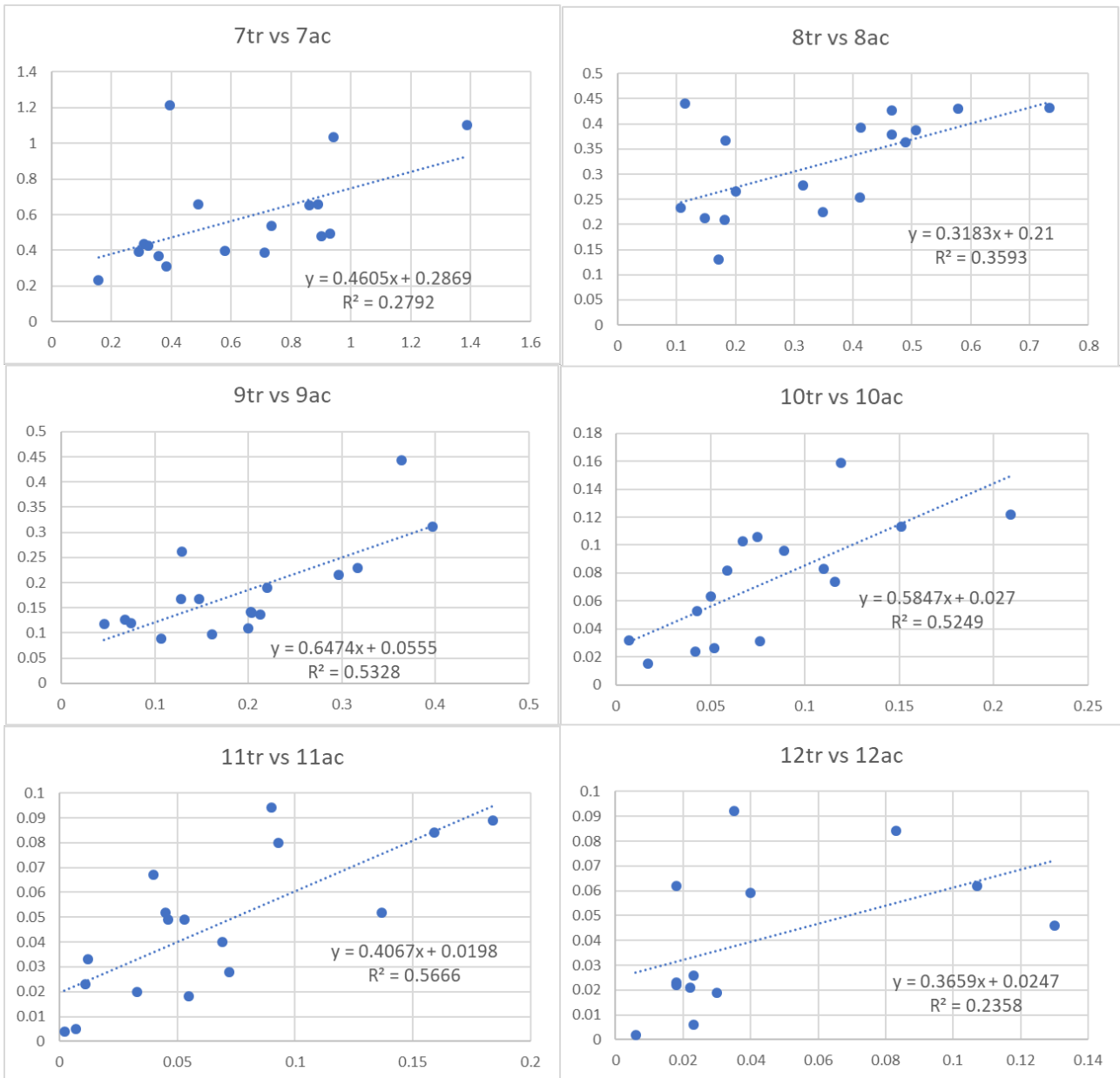


Figure 26. Comparison of acoustic index and trawl index for area A in the period 2003 to 2009, age groups 7-12.

8 - Conclusions by the data evaluation workshop regarding inclusion of these time series in the assessment of Norwegian Coastal Cod north of 62°N

Based on an evaluation of what is presented in this document concerning data quality, survey coverage, and year-to-year consistency, the data evaluation workshop held in December 2020 concluded that

1. The acoustic abundance index series from 1995 to 2019, for age groups 2-10+, may be used as input data in analytical assessment models for coastal cod in subarea A. The corresponding estimates of length- and weight-at-age may be used as estimates of length- and weight-at-age in the stock.
2. For subareas B and C, the acoustic indices for biomass of age 2+ may be used in biomass models or to assess changes in stock abundance from year to year, using methods for data-limited stocks.
3. The trawl index series from 2003 to 2019, for age groups 2-10, may be used as input data in analytical assessment models for coastal cod in subarea A. The corresponding estimates of length- and weight-at-age may be used as estimates of length- and weight-at-age in the stock.
4. For subareas B and C, the trawl indices of biomass of age 2+ may be used in biomass models or to assess changes in stock abundance from year to year, using methods for data-poor stocks.

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10 - Appendix A. Acoustic abundance indices

10.1 - Total area

Table A.1.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.050	26.961	11.015	7.254	7.207	7.023	4.618	1.561	0.678	0.341	0.042		0.134					
1996	23.006	17.763	10.743	12.628	6.669	7.434	3.386	1.269	0.213	0.035	0.123							
1997	0.030	17.724	17.907	20.326	9.288	5.243	2.652	0.919	0.393	0.091	0.016	0.029						
1998	1.445	8.713	10.675	10.731	9.626	4.238	1.806	0.951	0.141	0.123	0.038		0.013		0.026	0.026		
1999		2.562	3.990	4.112	3.283	2.794	0.941	0.214	0.030	0.067	0.023		0.007					
2000	2.175	5.264	8.468	7.426	4.935	4.320	3.106	0.712	0.307	0.087	0.029	0.026		0.015				
2001	0.298	2.725	4.847	4.734	4.343	2.516	1.637	1.018	0.219	0.031	0.040	0.029	0.010	0.020				
2002	0.518	1.822	2.894	3.842	4.809	3.659	3.273	1.154	0.459	0.126	0.105	0.005		0.051				
2003	4.819	3.324	2.401	3.516	3.757	2.245	1.743	0.749	0.423	0.207	0.024	0.005		0.027			0.024	
2004	4.822	3.297	3.038	3.454	3.633	2.398	1.521	0.587	0.316	0.126	0.108	0.005			0.004			
2005	0.044	1.451	1.799	3.303	2.867	2.178	1.390	0.495	0.263	0.156	0.032	0.067						
2006	6.949	5.377	2.439	4.039	3.274	2.394	2.178	1.246	0.206	0.186	0.017	0.033	0.006					
2007	26.132	2.578	3.742	3.234	4.091	2.597	1.728	1.276	0.464	0.125	0.028	0.020		0.006				
2008	13.880	2.399	1.815	1.733	1.573	1.015	0.763	0.425	0.230	0.099	0.026	0.023	0.025	0.000	0.000			
2009	1.929	3.973	1.930	2.833	3.263	1.728	0.812	0.468	0.556	0.200	0.033	0.061	0.002		0.001	0.002		
2010	1.293	5.708	2.689	3.141	2.527	1.981	0.679	0.364	0.467	0.248	0.120	0.052	0.023	0.006	0.002	0.004		
2011	0.518	3.795	3.527	2.746	3.011	2.018	1.544	0.421	0.355	0.149	0.094	0.019	0.060	0.014				
2012	0.098	3.649	2.309	3.651	2.025	1.348	0.894	0.530	0.256	0.111	0.122	0.049	0.019	0.023	0.007		0.004	
2013	0.585	5.142	3.306	1.857	1.960	1.510	0.952	0.695	0.451	0.216	0.088	0.089	0.062	0.006	0.006	0.003	0.006	
2014	15.684	6.133	4.296	3.148	2.205	2.951	1.647	1.154	0.695	0.490	0.091	0.084	0.084	0.008	0.010	0.028	0.017	0.024
2015	0.248	5.389	4.024	2.486	2.678	1.418	1.413	0.641	0.476	0.424	0.166	0.049	0.061	0.003	0.008		0.001	
2016	1.524	2.719	2.790	2.837	2.795	2.628	0.770	0.580	0.525	0.157	0.152	0.104	0.062	0.005	0.006		0.004	
2017	6.355	1.250	3.441	3.312	2.643	1.891	1.207	0.484	0.291	0.172	0.053	0.094	0.022	0.016				
2018	0.338	5.069	2.751	2.181	2.550	1.711	1.210	0.456	0.387	0.228	0.096	0.052	0.021	0.012		0.005	0.003	
2019	0.925	3.464	3.443	4.787	3.112	3.160	1.942	1.222	0.317	0.384	0.158	0.059	0.094	0.013	0.004	0.010	0.008	

Table A.1.2. CV on abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.522	0.165	0.103	0.063	0.112	0.125	0.200	0.163	0.308	0.472	0.408		0.221					
1996	0.641	0.197	0.093	0.105	0.118	0.105	0.217	0.437	0.393	0.501	0.301							
1997	0.424	0.228	0.214	0.134	0.134	0.127	0.229	0.218	0.412	0.427	0.656	0.634						
1998	0.722	0.249	0.118	0.094	0.139	0.142	0.266	0.509	0.313	0.862	0.992		0.509		0.000	0.000		
1999		0.237	0.092	0.093	0.169	0.154	0.184	0.157	0.459	0.132	0.455		0.509					
2000	0.781	0.136	0.145	0.097	0.076	0.080	0.094	0.133	0.244	0.399	0.393	0.333		0.480				
2001	0.683	0.178	0.294	0.163	0.139	0.161	0.163	0.201	0.286	0.701	0.587	0.470	0.639	0.740				
2002	0.632	0.162	0.126	0.136	0.101	0.088	0.062	0.149	0.253	0.555	0.563	0.552		0.400				
2003	0.310	0.262	0.238	0.122	0.120	0.113	0.142	0.160	0.188	0.245	0.344	0.671		1.652			0.596	
2004	0.251	0.177	0.118	0.092	0.072	0.115	0.109	0.132	0.167	0.715	0.260	0.543			0.485			
2005	0.872	0.114	0.153	0.121	0.064	0.092	0.124	0.112	0.263	0.327	0.285	0.788						
2006	0.498	0.999	0.509	0.100	0.100	0.077	0.206	0.184	0.149	0.148	0.000	0.392	0.496					
2007	0.645	0.200	0.170	0.168	0.140	0.152	0.150	0.199	0.291	0.429	0.804	0.846		0.920				
2008	0.343	0.238	0.182	0.138	0.129	0.114	0.136	0.187	0.231	0.379	0.373	0.476	0.501	0.357	0.357			
2009	1.051	0.215	0.153	0.108	0.096	0.137	0.107	0.158	0.129	0.229	0.307	0.204	0.523		0.672	0.514		
2010	0.501	0.394	0.166	0.147	0.115	0.101	0.183	0.189	0.208	0.199	0.200	0.206	0.558	0.242	0.406	0.537		
2011	0.827	0.125	0.126	0.110	0.119	0.108	0.125	0.252	0.163	0.192	0.277	0.517	0.338	0.767				
2012	0.599	0.211	0.233	0.122	0.123	0.119	0.090	0.159	0.160	0.227	0.185	0.423	0.466	0.492	0.402		0.315	
2013	0.538	0.129	0.149	0.120	0.133	0.119	0.118	0.165	0.195	0.312	0.345	0.357	0.485	0.649	0.550	0.390	0.557	
2014	0.815	0.158	0.178	0.087	0.115	0.123	0.118	0.134	0.089	0.204	0.416	0.336	0.312	0.831	0.170	0.522	0.687	0.31
2015	0.784	0.115	0.090	0.096	0.068	0.094	0.094	0.116	0.159	0.178	0.260	0.353	0.309	0.258	0.717		0.600	
2016	0.598	0.304	0.132	0.084	0.072	0.088	0.156	0.164	0.177	0.265	0.194	0.228	0.528	0.426	0.341		0.297	
2017	0.644	0.463	0.177	0.168	0.163	0.108	0.155	0.218	0.264	0.425	0.286	0.336	0.509	0.606				
2018	0.911	0.403	0.146	0.147	0.166	0.146	0.114	0.191	0.355	0.297	0.138	0.275	0.325	0.667		0.225	0.260	
2019	0.232	0.137	0.172	0.117	0.093	0.083	0.101	0.100	0.194	0.232	0.235	0.207	0.631	0.500	0.601	0.769	0.663	

Table A.1.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.000	1.595	3.414	5.298	10.124	14.865	12.579	7.364	4.352	2.470	0.144		2.387					
1996	0.157	0.716	2.459	9.286	9.228	14.394	9.253	5.554	1.402	0.388	2.020							
1997	0.000	0.742	4.335	13.470	12.866	10.135	7.839	2.911	1.564	0.874	0.176	0.148						
1998	0.014	0.459	3.533	9.317	13.530	9.495	5.873	4.444	0.832	0.676	0.615		0.157		0.525	0.690		
1999		0.163	1.110	3.412	5.253	5.734	2.634	0.974	0.225	0.768	0.050		0.121					
2000	0.025	0.368	2.708	5.928	7.447	10.068	8.850	3.148	2.040	0.714	0.343	0.322		0.062				
2001	0.001	0.202	1.940	4.520	7.163	5.798	5.105	3.435	1.292	0.213	0.497	0.518	0.086	0.311				
2002	0.004	0.207	1.324	4.145	10.772	12.037	15.280	7.214	2.094	0.372	0.688	0.108		0.629				
2003	0.044	0.232	0.878	2.892	5.256	4.996	5.326	2.982	2.183	1.278	0.216	0.011		0.297			0.602	
2004	0.032	0.294	1.069	3.050	6.188	5.196	4.794	2.187	1.267	0.530	1.069	0.053			0.031			
2005	0.001	0.158	0.766	3.133	6.391	5.533	4.219	2.099	0.909	0.747	0.456	1.119						
2006	0.056	0.418	0.991	4.012	5.343	5.421	7.007	4.649	1.058	1.169	0.109	0.837	0.027					
2007	0.170	0.273	1.925	3.470	7.754	6.811	5.634	5.958	3.044	1.401	0.463	0.056		0.136				
2008	0.086	0.236	0.820	1.990	3.216	3.378	2.586	1.968	1.111	0.416	0.105	0.272	0.125	0.005	0.004			
2009	0.017	0.295	0.766	3.172	6.214	4.608	2.897	2.052	2.655	1.152	0.153	0.244	0.007		0.003	0.017		
2010	0.013	0.349	1.379	3.545	4.865	5.500	2.392	1.708	2.664	1.538	0.755	0.340	0.187	0.013	0.030	0.036		
2011	0.004	0.263	1.323	3.126	6.611	6.104	6.308	2.243	2.143	0.960	0.491	0.070	0.498	0.066				
2012	0.001	0.268	0.828	4.271	4.190	4.127	3.332	2.484	1.427	0.699	0.847	0.233	0.120	0.128	0.049		0.018	
2013	0.007	0.423	1.246	1.662	3.477	4.405	3.267	2.707	2.361	1.239	0.363	0.805	0.768	0.019	0.050	0.051	0.099	
2014	0.107	0.476	1.707	3.558	4.234	8.651	6.267	5.510	3.663	2.927	0.869	0.585	0.606	0.033	0.076	0.282	0.144	0.601
2015	0.001	0.379	1.439	2.677	5.755	4.118	5.073	3.024	2.108	2.650	0.923	0.412	0.314	0.032	0.075		0.009	
2016	0.011	0.201	0.896	3.477	6.475	9.308	2.905	2.686	3.419	1.131	0.794	1.011	0.321	0.022	0.057		0.033	
2017	0.023	0.090	1.794	3.567	5.254	5.651	4.860	2.213	2.042	1.108	0.334	0.912	0.111	0.237				
2018	0.002	0.232	1.411	2.578	5.404	5.587	4.468	2.509	2.330	1.632	0.713	0.190	0.107	0.111		0.100	0.023	
2019	0.008	0.230	1.264	5.626	6.381	9.351	7.683	5.747	1.634	2.419	1.091	0.477	1.047	0.129	0.041	0.121	0.056	

Table A.1.4. Length at age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	10.32	18.93	32.17	42.33	51.98	59.07	64.26	77.92	84.99	87.89	66.98		121.24					
1996	9.36	16.66	28.83	42.12	52.28	58.17	64.66	75.70	86.68	99.18	117.56							
1997	9.01	16.70	29.27	40.89	51.93	58.40	66.89	68.71	71.67	102.00	104.42	83.00						
1998	10.62	18.05	32.04	44.30	52.03	60.09	68.11	75.99	85.28	83.72	108.43		105.00		121.00	135.00		
1999		19.52	31.19	44.18	54.57	59.18	65.77	75.68	89.32	101.33	59.00		118.00					
2000	10.84	20.08	32.38	43.35	53.30	61.11	64.79	74.55	84.79	86.55	107.35	102.13		79.00				
2001	8.09	19.99	33.90	45.84	55.13	60.77	65.76	67.88	81.74	87.23	107.06	114.32	99.84	112.68				
2002	10.48	22.97	35.07	47.29	59.65	67.22	75.42	81.62	76.42	67.24	85.16	115.00		108.00				
2003	9.71	19.33	33.45	43.70	52.16	60.48	67.16	72.87	77.01	80.32	92.80	61.00		106.31			143.00	
2004	8.97	21.14	33.03	44.26	54.96	59.27	67.27	69.90	71.79	75.35	94.15	91.37			89.00			
2005	11.42	22.30	34.93	45.12	58.67	62.84	65.37	72.60	71.13	75.09	108.25	108.92						
2006	9.50	20.87	34.69	46.11	54.54	59.96	67.03	70.13	77.68	82.59	86.00	125.00	76.00					
2007	9.20	21.59	36.48	47.12	56.97	63.04	67.82	74.34	84.51	100.75	113.52	63.01		123.00				
2008	9.28	22.26	35.87	48.72	58.44	68.49	69.09	76.16	75.58	72.09	71.91	100.25	75.56	100.00	89.00			
2009	9.74	19.82	33.58	47.80	57.19	64.24	69.97	75.08	75.45	81.76	75.15	69.59	69.00		73.00	94.94		
2010	10.64	18.92	37.05	48.19	57.32	64.37	70.59	76.38	77.19	82.08	83.16	80.20	88.28	61.59	104.00	89.97		
2011	9.48	20.10	33.60	48.36	60.20	66.93	72.32	78.96	80.93	81.32	77.59	74.36	93.14	75.21				
2012	9.99	20.39	33.07	48.58	59.74	66.44	71.89	76.67	80.60	82.69	84.96	78.38	84.87	83.30	90.72		79.00	
2013	11.56	20.96	34.05	45.15	56.49	66.80	70.65	72.89	78.61	82.37	74.51	90.29	100.75	69.54	88.38	113.00	125.00	
2014	9.23	20.92	34.57	48.76	58.05	66.80	73.31	77.93	79.82	82.24	98.26	85.29	84.24	81.05	85.00	91.57	93.45	132.00
2015	9.27	19.72	32.67	47.60	60.07	66.99	70.91	76.65	75.76	83.48	82.52	89.27	77.38	95.00	97.44		101.00	
2016	9.44	20.37	32.47	49.21	61.22	71.39	72.88	75.49	84.37	87.80	78.17	94.49	81.43	75.84	98.37		96.00	
2017	8.18	19.84	37.35	47.86	58.89	66.84	74.01	78.35	86.43	84.31	84.70	97.13	82.55	112.60				
2018	9.83	16.24	37.40	48.86	60.06	68.90	71.09	81.46	87.41	86.52	88.92	72.67	80.98	93.55		121.66	93.00	
2019	10.11	19.89	33.35	49.27	59.27	67.46	73.53	77.35	79.47	82.90	85.52	91.33	96.75	99.46	96.00	109.00	96.00	

Table A.1.5. Weight at age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	9	59	310	730	1405	2118	2754	4733	6494	7359	3297		17869					
1996	8	41	229	736	1385	1940	2702	4269	6627	10964	16213							
1997	8	42	240	665	1384	1932	2947	3175	4264	9600	11387	5140						
1998	10	53	332	869	1405	2229	3251	4432	5987	5884	16233		12260		19880	26100		
1999		64	278	828	1602	2059	2811	4567	7363	11535	2190		18340					
2000	12	70	320	798	1508	2329	2848	4424	6726	8851	12330	12873		4220				
2001	5	74	390	953	1648	2300	3116	3386	5983	7187	11653	17035	8460	15001				
2002	9	114	460	1077	2248	3295	4674	6289	4656	3785	7783	21980		12350				
2003	9	68	366	821	1397	2225	3056	3965	5110	6049	8878	2030		12562			25600	
2004	7	89	352	884	1705	2173	3152	3729	3976	4459	10347	9093			7130			
2005	16	109	425	952	2231	2542	3047	4245	3467	4716	14816	15482						
2006	8	87	423	993	1632	2265	3214	3767	5173	6240	6530	25080	4220					
2007	7	106	516	1074	1901	2631	3269	4690	6565	11169	15781	2984		21100				
2008	6	100	453	1148	2046	3321	3392	4648	4869	4344	4077	10683	4730	9250	8520			
2009	10	75	397	1120	1904	2664	3561	4368	4756	5743	4817	3886	3084		3122	9672		
2010	10	64	508	1128	1926	2779	3540	4692	5740	6199	6336	6553	7983	2058	12154	7475		
2011	8	69	374	1136	2195	3020	4096	5365	6040	6395	5275	3933	8509	4558				
2012	8	74	359	1165	2073	3068	3728	4666	5524	6269	6948	5022	7201	6460	7052		4630	
2013	12	83	377	893	1773	2915	3432	3911	5284	5662	4216	8854	12081	4092	7780	16220	16300	
2014	7	78	399	1130	1919	2931	3806	4775	5268	5980	9081	6864	7090	4752	7920	9733	8282	24950
2015	6	70	358	1076	2149	2906	3589	4725	4436	6305	5666	8150	5273	10170	9617		11240	
2016	7	75	322	1226	2317	3540	3774	4609	6533	7303	5138	9556	5174	4215	10057		8325	
2017	4	78	522	1079	1995	2985	4014	4531	7036	6375	6323	9637	5013	14338				
2018	5	50	513	1196	2112	3257	3696	5545	6065	7157	7429	3669	5306	9401		19356	7350	
2019	9	67	367	1176	2049	2959	3958	4696	5085	6396	6804	8025	10306	9786	9585	12345	7040	

Table A.1.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
1995		40.034	0.067
1996		42.500	0.057
1997		56.823	0.100
1998		38.388	0.074
1999		15.451	0.077
2000		29.426	0.072
2001		19.437	0.137
2002		20.341	0.072
2003		15.111	0.101
2004		15.189	0.063
2005		12.547	0.062
2006		16.004	0.084
2007		17.304	0.083
2008		7.728	0.100
2009		11.887	0.075
2010		12.303	0.074
2011		13.958	0.066
2012		11.346	0.078
2013		11.204	0.089
2014		16.921	0.070
2015		13.845	0.059
2016		13.414	0.051
2017		13.624	0.097
2018		11.660	0.074
2019		18.706	0.068

10.2 - Subarea A: North of 67°N

Table A.2.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.050	26.495	8.774	4.974	6.382	6.440	4.373	1.309	0.532	0.321	0.041		0.090					
1996	22.399	17.580	9.025	8.592	4.576	5.306	2.723	1.022	0.213	0.033	0.036							
1997	0.030	16.567	15.358	16.930	7.710	4.484	2.316	0.716	0.328	0.091	0.016	0.029						
1998	1.435	8.360	6.757	8.524	8.261	3.717	1.530	0.700	0.102	0.122	0.038		0.013					
1999		2.494	3.486	3.387	2.788	2.498	0.751	0.172	0.030	0.022	0.023		0.007					
2000	2.175	5.028	7.439	5.831	3.939	3.853	2.825	0.622	0.258	0.071	0.018	0.014		0.015				
2001	0.298	2.711	4.551	4.246	3.776	2.184	1.499	0.974	0.149	0.029	0.040	0.029	0.010	0.020				
2002	0.518	1.188	2.071	2.532	2.926	2.075	0.970	0.596	0.293	0.121	0.091	0.005		0.051				
2003	4.798	3.276	2.168	3.026	3.303	1.838	1.519	0.651	0.364	0.190	0.024	0.004		0.027			0.024	
2004	4.532	3.113	2.657	2.795	2.553	1.680	1.097	0.370	0.210	0.118	0.063	0.005			0.004			
2005	0.023	0.903	1.201	2.229	1.814	1.492	0.842	0.233	0.233	0.127	0.015	0.067						
2006	6.266	4.974	1.822	2.618	2.230	1.374	1.603	1.037	0.130	0.089		0.033	0.006					
2007	26.132	2.457	3.033	2.780	3.800	2.432	1.629	1.215	0.441	0.120	0.032	0.020		0.006				
2008	13.853	2.344	1.739	1.684	1.511	0.985	0.761	0.399	0.225	0.097	0.026	0.023	0.026	0.000	0.000			
2009	1.706	3.910	1.502	2.083	2.596	1.374	0.605	0.386	0.378	0.140	0.031	0.028	0.002		0.001	0.002		
2010	1.159	5.514	2.502	2.852	2.244	1.680	0.582	0.309	0.432	0.229	0.113	0.052	0.023	0.002	0.002	0.004		
2011	0.364	2.104	2.542	1.869	2.372	1.469	1.215	0.394	0.278	0.137	0.074	0.018	0.046	0.014				
2012	0.097	3.560	2.163	3.470	1.829	1.157	0.768	0.492	0.254	0.109	0.122	0.049	0.019	0.023	0.007		0.004	
2013	0.422	4.694	3.084	1.597	1.770	1.287	0.838	0.657	0.430	0.216	0.083	0.089	0.062	0.006	0.006	0.003	0.006	
2014	14.500	5.687	3.969	2.889	2.005	2.721	1.542	1.103	0.426	0.443	0.082	0.084	0.084	0.008	0.010	0.028	0.017	0.024
2015	0.248	3.264	2.903	1.976	1.652	0.977	1.072	0.480	0.387	0.311	0.159	0.049	0.059	0.003	0.008		0.001	
2016	1.513	2.675	2.572	2.433	1.883	1.976	0.726	0.536	0.393	0.142	0.103	0.080	0.062	0.003	0.006		0.004	
2017	6.355	1.205	3.290	3.217	2.454	1.771	1.120	0.436	0.266	0.168	0.053	0.094	0.022	0.016				
2018	0.336	5.013	2.615	2.008	2.321	1.375	1.002	0.427	0.366	0.167	0.096	0.052	0.021	0.012		0.005	0.003	
2019	0.310	2.607	2.992	3.724	2.221	2.149	1.272	0.656	0.212	0.262	0.106	0.040	0.092	0.013	0.004	0.010	0.008	

Table A.2.2. CV on abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.522	0.168	0.130	0.090	0.124	0.136	0.211	0.194	0.395	0.500	0.412		0.324					
1996	0.654	0.198	0.111	0.154	0.168	0.141	0.259	0.538	0.394	0.483	1.133							
1997	0.424	0.239	0.246	0.160	0.156	0.142	0.250	0.259	0.470	0.427	0.656	0.634						
1998	0.726	0.259	0.186	0.117	0.161	0.161	0.311	0.690	0.401	0.865	0.992		0.509					
1999		0.243	0.105	0.114	0.198	0.173	0.229	0.193	0.469	0.399	0.455		0.509					
2000	0.781	0.143	0.164	0.124	0.095	0.090	0.103	0.151	0.291	0.489	0.540	0.504		0.480				
2001	0.683	0.179	0.313	0.182	0.159	0.186	0.176	0.209	0.406	0.717	0.588	0.470	0.639	0.740				
2002	0.632	0.248	0.174	0.205	0.160	0.136	0.147	0.228	0.363	0.575	0.632	0.552		0.400				
2003	0.311	0.266	0.263	0.140	0.137	0.137	0.161	0.182	0.218	0.262	0.346	0.200		1.652			0.596	
2004	0.265	0.187	0.134	0.112	0.102	0.157	0.143	0.190	0.252	0.763	0.371	0.543			0.485			
2005	0.988	0.181	0.228	0.177	0.100	0.135	0.203	0.228	0.297	0.400	0.590	0.788						
2006	0.552	1.081	0.682	0.154	0.146	0.131	0.279	0.218	0.228	0.311		0.392	0.496					
2007	0.645	0.209	0.203	0.192	0.150	0.161	0.158	0.208	0.307	0.440	0.629	0.846		0.920				
2008	0.343	0.244	0.189	0.142	0.134	0.118	0.136	0.198	0.236	0.386	0.373	0.481	0.450	0.357	0.357			
2009	1.189	0.218	0.197	0.145	0.120	0.169	0.139	0.185	0.189	0.315	0.246	0.424	0.523		0.672	0.514		
2010	0.558	0.408	0.178	0.162	0.130	0.119	0.214	0.222	0.225	0.215	0.212	0.207	0.558	0.661	0.406	0.537		
2011	1.073	0.218	0.170	0.159	0.146	0.147	0.155	0.268	0.205	0.195	0.347	0.510	0.443	0.767				
2012	0.601	0.217	0.249	0.129	0.136	0.138	0.104	0.172	0.162	0.232	0.186	0.423	0.466	0.492	0.402		0.315	
2013	0.677	0.140	0.160	0.140	0.147	0.139	0.134	0.174	0.204	0.312	0.365	0.357	0.485	0.649	0.550	0.390	0.557	
2014	0.880	0.170	0.192	0.094	0.126	0.133	0.126	0.141	0.144	0.226	0.463	0.336	0.312	0.831	0.170	0.522	0.687	0.312
2015	0.784	0.178	0.121	0.118	0.105	0.134	0.116	0.143	0.183	0.236	0.255	0.353	0.298	0.258	0.717		0.600	
2016	0.602	0.309	0.144	0.098	0.107	0.117	0.165	0.178	0.237	0.292	0.287	0.295	0.528	0.686	0.341		0.297	
2017	0.644	0.481	0.185	0.173	0.176	0.116	0.167	0.242	0.289	0.436	0.286	0.336	0.509	0.606				
2018	0.909	0.409	0.152	0.159	0.182	0.182	0.137	0.204	0.376	0.406	0.138	0.278	0.325	0.667		0.225	0.260	
2019	0.660	0.180	0.198	0.147	0.127	0.120	0.151	0.176	0.283	0.333	0.348	0.275	0.636	0.500	0.601	0.769	0.663	

Table A.2.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	0.000	1.541	2.472	3.574	8.904	13.457	11.950	6.114	3.126	2.279	0.143		1.580					
1996	0.152	0.709	1.947	5.779	6.165	10.249	7.685	4.485	1.401	0.378	0.715							
1997	0.000	0.677	3.790	11.041	10.756	8.589	6.793	2.140	1.152	0.874	0.176	0.148						
1998	0.014	0.410	1.751	7.160	11.622	8.458	4.866	3.312	0.527	0.676	0.615		0.157					
1999		0.155	0.947	2.695	4.204	4.894	2.062	0.733	0.218	0.144	0.050		0.121					
2000	0.025	0.347	2.398	4.816	6.154	9.109	7.947	2.654	1.529	0.406	0.155	0.128		0.062				
2001	0.001	0.199	1.778	3.973	6.276	5.075	4.503	3.240	0.679	0.206	0.497	0.518	0.086	0.311				
2002	0.004	0.105	0.737	2.351	4.653	4.935	3.358	2.646	1.109	0.330	0.570	0.108		0.629				
2003	0.044	0.228	0.783	2.488	4.716	4.167	4.746	2.687	2.016	1.232	0.216	0.009		0.297			0.602	
2004	0.029	0.276	0.896	2.449	4.212	3.600	3.513	1.412	0.993	0.464	0.322	0.053			0.031			
2005	0.000	0.089	0.526	1.947	3.129	3.294	2.134	0.857	0.813	0.706	0.131	1.119						
2006	0.050	0.367	0.691	2.624	3.674	3.129	5.589	4.035	0.575	0.714		0.837	0.027					
2007	0.170	0.239	1.465	2.959	7.066	6.257	5.154	5.472	2.811	1.352	0.556	0.056		0.136				
2008	0.086	0.225	0.742	1.869	2.978	3.285	2.581	1.807	1.097	0.402	0.105	0.272	0.130	0.005	0.004			
2009	0.014	0.288	0.538	2.152	4.876	3.708	2.309	1.786	1.958	0.763	0.150	0.163	0.007		0.003	0.017		
2010	0.013	0.329	1.271	3.109	4.196	4.604	2.072	1.448	2.196	1.432	0.722	0.340	0.187	0.006	0.030	0.036		
2011	0.003	0.125	1.024	2.183	5.403	4.579	4.488	2.024	1.561	0.855	0.388	0.067	0.360	0.066				
2012	0.001	0.259	0.768	3.956	3.675	3.333	2.816	2.292	1.421	0.668	0.847	0.233	0.120	0.128	0.049		0.018	
2013	0.005	0.399	1.184	1.469	3.215	3.913	2.883	2.593	2.101	1.239	0.350	0.805	0.768	0.019	0.050	0.051	0.099	
2014	0.095	0.442	1.415	3.201	3.762	7.909	5.684	5.150	2.363	2.482	0.801	0.585	0.605	0.033	0.076	0.282	0.144	0.601
2015	0.001	0.228	1.068	2.143	3.604	2.897	4.120	2.284	1.801	1.743	0.901	0.412	0.310	0.032	0.075		0.009	
2016	0.011	0.197	0.823	2.555	3.643	6.702	2.776	2.567	2.266	0.980	0.626	0.768	0.321	0.015	0.057		0.033	
2017	0.023	0.086	1.667	3.416	4.788	5.220	4.523	2.068	1.855	1.072	0.334	0.912	0.111	0.237				
2018	0.002	0.231	1.366	2.266	4.909	4.355	3.679	2.334	2.179	1.388	0.713	0.188	0.107	0.111		0.100	0.023	
2019	0.002	0.163	1.112	4.212	4.414	6.413	4.854	3.382	1.272	1.623	0.840	0.392	1.042	0.129	0.041	0.121	0.056	

Table A.2.4. Length by age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	10.32	18.86	31.39	42.05	51.83	58.77	64.27	77.55	82.36	87.08	67.02		123.50					
1996	9.35	16.68	28.32	41.25	51.87	58.06	65.16	74.80	86.75	99.57	115.00							
1997	9.01	16.61	29.56	40.75	51.99	58.11	66.89	66.80	68.62	102.00	104.42	83.00						
1998	10.62	17.76	30.26	44.04	51.99	60.31	67.81	74.93	82.22	83.81	108.43		105.00					
1999		19.41	31.17	44.06	54.06	58.69	65.44	74.00	88.95	88.21	59.00		118.00					
2000	10.84	20.01	32.55	43.97	53.96	61.39	64.53	73.81	81.94	80.31	95.00	95.83		79.00				
2001	8.09	19.97	33.70	45.70	55.37	61.09	65.17	67.64	76.07	87.23	107.08	114.32	99.84	112.68				
2002	10.48	21.64	32.65	45.02	54.46	62.01	68.83	72.35	70.52	66.73	85.06	115.00		108.00				
2003	9.71	19.30	33.32	43.76	52.60	60.94	67.73	73.67	78.79	81.86	92.81	61.00		106.31			143.00	
2004	8.95	21.13	32.67	44.05	54.52	59.26	67.72	70.47	75.66	73.91	78.59	91.37			89.00			
2005	10.81	21.56	35.73	44.68	55.44	60.55	62.62	71.48	71.73	80.28	93.23	108.92						
2006	9.38	20.54	34.11	46.36	54.97	60.44	68.74	71.20	74.57	89.01		125.00	76.00					
2007	9.20	21.18	35.88	47.14	56.79	62.75	67.34	73.72	83.42	100.55	116.00	63.01		123.00				
2008	9.28	22.14	35.38	48.30	57.91	68.55	69.09	75.83	75.85	71.71	71.91	100.50	76.19	100.00	89.00			
2009	9.32	19.78	32.92	46.75	57.07	64.71	71.37	76.56	76.92	81.19	75.56	77.65	69.00		73.00	94.94		
2010	10.96	18.85	36.95	47.84	56.91	64.12	71.24	76.42	75.45	82.04	83.12	80.27	88.28	60.00	104.00	89.97		
2011	9.48	19.13	34.62	48.69	61.02	67.55	71.22	78.14	80.80	80.53	78.30	74.68	91.37	75.21				
2012	9.99	20.33	32.92	48.14	59.16	65.29	71.21	76.19	80.69	82.10	84.99	78.38	84.87	83.30	90.72		79.00	
2013	11.52	21.22	34.28	45.56	56.92	67.73	70.94	73.28	77.28	82.37	75.33	90.29	100.75	69.54	88.38	113.00	125.00	
2014	9.10	20.91	33.72	48.61	57.78	66.75	72.83	77.50	81.58	80.84	98.65	85.29	84.26	81.05	85.00	91.57	93.45	132.00
2015	9.27	19.53	33.54	47.67	60.74	67.79	72.91	77.37	77.14	81.76	83.06	89.27	77.53	95.00	97.44		101.00	
2016	9.43	20.35	32.47	47.38	58.18	69.76	73.27	76.41	81.13	86.63	80.74	90.52	81.43	80.85	98.37		96.00	
2017	8.18	19.80	37.05	47.69	58.55	66.73	74.09	79.55	85.97	84.07	84.70	97.13	82.55	112.60				
2018	9.83	16.29	37.64	48.45	60.08	68.36	71.05	81.20	87.30	92.19	88.92	72.72	80.98	93.55		121.66	93.00	
2019	9.51	19.64	33.67	49.05	59.01	68.22	73.51	80.38	84.43	84.10	91.63	97.77	97.12	99.46	96.00	109.00	96.00	

Table A.2.5. Weight by age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16	Age 17
1995	9	58	282	719	1395	2091	2767	4693	5905	7211	3300		17490					
1996	8	41	216	672	1349	1939	2779	4223	6638	11146	20000							
1997	8	41	244	655	1393	1914	2921	2988	3768	9600	11387	5140						
1998	10	49	259	840	1406	2261	3173	4320	5275	5896	16233		12260					
1999		63	272	793	1508	1964	2759	4257	7262	6561	2190		18340					
2000	12	69	322	826	1561	2363	2811	4260	5977	6061	8736	9458		4220				
2001	5	74	377	933	1660	2320	2998	3338	4478	7193	11658	17035	8460	15001				
2002	9	88	357	918	1595	2377	3468	4415	3868	3588	8921	21980		12350				
2003	9	68	361	820	1427	2269	3127	4114	5493	6350	8881	2030		12562			25600	
2004	6	88	337	877	1652	2154	3198	3816	4696	4092	5206	9093			7130			
2005	14	99	436	878	1725	2205	2545	3674	3521	5562	8817	15482						
2006	8	82	401	1002	1648	2277	3500	3948	4445	8003		25080	4220					
2007	7	97	485	1065	1864	2581	3170	4520	6363	11113	17480	2984		21100				
2008	6	97	427	1109	1971	3327	3393	4543	4921	4270	4077	10741	4962	9250	8520			
2009	8	74	357	1032	1877	2694	3804	4600	5147	5349	4887	5518	3084		3122	9672		
2010	11	63	502	1089	1871	2743	3587	4682	5095	6261	6449	6565	7983	2635	12154	7475		
2011	8	59	401	1165	2279	3109	3702	5163	5593	6174	5325	3982	8151	4558				
2012	8	73	355	1134	2014	2886	3663	4633	5548	6099	6953	5022	7201	6460	7052		4630	
2013	12	85	384	918	1817	3041	3438	3963	4926	5662	4340	8854	12081	4092	7780	16220	16300	
2014	7	78	357	1108	1874	2906	3686	4668	5541	5585	9243	6864	7094	4752	7920	9733	8282	24950
2015	6	69	369	1083	2181	2969	3842	4763	4675	5648	5767	8150	5309	10170	9617		11240	
2016	7	74	321	1050	1932	3385	3832	4767	5755	6972	6003	9218	5174	5537	10057		8325	
2017	4	78	507	1063	1959	2944	4023	4695	7003	6312	6323	9637	5013	14338				
2018	5	50	523	1143	2107	3151	3676	5510	5992	8487	7429	3678	5306	9401		19356	7350	
2019	8	62	372	1131	1984	2983	3815	5141	5908	6420	7801	9778	10405	9786	9585	12345	7040	

Table A.2.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
1995		33.395	2.667
1996		31.513	2.386
1997		47.938	5.599
1998		29.757	2.844
1999		13.154	1.183
2000		24.871	2.111
2001		17.500	2.666
2002		11.695	1.446
2003		13.128	1.526
2004		11.551	0.946
2005		8.250	0.773
2006		10.931	1.348
2007		15.491	1.424
2008		7.476	0.770
2009		9.127	0.886
2010		11.024	0.905
2011		10.425	0.917
2012		10.463	0.884
2013		10.131	0.993
2014		15.424	1.184
2015		10.035	0.807
2016		10.917	0.687
2017		12.905	1.319
2018		10.468	0.860
2019		13.753	1.271

10.3 - Subarea B: Between 65° and 67°N

Table A.3.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.319	1.494	1.205	0.390	0.219	0.204	0.155	0.117	0.040	0.015		0.044				
1996	0.612	0.084	1.390	3.276	1.178	1.406	0.425	0.134			0.099						
1997		0.934	1.928	2.312	1.023	0.383	0.094	0.036	0.035								
1998		0.264	1.216	0.903	0.846	0.406	0.070	0.053	0.039	0.027					0.026	0.026	
1999		0.036	0.360	0.466	0.260	0.202	0.127	0.023	0.001	0.045							
2000		0.236	0.976	1.511	0.814	0.350	0.244	0.089	0.049	0.016	0.016	0.016					
2001		0.110	0.315	0.358	0.382	0.399	0.162	0.064	0.065	0.007			0.006				
2002	0.039	0.203	0.422	0.342	0.375	0.119	0.116	0.048	0.032		0.016						
2003	0.027	0.085	0.293	0.764	0.518	0.436	0.237	0.116	0.085	0.023		0.005					
2004	0.064	0.174	0.526	0.750	1.015	0.686	0.390	0.185	0.120	0.015	0.041						
2005	0.054	0.130	0.488	0.769	0.485	0.464	0.261	0.196	0.036	0.029	0.019						
2006	0.166	0.411	0.557	1.325	0.810	0.771	0.520	0.195	0.033	0.080							
2007	0.075	0.100	0.682	0.412	0.204	0.145	0.177	0.056	0.015			0.017					
2008	0.323	0.140	0.098	0.028	0.028	0.020	0.006	0.014	0.013	0.002		0.004	0.001				
2009	0.223	0.116	0.533	0.481	0.616	0.283	0.197	0.066	0.165	0.062	0.018	0.013					
2010	0.014	0.488	0.343	0.282	0.211	0.258	0.113	0.064	0.010	0.021	0.022	0.005	0.004	0.005			
2011	0.170	1.784	1.046	0.828	0.553	0.425	0.178	0.028	0.069	0.015	0.016	0.013	0.012				
2012	0.002	0.219	0.573	0.323	0.084	0.086	0.044	0.052	0.018	0.009	0.014	0.020	0.006	0.012			0.004
2013	0.171	0.620	0.618	0.509	0.340	0.303	0.164	0.075	0.044	0.021	0.015	0.013	0.016				
2014	1.113	0.357	0.392	0.159	0.062	0.080	0.052	0.065	0.235	0.114	0.010		0.018	0.007			
2015		2.151	1.048	0.429	0.620	0.356	0.229	0.114	0.050	0.078	0.066	0.007	0.016		0.006		
2016	0.057	0.477	0.387	0.131	0.144	0.228	0.164	0.134	0.076	0.032	0.023	0.025	0.028	0.002			
2017		0.052	0.202	0.116	0.052	0.122	0.052	0.055	0.022	0.012	0.013	0.010	0.005	0.003			
2018	0.006	0.283	0.146	0.167	0.088	0.096	0.119	0.060	0.046	0.027	0.014	0.006	0.003	0.007			
2019	0.631	0.874	0.616	1.017	0.850	0.681	0.191	0.237	0.066	0.087	0.054	0.027	0.005				

Table A.3.2. CV on abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.027	0.008	0.023	0.074	0.081	0.055	0.036	0.167	0.104							
1996	0.280	0.298	0.011	0.010	0.054	0.055	0.115	0.174									
1997		0.234	0.174	0.060	0.092	0.137	0.353	0.501	0.485								
1998		0.145	0.075	0.100	0.080	0.104	0.464	0.240	0.443								
1999		0.010	0.002	0.001	0.001	0.001		0.000	0.019								
2000		0.038	0.013	0.012	0.027	0.075	0.101	0.080	0.038	0.103							
2001		0.682	0.384	0.257	0.110	0.156	0.164	0.255	0.176	0.619			0.727				
2002	0.937	0.263	0.394	0.096	0.048	0.298	0.564	0.924	0.662								
2003	0.000	0.324	0.099	0.061	0.092	0.074	0.090	0.129	0.156	0.284		0.671					
2004	0.351	0.051	0.069	0.078	0.055	0.101	0.117	0.151	0.106	0.743	0.289						
2005	0.487	0.251	0.045	0.032	0.027	0.032	0.038	0.080	0.265		0.118						
2006	0.000	0.027	0.036	0.023	0.042	0.035	0.033	0.093	0.199								
2007	0.644	0.313	0.144	0.144	0.143	0.145	0.201	0.201	0.616			0.487					
2008	0.723	0.555	0.336	0.708	0.471	0.101	0.856	0.584	0.695	0.201		0.685	0.040				
2009	0.000	0.376	0.179	0.079	0.109	0.086	0.092	0.291	0.081	0.178	0.543	0.267					
2010	0.212	0.366	0.167	0.147	0.079	0.076	0.073	0.059	0.362	0.713	0.248	0.000	0.427	0.000			
2011	0.606	0.078	0.098	0.087	0.103	0.080	0.144	0.736	0.111	0.496	1.063	0.230	0.000				
2012	0.369	0.213	0.506	0.527	0.318	0.304	0.467	0.434	0.410	0.444	0.353	0.599	0.286	0.349			0.315
2013	0.548	0.160	0.191	0.092	0.067	0.057	0.160	0.271	0.254	0.528	0.633	0.651	0.590				
2014	0.112	0.150	0.159	0.173	0.107	0.230	0.272	0.416	0.039	0.335	0.644		0.114	0.866			
2015		0.052	0.064	0.105	0.084	0.083	0.161	0.203	0.442	0.265	0.688	0.754	0.615		0.930		
2016	0.872	0.621	0.256	0.158	0.134	0.243	0.198	0.204	0.169	0.326	0.385	0.291	1.181	0.000			
2017		0.679	0.351	0.274	0.219	0.306	0.359	0.405	0.574	0.387	0.736	0.668	1.067	0.612			
2018	0.729	0.733	0.276	0.189	0.209	0.347	0.508	0.501	0.527	0.041	0.375	0.450	0.707	0.558			
2019	0.056	0.097	0.145	0.075	0.077	0.076	0.192	0.108	0.183	0.117	0.097	0.195	1.231				

Table A.3.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.029	0.528	0.814	0.573	0.469	0.517	0.822	1.037	0.377	0.036		0.811				
1996	0.005	0.001	0.404	2.548	1.454	2.479	0.939	0.622			1.546						
1997		0.053	0.377	1.398	1.149	0.663	0.257	0.113	0.054								
1998		0.034	0.375	0.753	1.019	0.735	0.197	0.242	0.305	0.045					0.525	0.690	
1999		0.004	0.088	0.302	0.306	0.384	0.325	0.107	0.008	0.624							
2000		0.022	0.290	1.016	0.966	0.688	0.779	0.495	0.511	0.308	0.232	0.233					
2001		0.010	0.097	0.234	0.421	0.519	0.577	0.190	0.499	0.052			0.077				
2002	0.000	0.019	0.117	0.437	0.880	0.217	0.194	0.080	0.088		0.135						
2003	0.000	0.006	0.104	0.466	0.540	0.775	0.590	0.321	0.283	0.054		0.011					
2004	0.000	0.017	0.180	0.552	1.501	1.205	1.039	0.538	0.304	0.047	0.734						
2005	0.001	0.009	0.167	0.511	0.777	1.091	0.732	0.587	0.104	0.042	0.356						
2006	0.002	0.052	0.252	1.211	1.089	1.385	1.205	0.462	0.144	0.371							
2007	0.001	0.013	0.328	0.328	0.293	0.306	0.444	0.176	0.099			0.028					
2008	0.003	0.018	0.044	0.040	0.066	0.053	0.021	0.056	0.072	0.015		0.026	0.003				
2009	0.003	0.009	0.190	0.570	1.034	0.697	0.533	0.170	0.602	0.395	0.037	0.027					
2010	0.000	0.030	0.121	0.229	0.388	0.607	0.308	0.289	0.026	0.059	0.109	0.011	0.009	0.009			
2011	0.001	0.146	0.298	0.783	0.895	1.020	0.541	0.093	0.560	0.035	0.053	0.032	0.119				
2012	0.000	0.021	0.192	0.181	0.104	0.183	0.106	0.165	0.078	0.057	0.057	0.101	0.023	0.053			0.018
2013	0.002	0.037	0.147	0.321	0.393	0.675	0.400	0.231	0.199	0.089	0.038	0.045	0.063				
2014	0.011	0.030	0.231	0.114	0.062	0.157	0.173	0.251	1.117	0.437	0.043		0.066	0.022			
2015		0.153	0.229	0.455	1.060	0.976	0.550	0.373	0.167	0.814	0.245	0.030	0.068		0.044		
2016	0.001	0.041	0.102	0.083	0.187	0.601	0.501	0.470	0.345	0.311	0.108	0.147	0.153	0.008			
2017		0.004	0.072	0.101	0.102	0.307	0.164	0.180	0.084	0.074	0.057	0.041	0.022	0.033			
2018	0.000	0.014	0.044	0.266	0.145	0.262	0.381	0.239	0.237	0.127	0.071	0.021	0.023	0.044			
2019	0.006	0.069	0.184	1.140	1.734	1.720	0.582	0.841	0.199	0.370	0.251	0.143	0.021				

Table A.3.4. Mean length (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		21.94	33.66	41.58	52.72	60.33	64.29	80.92	94.71	99.01	60.00		117.00				
1996	9.77	13.00	31.63	42.75	51.16	57.11	61.34	80.03			118.00						
1997		18.27	27.13	39.84	49.63	57.20	64.53	75.17	54.90								
1998		24.38	31.97	43.56	49.98	57.23	65.97	77.02	93.29	57.00					121.00	135.00	
1999		23.93	29.19	40.33	49.29	57.53	64.02	79.87	97.41	107.50							
2000		21.57	31.06	40.66	49.45	58.17	67.45	79.64	98.84	109.64	114.00	105.00					
2001		21.77	31.73	41.09	48.33	51.45	67.05	65.76	90.48	89.36			117.00				
2002	10.00	21.90	30.75	48.87	60.98	55.74	53.59	54.19	64.97		97.00						
2003	10.00	19.94	32.96	39.46	47.12	56.05	62.67	65.60	69.22	62.20		61.00					
2004	8.78	21.77	32.31	42.25	52.07	55.61	63.78	65.68	64.11	72.33	119.74						
2005	14.00	20.18	31.72	40.21	52.84	60.99	64.04	65.15	65.77	55.00	118.60						
2006	11.67	23.80	35.49	45.03	51.23	55.95	61.56	63.11	77.31	75.96							
2007	9.93	23.80	35.85	43.51	51.89	58.93	62.27	68.55	89.30			57.00					
2008	10.73	25.27	36.20	53.57	62.11	63.98	69.17	71.80	79.42	88.53		88.78	69.99				
2009	12.06	20.77	32.24	48.29	54.11	61.31	64.81	63.53	70.97	81.89	59.00	59.21					
2010	12.07	19.16	32.56	42.26	55.80	60.52	64.49	74.90	61.80	66.77	81.14	58.00	60.00	62.00			
2011	9.38	21.22	30.50	45.76	54.64	62.29	66.89	72.58	83.47	61.36	69.07	64.00	102.00				
2012	10.08	22.09	32.87	39.25	50.99	59.63	63.30	67.45	74.09	83.90	74.29	78.35	73.00	75.00			79.00
2013	11.77	19.05	30.12	40.89	49.69	62.10	64.29	68.26	76.04	76.13	64.04	69.00	74.35				
2014	10.68	21.23	38.25	42.25	47.41	58.78	70.43	73.83	76.04	74.19	81.08		73.00	75.00			
2015		19.98	28.38	46.96	56.02	64.47	61.88	69.70	70.49	97.01	74.19	77.00	75.97		95.00		
2016	10.17	21.51	30.89	39.64	50.72	62.92	66.87	69.58	76.89	94.71	75.77	83.81	82.33	73.00			
2017		22.41	33.81	44.66	57.33	63.23	69.02	68.73	73.62	85.84	77.96	76.14	81.37	99.00			
2018	10.00	17.57	32.27	51.22	54.42	63.85	66.85	73.31	77.17	77.83	79.02	73.70	93.65	81.74			
2019	10.55	20.66	30.44	48.03	58.75	62.90	66.59	71.27	67.22	73.38	73.15	82.61	76.59				

Table A.3.5. Mean weight (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		91	354	676	1470	2148	2538	5295	8844	9406	2400		18580				
1996	8	17	291	778	1233	1763	2214	4688			15560						
1997		57	198	604	1124	1733	2787	3282	1506								
1998		128	309	835	1204	1809	2823	4634	7894	1655					19880	26100	
1999		115	245	648	1175	1906	2556	4722	9728	13870							
2000		92	297	672	1186	1962	3185	5549	10436	18769	14266	14380					
2001		96	316	670	1106	1305	3618	2991	7694	7230			12000				
2002	8	93	281	1286	2350	1887	1755	1800	2999		8358						
2003	9	67	354	610	1045	1780	2491	2787	3325	2370		2030					
2004	6	100	343	738	1479	1758	2669	2925	2549	3406	18680						
2005	25	76	342	664	1601	2352	2804	3001	2954	1456	18544						
2006	13	127	453	914	1343	1798	2317	2363	4449	4608							
2007	7	140	483	801	1442	2115	2557	3154	6675			1648					
2008	10	165	456	1543	2445	2691	3419	4277	5767	7574		6239	2733				
2009	16	75	361	1190	1687	2469	2704	2580	3664	6423	2096	2033					
2010	14	62	355	821	1851	2355	2731	4543	2399	2843	4951	2128	2285	1910			
2011	8	82	286	947	1620	2404	3064	4232	8231	2328	3590	2440	10116				
2012	8	96	338	581	1286	2207	2533	3215	4211	7063	4248	4862	3745	4325			4630
2013	13	60	241	631	1160	2225	2436	3071	4535	4334	2569	3425	4214				
2014	10	85	601	723	992	2003	3273	4023	4751	3973	4632		3634	3340			
2015		71	218	1058	1709	2748	2397	3311	3329	10905	3492	4310	4381		7785		
2016	9	88	266	637	1299	2644	3007	3441	4570	9507	4613	5960	5345	3425			
2017		91	367	878	1938	2496	3208	3272	3821	6200	4275	4325	4387	10610			
2018	5	47	302	1623	1627	2653	3092	4115	4976	4771	4989	3209	7866	6455			
2019	10	79	299	1121	2042	2529	3058	3557	3014	4284	4647	5383	4261				

Table A.3.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
1995		3.848	0.030
1996		7.908	0.072
1997		5.782	0.365
1998		3.587	0.104
1999		1.483	0.001
2000		4.082	0.033
2001		1.753	0.309
2002		1.467	0.289
2003		2.474	0.049
2004		3.724	0.076
2005		2.746	0.026
2006		4.291	0.037
2007		1.687	0.104
2008		0.214	0.060
2009		2.417	0.195
2010		1.331	0.107
2011		3.157	0.150
2012		1.238	0.565
2013		2.113	0.138
2014		1.184	0.068
2015		3.014	0.149
2016		1.363	0.042
2017		0.664	0.197
2018		0.770	0.252
2019		3.830	0.106

10.4 - Subarea C: Between 62°N and 65°N

Table A.4.1. Abundance index (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.147	0.748	1.075	0.435	0.364	0.050	0.097	0.029	0.021							
1996	0.008	0.118	0.333	0.816	0.966	0.761	0.249	0.113	0.015	0.014							
1997		0.223	0.621	1.083	0.556	0.376	0.242	0.167	0.059								
1998	0.015	0.089	2.701	1.303	0.520	0.115	0.206	0.198									
1999		0.031	0.145	0.259	0.235	0.094	0.062	0.019									
2000			0.053	0.085	0.182	0.117	0.036										
2001		0.102	0.350	0.462	0.379	0.288	0.137	0.052	0.030	0.005	0.002		0.006				
2002	0.039	0.604	0.930	0.969	1.552	1.570	2.387	0.604	0.167	0.010							
2003		0.040	0.063	0.314	0.146	0.096	0.044	0.027	0.031	0.010	0.000	0.004					
2004	0.226	0.040	0.209	0.270	0.391	0.234	0.075	0.051	0.014	0.015	0.010						
2005		0.417	0.143	0.356	0.618	0.293	0.302	0.076	0.007		0.004						
2006	0.517	0.009	0.080	0.095	0.264	0.296	0.080	0.029	0.043	0.017	0.017						
2007	0.075	0.103	0.190	0.125	0.140	0.122	0.179	0.080	0.032	0.005	0.005	0.017					
2008	0.350	0.129	0.124	0.053	0.054	0.011	0.007	0.025	0.010			0.005					
2009		0.063	0.230	0.386	0.233	0.080	0.016	0.036	0.028	0.006	0.006	0.020					
2010	0.123	0.399	0.181	0.222	0.154	0.162	0.026	0.009	0.044	0.025	0.015		0.004				
2011	0.000	0.094	0.102	0.131	0.120	0.134	0.164	0.036	0.008	0.008	0.032	0.000	0.002	0.000			
2012		0.130	0.441	0.385	0.189	0.182	0.155	0.083	0.021	0.007	0.013	0.020	0.006	0.012			0.004
2013	0.023	0.172	0.396	0.249	0.150	0.095	0.108	0.052	0.065	0.021	0.013	0.013	0.016				
2014	0.119	0.427	0.203	0.180	0.174	0.250	0.151	0.101	0.106	0.161	0.019		0.018	0.007			
2015		0.027	0.099	0.125	0.487	0.095	0.179	0.064	0.082	0.087	0.059	0.007	0.014		0.006		
2016	0.053	0.433	0.219	0.428	0.927	0.744	0.137	0.118	0.188	0.023	0.071	0.047	0.028				
2017		0.095	0.202	0.082	0.175	0.145	0.110	0.082	0.042	0.008	0.013	0.010	0.005	0.003			
2018		0.283	0.084	0.091	0.177	0.332	0.272	0.064	0.059	0.081	0.014	0.007	0.003	0.007			
2019	0.017	0.039	0.166	0.136	0.083	0.372	0.489	0.393	0.067	0.055	0.013	0.012	0.004				

Table A.4.2. CV on abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.139	0.050	0.040	0.094	0.103	0.510	0.112	0.455	0.105							
1996	0.253	0.313	0.202	0.129	0.116	0.160	0.440	0.349									
1997		0.342	0.143	0.052	0.122	0.151	0.287	0.258	0.502								
1998	0.394	0.073															
1999		0.289	0.080	0.052	0.057	0.122	0.154	0.294									
2000																	
2001		0.737	0.345	0.200	0.116	0.222	0.244	0.418	0.494	0.903			0.727				
2002	0.937	0.083	0.172	0.009	0.053	0.109	0.069	0.185	0.315								
2003		0.675	0.325	0.108	0.205	0.188	0.222	0.273	0.370	0.452		0.200					
2004	0.149	0.221	0.152	0.200	0.086	0.197	0.147	0.172	0.453	0.550	0.319						
2005			0.019	0.020	0.010	0.034	0.011	0.047	0.334		0.488						
2006		0.578	0.035		0.029	0.015	0.049	0.077									
2007	0.644	0.311	0.334	0.173	0.088	0.112	0.188	0.123	0.315			0.487					
2008	0.668	0.600	0.267	0.373	0.247	0.124	0.734	0.318	0.896			0.108					
2009		0.698	0.415	0.090	0.253	0.068	0.252	0.292	0.169	0.671							
2010	0.137	0.448	0.317	0.187	0.099	0.115	0.297	0.319	0.081	0.577	0.368		0.427				
2011	0.669	0.833	0.603	0.270	0.148	0.069	0.064	0.527	0.142	0.012	0.487	0.427	0.004				
2012		0.358	0.658	0.443	0.139	0.143	0.133	0.275	0.364	0.515	0.357	0.599	0.286	0.349			0.315
2013	0.542	0.524	0.296	0.192	0.150	0.182	0.240	0.388	0.172	0.528	0.624	0.651	0.590				
2014	0.647	0.150	0.348	0.151	0.046	0.076	0.096	0.270	0.089	0.239	0.366		0.147	0.866			
2015		0.662	0.105	0.159	0.047	0.066	0.096	0.110	0.140	0.160	0.722	0.754	0.502		0.930		
2016	0.906	0.684	0.451	0.049	0.021	0.074	0.238	0.232	0.068	0.455	0.143	0.195	1.181				
2017		0.371	0.352	0.387	0.065	0.257	0.170	0.273	0.294	0.583	0.736	0.668	1.067	0.612			
2018		0.628	0.462	0.348	0.097	0.102	0.221	0.473	0.406	0.146	0.375	0.307	0.707	0.558			
2019	0.453	0.532	0.426	0.161	0.185	0.052	0.035	0.039	0.130	0.134	0.516	0.490	0.573				

Table A.4.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		0.025	0.414	0.910	0.647	0.940	0.133	0.428	0.189	0.063							
1996	0.000	0.006	0.110	0.982	1.667	1.735	0.652	0.447	0.045	0.074							
1997		0.012	0.168	1.030	0.961	0.883	0.790	0.658	0.403								
1998	0.000	0.015	1.406	1.404	0.889	0.302	0.809	0.890									
1999		0.004	0.075	0.415	0.743	0.455	0.247	0.134									
2000			0.020	0.096	0.328	0.270	0.125										
2001		0.009	0.167	0.455	0.595	0.593	0.305	0.158	0.250	0.036	0.004		0.077				
2002	0.000	0.094	0.602	1.357	5.275	7.009	12.038	4.644	0.964	0.083							
2003		0.002	0.011	0.136	0.141	0.170	0.110	0.070	0.143	0.036	0.003	0.009					
2004	0.002	0.002	0.055	0.203	0.697	0.556	0.301	0.266	0.031	0.091	0.036						
2005		0.059	0.081	0.693	2.536	1.236	1.372	0.680	0.011		0.045						
2006	0.004	0.001	0.053	0.177	0.609	0.964	0.274	0.178	0.339	0.084	0.109						
2007	0.001	0.025	0.157	0.231	0.441	0.429	0.619	0.500	0.295	0.055	0.063	0.028					
2008	0.003	0.012	0.097	0.115	0.201	0.042	0.024	0.152	0.074			0.039					
2009		0.004	0.105	0.497	0.420	0.215	0.072	0.155	0.136	0.016	0.016	0.054					
2010	0.001	0.028	0.046	0.285	0.346	0.461	0.103	0.030	0.490	0.122	0.076		0.009				
2011	0.000	0.007	0.028	0.188	0.339	0.517	1.286	0.233	0.021	0.095	0.145	0.000	0.019	0.000			
2012		0.012	0.145	0.401	0.481	0.727	0.579	0.330	0.085	0.028	0.056	0.101	0.023	0.053			0.018
2013	0.000	0.014	0.085	0.128	0.132	0.229	0.415	0.182	0.459	0.089	0.034	0.045	0.063				
2014	0.001	0.031	0.102	0.278	0.446	0.762	0.741	0.517	0.430	0.883	0.109		0.065	0.022			
2015		0.002	0.146	0.092	1.151	0.249	0.624	0.418	0.334	0.343	0.224	0.030	0.064		0.044		
2016	0.000	0.037	0.067	0.931	2.830	2.838	0.452	0.435	1.413	0.212	0.269	0.381	0.153				
2017		0.008	0.121	0.114	0.441	0.507	0.391	0.253	0.255	0.038	0.057	0.041	0.022	0.033			
2018		0.016	0.025	0.095	0.417	1.282	1.033	0.293	0.360	0.344	0.071	0.024	0.023	0.044			
2019	0.000	0.002	0.032	0.309	0.281	1.281	2.282	1.752	0.294	0.495	0.058	0.081	0.017				

Table A.4.4. Length by age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		26.44	38.14	44.42	53.51	63.65	64.79	78.31	88.80	65.00							
1996	8.00	16.98	30.91	48.14	55.40	60.93	64.48	76.20	65.00	87.00							
1997		16.88	29.03	45.38	55.34	63.09	67.60	75.88	90.63								
1998	10.78	25.15	36.44	46.50	55.90	62.52	71.00	77.88									
1999		23.52	36.75	52.54	66.26	75.73	73.44	86.23									
2000			33.79	49.42	56.33	60.59	67.12										
2001		21.79	35.36	44.63	52.72	57.48	59.25	64.73	90.77	90.74	69.00		117.00				
2002	10.00	25.10	39.62	52.40	68.57	73.74	77.28	88.77	85.79	89.00							
2003		17.33	27.22	35.36	45.55	54.61	63.06	61.49	75.71	71.34	88.00	61.00					
2004	9.32	16.24	28.74	41.36	54.44	58.34	70.28	76.33	63.77	86.41	71.98						
2005		24.63	38.12	57.05	71.76	74.33	73.31	93.97	57.50		108.00						
2006	9.95	21.95	41.03	53.92	60.02	66.84	69.41	73.52	87.55	82.00	86.00						
2007	9.93	27.66	40.74	54.78	64.91	67.79	67.72	79.55	100.83	102.00	110.00	57.00					
2008	9.81	22.77	42.89	60.65	70.68	71.54	71.69	82.27	100.17			99.00					
2009		20.02	34.66	49.51	55.07	65.42	78.03	75.82	75.34	62.62	66.00	65.00					
2010	8.22	19.68	28.95	47.44	58.93	64.68	71.07	67.04	90.95	80.29	79.43		60.00				
2011	9.10	20.22	33.14	53.10	64.73	73.65	84.34	87.10	64.73	103.35	73.70	67.26	82.97	74.00			
2012		21.75	32.49	47.42	63.89	71.33	73.02	74.45	73.56	71.30	74.42	78.35	73.00	75.00			79.00
2013	11.72	20.98	29.72	38.97	46.18	64.47	72.53	72.98	85.58	76.13	64.02	69.00	74.35				
2014	10.85	21.04	34.54	51.93	63.01	66.43	77.67	79.32	74.99	80.31	86.93		72.95	75.00			
2015		19.21	51.42	43.36	60.06	65.64	69.97	82.20	73.27	75.01	74.72	77.00	76.20		95.00		
2016	10.00	21.48	32.60	59.10	66.87	74.80	68.93	70.59	88.76	94.69	73.90	95.69	82.33				
2017		21.81	38.61	50.38	63.75	68.40	71.31	67.88	85.44	81.72	77.96	76.14	81.37	99.00			
2018		19.22	32.07	47.58	61.90	72.75	71.60	78.40	83.80	74.26	79.02	75.90	93.65	81.74			
2019	14.17	19.07	28.08	55.60	66.71	69.89	76.19	74.94	74.76	91.90	77.99	92.20	76.83				

Table A.4.5. Weight by age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1995		171	555	846	1489	2590	2748	4417	6905	2996							
1996	5	59	330	1212	1730	2284	2632	3977	2970	5220							
1997		58	275	952	1730	2359	3239	3982	7487								
1998	10	167	520	1078	1710	2620	3931	4494									
1999		120	517	1605	3163	4878	3958	7302									
2000			376	1134	1799	2305	3429										
2001		96	499	1005	1580	2089	2210	3051	9206	7802	2808		12000				
2002	8	156	658	1401	3400	4481	5053	7831	5977	8640							
2003		41	166	436	977	1800	2509	2644	4551	4036	7366	2030					
2004	9	45	265	772	1791	2443	4062	5359	2477	7008	3745						
2005		142	562	1946	4103	4216	4542	8977	1676		12140						
2006	8	81	660	1854	2309	3260	3408	6066	7957	5035	6530						
2007	7	267	921	1892	3165	3555	3539	6328	9361	11610	13370	1648					
2008	8	105	822	2259	3862	3886	3739	6215	10013			7675					
2009		69	510	1294	1875	2695	4485	4363	4879	2713	2656	2730					
2010	4	73	255	1317	2258	2862	4169	3162	11197	5199	5031		2285				
2011	7	66	386	1511	2859	3864	7854	7474	2569	11848	4739	2910	7858	3888			
2012		93	341	1193	2572	4047	3773	4087	4039	3717	4267	4862	3745	4325			4630
2013	12	78	217	515	889	2398	3969	3546	7124	4334	2499	3425	4214				
2014	15	73	541	1565	2571	3057	4905	5291	4053	5677	6020		3632	3340			
2015		52	1490	747	2367	2638	3492	6539	4080	3934	3530	4310	4412		7785		
2016	9	87	316	2178	3054	3821	3291	3599	7527	8880	3771	8236	5345				
2017		88	652	1501	2514	3569	3585	3089	6208	4598	4275	4325	4387	10610			
2018		56	302	1100	2361	3864	3816	5006	6354	4221	4989	3478	7866	6455			
2019	23	61	190	2317	3433	3443	4671	4456	4388	9163	4210	7453	4298				

Table A.4.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
1995		2.791	0.052
1996		3.241	0.168
1997		3.103	0.141
1998		5.044	
1999		0.815	0.020
2000		0.474	
2001		1.707	0.312
2002		8.183	0.353
2003		0.735	0.038
2004		1.262	0.040
2005		1.796	0.013
2006		0.921	0.018
2007		0.877	0.067
2008		0.282	0.060
2009		1.034	0.195
2010		0.841	0.108
2011		0.739	0.139
2012		1.510	0.566
2013		1.169	0.138
2014		1.361	0.076
2015		1.300	0.129
2016		2.922	0.042
2017		0.876	0.197
2018		1.187	0.250
2019		1.788	0.082

11 - Appendix B Swept area abundance indices

11.1 - Total area

Table B.1.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	6.253	5.298	3.531	4.329	5.087	3.391	2.719	0.999	0.577	0.271	0.043	0.002		0.025			0.015
2004	5.077	2.987	2.495	2.885	3.852	2.109	1.079	0.560	0.238	0.054	0.072	0.007			0.008		
2005	0.033	0.906	1.319	2.469	1.892	1.508	0.949	0.293	0.137	0.088	0.017	0.040					
2006	6.846	1.914	2.500	3.237	3.351	2.146	1.328	1.108	0.277	0.146		0.012	0.023				
2007	6.561	0.746	1.935	1.730	1.710	1.233	0.636	0.534	0.137	0.082	0.007	0.035		0.003			
2008	18.407	3.291	2.689	3.568	2.550	1.912	1.271	0.758	0.436	0.200	0.068	0.030	0.033	0.007	0.007		
2009	3.670	6.757	2.715	4.221	4.487	2.045	1.147	0.803	0.615	0.256	0.081	0.092	0.006		0.003	0.006	
2010	0.957	7.954	2.777	3.931	4.038	3.054	1.019	0.518	0.735	0.378	0.167	0.138	0.018	0.018	0.006	0.015	
2011	0.480	3.763	4.715	3.812	4.001	2.977	1.828	0.374	0.435	0.256	0.118	0.056	0.149	0.009			
2012	0.403	5.463	3.970	5.075	3.391	2.092	1.341	1.001	0.504	0.225	0.210	0.046	0.030	0.045	0.020		0.003
2013	0.985	7.727	4.770	2.383	3.144	2.867	2.217	1.493	0.685	0.297	0.121	0.184	0.107	0.005	0.007	0.004	0.007
2014	20.339	7.671	5.936	5.326	3.630	4.146	2.149	1.530	0.532	0.384	0.059	0.161	0.084	0.006	0.012	0.016	0.005
2015	0.383	6.573	6.861	5.286	4.975	2.616	2.173	0.986	0.543	0.481	0.122	0.053	0.041	0.003	0.006		0.003
2016	3.288	4.156	5.075	5.112	3.051	2.384	0.908	0.876	0.494	0.259	0.093	0.093	0.018	0.014	0.022		0.010
2017	6.503	0.849	3.209	2.733	1.805	1.395	0.882	0.395	0.254	0.171	0.043	0.090	0.018	0.006			
2018	0.157	4.355	3.451	2.099	2.116	1.371	0.945	0.355	0.207	0.159	0.089	0.045	0.022	0.005		0.004	0.005
2019	0.439	2.571	2.269	2.949	1.956	1.964	1.144	0.818	0.224	0.215	0.101	0.083	0.040	0.022	0.004	0.003	0.010

Table B.1.2. CV abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.286	0.229	0.219	0.147	0.133	0.107	0.104	0.220	0.282	0.232	0.674	1.337		0.409			0.421
2004	0.240	0.257	0.128	0.154	0.169	0.192	0.227	0.211	0.349	0.384	0.397	0.859			0.701		
2005	0.579	0.243	0.226	0.248	0.208	0.158	0.216	0.206	0.281	0.377	0.521	0.663					
2006	0.216	0.185	0.285	0.200	0.224	0.153	0.116	0.198	0.247	0.306		0.421	0.258				
2007	0.275	0.233	0.400	0.353	0.232	0.201	0.169	0.216	0.269	0.411	0.421	0.527		0.429			
2008	0.245	0.163	0.234	0.161	0.126	0.097	0.161	0.138	0.186	0.338	0.282	0.416	0.423	0.456	0.380		
2009	0.621	0.157	0.137	0.176	0.126	0.123	0.150	0.136	0.214	0.234	0.334	0.340	1.015		0.962	0.420	
2010	0.537	0.087	0.163	0.151	0.183	0.140	0.164	0.225	0.271	0.247	0.181	0.374	0.548	0.515	0.439	0.418	
2011	0.476	0.342	0.221	0.268	0.178	0.193	0.176	0.236	0.194	0.265	0.344	0.610	0.364	0.570			
2012	0.611	0.128	0.297	0.211	0.138	0.181	0.164	0.165	0.223	0.220	0.197	0.258	0.373	0.520	0.463		0.273
2013	0.465	0.123	0.145	0.177	0.218	0.205	0.225	0.282	0.177	0.307	0.353	0.477	0.405	0.507	0.482	0.429	0.353
2014	0.326	0.164	0.291	0.188	0.152	0.150	0.243	0.139	0.156	0.207	0.389	0.392	0.349	0.691	0.357	0.458	0.393
2015	0.620	0.154	0.127	0.192	0.244	0.265	0.200	0.286	0.185	0.182	0.236	0.400	0.274	0.476	0.414		0.746
2016	0.495	0.198	0.122	0.122	0.095	0.087	0.131	0.153	0.201	0.205	0.287	0.315	0.335	0.628	0.441		0.643
2017	0.465	0.271	0.183	0.152	0.139	0.087	0.159	0.178	0.261	0.270	0.273	0.391	0.530	0.625			
2018	0.718	0.144	0.187	0.145	0.138	0.121	0.121	0.149	0.254	0.236	0.186	0.303	0.420	0.520		0.493	0.187
2019	0.381	0.127	0.157	0.143	0.123	0.149	0.142	0.194	0.286	0.274	0.361	0.297	0.511	0.496	0.512	0.476	0.384

Table B.1.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.059	0.444	1.422	3.546	6.782	7.575	9.209	4.858	3.188	1.839	0.465	0.005		0.429			0.382
2004	0.035	0.300	0.976	2.731	7.157	4.948	3.832	2.296	1.214	0.248	0.609	0.044			0.058		
2005	0.000	0.105	0.554	2.360	3.563	3.724	2.409	1.335	0.540	0.524	0.137	0.632					
2006	0.047	0.197	1.352	3.706	6.120	5.268	4.683	4.184	1.369	0.960		0.299	0.097				
2007	0.046	0.095	1.237	2.218	3.615	3.344	2.253	2.656	1.094	0.856	0.115	0.115		0.057			
2008	0.129	0.325	1.560	4.785	5.534	6.240	4.478	3.679	2.084	0.891	0.308	0.147	0.127	0.061	0.056		
2009	0.026	0.497	1.027	4.394	8.242	5.397	4.156	3.320	2.575	1.197	0.402	0.511	0.020		0.008	0.056	
2010	0.007	0.484	1.157	4.367	7.776	8.335	3.848	2.243	3.385	2.313	1.000	1.206	0.149	0.036	0.076	0.103	
2011	0.005	0.246	1.723	4.247	8.519	8.424	7.248	2.316	2.197	1.935	0.683	0.197	1.123	0.043			
2012	0.003	0.425	1.349	5.044	6.842	6.441	4.708	4.271	2.868	1.501	1.468	0.197	0.185	0.264	0.142		0.012
2013	0.011	0.638	1.868	2.284	6.150	8.462	9.972	6.377	4.333	1.699	0.700	1.331	1.302	0.028	0.057	0.058	0.112
2014	0.179	0.614	2.634	6.209	6.622	11.656	7.820	6.943	3.019	2.252	0.406	1.182	0.641	0.036	0.097	0.120	0.042
2015	0.002	0.517	3.110	6.432	10.737	7.299	7.537	4.454	3.416	2.772	0.841	0.545	0.180	0.033	0.067		0.030
2016	0.022	0.280	1.891	5.894	6.053	7.885	3.441	3.994	3.241	1.915	0.566	0.888	0.095	0.057	0.204		0.081
2017	0.032	0.074	1.561	2.963	3.482	4.457	3.505	1.721	1.842	1.152	0.250	0.976	0.098	0.094			
2018	0.001	0.249	1.779	2.333	4.184	4.289	3.516	2.017	1.285	1.218	0.623	0.212	0.098	0.040		0.083	0.038
2019	0.004	0.170	0.836	3.480	4.190	6.171	4.676	3.822	1.039	1.523	0.680	0.712	0.358	0.170	0.041	0.041	0.067

Table B.1.4. Length at age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	9.69	19.86	34.62	44.13	51.43	60.37	69.24	77.02	77.79	83.29	95.32	61.06		118.78			143.00
2004	8.97	21.32	33.97	44.88	56.38	60.30	69.51	72.16	76.45	74.73	85.78	87.83			88.94		
2005	10.97	22.58	34.77	45.23	56.19	61.91	62.55	73.38	73.35	79.01	90.27	107.44					
2006	9.38	21.82	37.77	48.09	56.62	61.73	69.12	69.81	75.40	85.66		125.00	76.00				
2007	9.20	22.55	39.17	49.46	58.43	63.90	69.13	75.48	89.59	95.22	116.00	65.07		123.00			
2008	9.16	21.76	38.19	51.09	59.41	68.28	69.74	75.52	74.14	72.32	74.63	75.35	72.40	100.00	89.00		
2009	8.66	19.63	33.16	46.77	56.59	64.32	70.88	73.50	72.55	75.67	76.48	77.81	68.97		72.98	94.96	
2010	9.59	18.17	34.72	47.50	56.93	63.86	71.93	73.91	74.50	82.06	82.01	88.38	87.68	61.46	104.00	85.23	
2011	10.24	19.25	33.54	48.18	59.34	65.19	71.74	82.77	77.55	85.42	80.34	73.91	88.09	75.38			
2012	9.39	20.46	32.48	46.80	59.04	66.77	70.76	74.60	80.30	84.34	85.31	76.60	82.78	85.38	90.46		79.00
2013	10.94	20.52	34.29	46.17	58.60	67.36	75.98	75.66	83.17	83.43	80.71	86.66	102.07	74.29	88.25	113.00	125.00
2014	10.05	20.36	35.64	49.14	56.94	65.78	71.85	77.13	81.66	81.48	84.80	87.93	85.79	83.56	85.01	86.50	93.40
2015	8.42	20.25	35.43	49.97	60.45	66.47	70.53	76.83	83.94	79.66	85.60	89.93	72.35	95.00	98.40		101.56
2016	9.30	19.09	33.58	48.49	58.81	69.78	73.30	76.15	85.26	88.16	83.07	90.66	81.80	78.15	97.36		96.42
2017	8.05	21.43	36.63	47.83	58.27	68.42	73.93	76.04	87.70	84.72	82.68	98.12	84.10	110.37			
2018	10.11	17.66	37.16	48.17	58.95	68.27	71.52	82.27	85.86	89.11	88.21	78.40	77.58	86.91		120.15	93.00
2019	9.97	19.70	33.51	49.13	59.79	68.59	74.86	77.86	78.44	85.97	86.19	93.47	92.04	92.37	96.34	109.00	96.04

Table B.1.5. Weight at age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	9	80	400	819	1332	2233	3379	4761	5346	6805	9921	2033		17080			25600
2004	7	98	391	945	1852	2350	3563	4100	5035	4538	7973	7865			7130		
2005	14	115	417	955	1884	2462	2553	4462	3959	5552	8077	14845					
2006	7	103	537	1140	1819	2457	3528	3824	4901	6596		25080	4220				
2007	7	125	659	1321	2135	2714	3540	4935	7953	10119	17480	3485		21100			
2008	7	99	575	1339	2167	3265	3524	4849	4770	4493	4541	5040	4114	9250	8520		
2009	9	74	379	1040	1838	2638	3629	4138	4190	4700	5112	5553	3082		3122	9681	
2010	7	61	418	1111	1924	2730	3772	4343	4720	6084	5958	8337	7793	2120	12154	6475	
2011	10	64	366	1123	2139	2853	3957	6170	5047	7495	5668	4111	7567	4653			
2012	7	78	335	995	2013	3064	3499	4275	5585	6622	6957	4411	6173	6953	7006		4630
2013	12	83	389	960	1962	2954	4424	4270	6290	5632	5543	7587	12149	5104	7738	16220	16300
2014	9	80	442	1168	1825	2813	3629	4533	5684	5840	6604	7543	7420	5313	7920	8237	8263
2015	4	78	453	1212	2149	2818	3480	4558	6243	5795	6695	9301	4334	10170	10132		11296
2016	7	68	371	1152	1982	3309	3793	4555	6535	7434	6152	9403	5218	4791	9660		8325
2017	5	88	486	1086	1932	3193	3975	4369	7099	6769	5913	10482	5300	13790			
2018	6	57	512	1109	1975	3125	3719	5692	6216	7726	6947	4781	4564	8512		18477	7350
2019	9	66	368	1181	2139	3130	4085	4660	4640	7008	6731	8592	8869	7996	9585	12345	7040

Table B.1.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
2003		20.974	0.115
2004		13.357	0.126
2005		8.710	0.180
2006		14.114	0.159
2007		8.027	0.257
2008		13.522	0.117
2009		16.474	0.101
2010		16.805	0.127
2011		18.730	0.166
2012		17.947	0.148
2013		18.286	0.133
2014		23.973	0.170
2015		24.148	0.149
2016		18.404	0.084
2017		11.001	0.121
2018		10.871	0.111
2019		11.798	0.091

11.2 - Subarea A: North of 67°N

Table B.2.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	6.238	5.254	3.268	3.763	4.521	2.700	2.319	0.863	0.489	0.220	0.042	0.002		0.025			0.015
2004	4.997	2.837	2.201	2.396	2.602	1.463	0.722	0.359	0.181	0.046	0.050	0.007			0.008		
2005	0.029	0.665	1.042	1.988	1.478	1.268	0.746	0.157	0.107	0.068	0.017	0.040					
2006	5.896	1.802	2.156	2.623	2.946	1.554	1.026	0.941	0.171	0.107		0.012	0.023				
2007	6.561	0.446	0.911	0.853	1.071	0.789	0.465	0.394	0.114	0.075	0.007	0.033		0.003			
2008	15.128	2.463	1.822	2.795	1.883	1.419	1.145	0.580	0.348	0.161	0.052	0.011	0.023	0.007	0.007		
2009	3.454	6.642	2.251	3.570	3.716	1.584	0.868	0.712	0.466	0.204	0.076	0.072	0.006		0.002	0.006	
2010	0.428	7.412	2.353	3.268	3.385	2.397	0.784	0.383	0.733	0.317	0.151	0.137	0.018	0.003	0.006	0.015	
2011	0.309	2.322	3.471	2.498	2.866	2.095	1.445	0.292	0.315	0.213	0.116	0.055	0.130	0.009			
2012	0.391	4.299	3.218	4.485	2.784	1.537	1.042	0.930	0.411	0.200	0.209	0.046	0.030	0.045	0.020		0.003
2013	0.509	6.382	4.101	1.706	2.666	1.887	1.575	0.890	0.578	0.297	0.110	0.184	0.107	0.005	0.007	0.004	0.007
2014	9.259	5.696	5.448	4.026	3.034	3.521	2.016	1.388	0.465	0.364	0.059	0.159	0.083	0.006	0.012	0.016	0.005
2015	0.381	4.298	4.733	4.154	3.727	2.068	1.818	0.902	0.506	0.397	0.119	0.053	0.040	0.003	0.006		0.003
2016	3.233	3.944	4.433	4.522	2.610	1.995	0.746	0.735	0.413	0.203	0.067	0.093	0.018	0.006	0.022		0.010
2017	6.503	0.768	2.891	2.407	1.563	1.151	0.715	0.308	0.200	0.147	0.043	0.090	0.018	0.006			
2018	0.145	4.070	3.197	1.916	1.879	1.049	0.748	0.323	0.183	0.128	0.089	0.045	0.022	0.005		0.004	0.005
2019	0.154	2.234	2.114	2.470	1.508	1.460	0.839	0.490	0.148	0.129	0.075	0.069	0.035	0.021	0.004	0.003	0.010

Table B.2.2. CV abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.287	0.231	0.230	0.159	0.140	0.120	0.116	0.244	0.319	0.245	0.680	0.531		0.409			0.421
2004	0.240	0.274	0.158	0.158	0.161	0.209	0.205	0.234	0.344	0.399	0.374	0.859			0.701		
2005	0.500	0.208	0.282	0.295	0.220	0.160	0.248	0.241	0.254	0.452	0.521	0.663					
2006	0.248	0.199	0.336	0.242	0.257	0.174	0.129	0.244	0.299	0.339		0.421	0.258				
2007	0.275	0.226	0.276	0.295	0.180	0.170	0.153	0.238	0.306	0.443	0.421	0.477		0.429			
2008	0.192	0.150	0.263	0.214	0.126	0.109	0.169	0.152	0.202	0.365	0.356	0.336	0.468	0.456	0.380		
2009	0.658	0.160	0.160	0.182	0.144	0.135	0.179	0.147	0.207	0.244	0.273	0.407	0.353		0.404	0.420	
2010	0.463	0.087	0.157	0.192	0.212	0.163	0.180	0.258	0.271	0.213	0.161	0.373	0.518	0.485	0.439	0.418	
2011	0.400	0.203	0.242	0.267	0.186	0.230	0.173	0.246	0.230	0.232	0.353	0.597	0.366	0.570			
2012	0.622	0.091	0.374	0.237	0.132	0.116	0.127	0.160	0.174	0.230	0.196	0.258	0.373	0.520	0.463		0.273
2013	0.611	0.137	0.170	0.148	0.231	0.199	0.213	0.164	0.172	0.307	0.385	0.477	0.405	0.507	0.482	0.429	0.353
2014	0.411	0.166	0.303	0.166	0.165	0.172	0.262	0.141	0.154	0.221	0.389	0.394	0.348	0.691	0.357	0.448	0.393
2015	0.624	0.188	0.174	0.184	0.271	0.294	0.220	0.300	0.190	0.188	0.230	0.402	0.174	0.476	0.414		0.746
2016	0.499	0.197	0.126	0.134	0.104	0.093	0.130	0.158	0.237	0.202	0.196	0.315	0.335	0.440	0.441		0.643
2017	0.465	0.297	0.195	0.169	0.155	0.092	0.174	0.184	0.385	0.297	0.273	0.391	0.530	0.625			
2018	0.734	0.146	0.186	0.156	0.151	0.125	0.109	0.153	0.269	0.189	0.185	0.303	0.420	0.516		0.493	0.187
2019	0.555	0.149	0.155	0.161	0.128	0.102	0.094	0.122	0.173	0.247	0.304	0.220	0.416	0.420	0.512	0.476	0.384

Table B.2.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.059	0.441	1.309	2.981	5.981	5.664	7.962	4.249	2.840	1.442	0.458	0.003		0.429			0.382
2004	0.035	0.287	0.834	2.192	4.133	3.134	2.433	1.425	1.066	0.177	0.214	0.044			0.058		
2005	0.000	0.067	0.455	1.676	2.424	2.851	1.689	0.577	0.441	0.467	0.137	0.632					
2006	0.039	0.181	1.157	3.060	5.387	3.748	3.916	3.379	0.683	0.752		0.299	0.097				
2007	0.046	0.042	0.583	1.135	2.270	2.186	1.667	2.111	0.942	0.812	0.115	0.112		0.057			
2008	0.105	0.243	0.865	3.573	3.734	4.699	3.993	2.929	1.845	0.743	0.246	0.043	0.104	0.061	0.056		
2009	0.023	0.482	0.744	3.412	6.385	4.067	3.210	2.919	2.026	0.854	0.387	0.428	0.017		0.007	0.056	
2010	0.004	0.423	0.937	3.410	6.240	6.423	3.067	1.606	3.382	1.945	0.926	1.204	0.149	0.009	0.076	0.103	
2011	0.003	0.133	1.312	2.732	6.143	5.850	5.185	1.517	1.607	1.519	0.679	0.194	0.933	0.043			
2012	0.003	0.309	1.105	4.272	5.579	4.475	3.593	3.946	1.939	1.145	1.466	0.197	0.185	0.264	0.142		0.012
2013	0.006	0.534	1.662	1.713	5.321	5.893	5.866	3.591	3.093	1.699	0.673	1.331	1.302	0.028	0.057	0.058	0.112
2014	0.074	0.454	2.257	4.761	5.729	9.852	7.328	6.114	2.715	2.126	0.406	1.179	0.639	0.036	0.097	0.120	0.042
2015	0.002	0.337	2.282	5.151	8.598	5.904	6.803	4.167	3.300	2.186	0.831	0.544	0.176	0.033	0.067		0.030
2016	0.021	0.263	1.669	5.006	5.353	6.663	3.002	3.617	2.682	1.347	0.476	0.888	0.095	0.029	0.204		0.081
2017	0.032	0.067	1.339	2.470	2.994	3.707	2.883	1.438	1.415	0.961	0.250	0.976	0.098	0.094			
2018	0.001	0.242	1.694	2.127	3.711	3.143	2.776	1.840	1.115	1.096	0.623	0.211	0.098	0.040		0.083	0.038
2019	0.001	0.143	0.790	2.681	2.890	4.449	3.301	2.317	0.724	0.883	0.553	0.641	0.338	0.164	0.041	0.041	0.067

Table B.2.4. Length at age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	9.69	19.86	34.52	43.95	51.38	59.50	69.59	77.30	78.67	82.01	95.43	61.05		118.78			143.00
2004	8.98	21.36	33.66	44.33	54.01	59.14	68.71	71.61	79.70	71.48	73.81	87.83			88.94		
2005	10.96	21.73	35.51	44.17	54.42	60.43	60.45	71.41	74.38	83.28	90.27	107.44					
2006	9.29	21.60	37.56	48.50	56.86	61.62	70.83	69.49	71.54	87.71		125.00	76.00				
2007	9.20	20.57	38.99	50.03	58.86	63.84	69.77	76.79	89.42	95.97	116.00	65.20		123.00			
2008	9.21	21.88	36.48	50.50	58.37	68.79	69.74	76.98	76.30	74.10	75.26	71.91	74.37	100.00	89.00		
2009	8.31	19.55	32.28	45.69	55.67	64.07	71.00	73.52	72.96	73.82	76.91	79.39	69.00		73.00	94.96	
2010	10.54	17.93	34.24	46.78	56.25	63.65	73.25	73.24	74.52	81.68	81.95	88.49	87.77	60.09	104.00	85.23	
2011	10.39	18.66	34.05	48.06	59.55	65.11	70.59	78.70	79.45	83.87	80.60	74.00	86.43	75.38			
2012	9.35	19.99	32.61	46.25	58.88	65.58	70.11	74.24	76.02	81.24	85.38	76.60	82.78	85.38	90.46		79.00
2013	10.64	20.68	34.70	46.99	59.21	68.33	73.12	74.04	80.24	83.43	82.22	86.66	102.07	74.29	88.25	113.00	125.00
2014	9.28	20.37	34.99	49.60	57.77	65.93	71.85	76.62	82.41	81.31	84.80	88.16	85.85	83.56	85.01	86.51	93.40
2015	8.41	20.00	36.42	50.33	62.01	67.46	72.79	77.52	85.01	79.01	85.87	90.02	72.48	95.00	98.40		101.56
2016	9.26	19.08	33.66	48.12	59.56	70.51	74.95	78.42	85.00	85.34	86.21	90.66	81.80	81.11	97.36		96.42
2017	8.05	21.43	36.14	47.20	58.11	68.93	74.45	78.57	86.22	83.86	82.68	98.12	84.10	110.37			
2018	10.09	18.05	37.50	48.27	59.09	67.72	71.64	82.25	85.73	92.34	88.22	78.41	77.58	86.93		120.15	93.00
2019	9.35	19.56	33.76	48.32	58.51	68.48	74.41	78.87	80.57	86.10	89.59	95.89	92.88	92.56	96.34	109.00	96.04

Table B.2.5. Weight at age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	9	80	397	791	1322	2098	3421	4774	5559	6519	9954	2033		17080			25600
2004	7	98	378	913	1588	2154	3373	3942	5693	3751	4183	7865			7130		
2005	14	101	431	843	1649	2249	2277	3662	4139	6331	8077	14845					
2006	7	100	529	1162	1816	2410	3822	3645	4026	7059		25080	4220				
2007	7	94	629	1312	2113	2762	3581	5277	8139	10381	17480	3523		21100			
2008	7	99	470	1272	1985	3314	3489	5036	5253	4742	4719	3796	4960	9250	8520		
2009	8	73	331	953	1719	2567	3703	4102	4347	4217	5204	5874	3084		3122	9681	
2010	9	57	399	1043	1840	2685	3902	4217	4724	6131	6111	8362	7813	2635	12154	6475	
2011	10	57	377	1091	2153	2814	3589	5181	5110	7083	5714	4122	7288	4653			
2012	7	72	336	954	2004	2911	3449	4248	4712	5714	6970	4411	6173	6953	7006		4630
2013	12	84	402	1004	2003	3119	3724	4042	5371	5632	5803	7587	12149	5104	7738	16220	16300
2014	8	80	411	1179	1887	2802	3623	4402	5840	5812	6604	7585	7436	5313	7920	8240	8263
2015	4	78	480	1232	2287	2891	3756	4679	6466	5492	6759	9330	4369	10170	10132		11296
2016	7	67	375	1104	2049	3340	4025	4916	6451	6672	7009	9403	5218	5602	9660		8325
2017	5	88	462	1027	1919	3218	4031	4685	6872	6553	5913	10482	5300	13790			
2018	6	60	526	1106	1974	2996	3712	5699	6147	8461	6949	4782	4564	8517		18477	7350
2019	10	64	373	1085	1918	3053	3936	4721	4906	6788	7312	9241	9115	8042	9585	12345	7040

Table B.2.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
2003		18.212	0.126
2004		10.031	0.122
2005		6.908	0.207
2006		11.547	0.201
2007		4.700	0.176
2008		10.247	0.138
2009		13.530	0.103
2010		13.947	0.144
2011		13.505	0.166
2012		14.952	0.168
2013		14.120	0.128
2014		20.602	0.174
2015		18.528	0.161
2016		15.865	0.083
2017		9.540	0.132
2018		9.591	0.113
2019		9.368	0.094

11.3 – Subarea B: Between 65° and 67°N

Table B.3.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.039	0.054	0.235	0.479	0.344	0.296	0.161	0.073	0.049	0.014		0.002					
2004	0.039	0.094	0.315	0.350	0.567	0.345	0.207	0.098	0.062	0.005	0.031						
2005	0.030	0.054	0.186	0.275	0.153	0.152	0.075	0.073	0.016	0.022	0.002						
2006	0.158	0.119	0.248	0.499	0.275	0.317	0.254	0.159	0.040	0.042							
2007	0.013	0.247	0.912	0.696	0.501	0.309	0.183	0.069	0.003	0.043		0.042					
2008	0.451	0.341	0.517	0.578	0.376	0.369	0.107	0.119	0.087	0.032	0.023	0.017	0.016				
2009	0.234	0.131	0.457	0.440	0.548	0.251	0.202	0.059	0.148	0.053	0.026	0.018	0.024		0.028		
2010	0.047	0.595	0.514	0.484	0.442	0.527	0.225	0.141	0.009	0.024	0.026	0.026	0.003	0.018			
2011	0.206	1.487	1.216	1.124	0.871	0.562	0.223	0.017	0.049	0.038	0.006	0.033	0.028				
2012	0.053	1.248	1.001	0.509	0.396	0.359	0.107	0.055	0.013	0.030	0.010	0.012	0.003	0.007			0.003
2013	0.364	1.070	0.669	0.689	0.462	0.604	0.212	0.079	0.009	0.005	0.013	0.002	0.003				
2014	10.944	1.749	0.341	1.019	0.350	0.242	0.048	0.071	0.049	0.039	0.003		0.010	0.001			
2015	0.040	2.208	1.299	0.968	1.030	0.454	0.286	0.087	0.028	0.076	0.025	0.003	0.007		0.002		
2016	0.080	0.358	0.621	0.258	0.303	0.321	0.187	0.158	0.058	0.052	0.008	0.009		0.013			
2017		0.038	0.289	0.272	0.116	0.166	0.079	0.067	0.061	0.027	0.006	0.004	0.001	0.002			
2018	0.035	0.405	0.226	0.172	0.145	0.118	0.099	0.056	0.036	0.009	0.011	0.006	0.001	0.004			
2019	0.323	0.348	0.239	0.335	0.291	0.229	0.053	0.087	0.024	0.035	0.019	0.012	0.002				

Table B.3.2. CV abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.503	0.533	0.626	0.405	0.460	0.420	0.456	0.528	0.580	0.788		1.332					
2004	0.455	0.642	0.302	0.312	0.308	0.363	0.658	0.571	0.603	1.421	0.516						
2005	0.447	0.544	0.452	0.486	0.407	0.369	0.451	0.450	0.615	0.387	0.421						
2006	0.509	0.460	0.463	0.305	0.405	0.356	0.284	0.355	0.477	0.447							
2007	0.505	0.635	0.850	0.873	0.764	0.706	0.433	0.642	0.436	0.372		0.408					
2008	0.536	0.251	0.458	0.383	0.301	0.262	0.458	0.262	0.351	0.497	0.282	0.322	0.330				
2009	0.597	0.500	0.423	0.515	0.406	0.437	0.489	0.555	0.475	0.544	0.554	0.481	0.498		0.471		
2010	0.457	0.366	0.378	0.347	0.306	0.336	0.358	0.443	0.831	0.576	0.582	0.459	1.240	0.355			
2011	0.730	0.680	0.556	0.831	0.625	0.572	0.523	1.062	0.513	0.622	1.208	0.538	0.476				
2012	0.596	0.475	0.315	0.235	0.395	0.397	0.360	0.397	0.620	0.780	0.749	0.613	0.301	0.392			0.273
2013	0.697	0.531	0.260	0.371	0.403	0.504	0.417	0.485	0.069	0.382	0.596	0.361	0.334				
2014	0.455	0.405	0.307	0.548	0.467	0.445	0.479	0.683	0.493	0.702	0.438		0.525	0.343			
2015	0.525	0.354	0.318	0.521	0.522	0.416	0.426	0.517	0.717	0.701	0.675	1.312	1.217		0.408		
2016	1.219	0.538	0.315	0.434	0.344	0.289	0.387	0.376	0.584	0.579	0.663	0.351		0.462			
2017		0.655	0.293	0.339	0.313	0.304	0.338	0.305	0.511	0.369	0.608	0.198	0.258	0.364			
2018	0.785	0.624	0.467	0.323	0.321	0.297	0.271	0.263	0.362	0.430	0.468	0.541	0.429	0.600			
2019	0.456	0.480	0.358	0.354	0.471	0.382	0.405	0.359	0.459	0.430	0.640	0.549	0.808				

Table B.3.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	0.000	0.004	0.090	0.324	0.371	0.537	0.406	0.212	0.146	0.032		0.004					
2004	0.000	0.009	0.140	0.273	0.995	0.635	0.561	0.294	0.157	0.015	0.578						
2005	0.000	0.004	0.060	0.168	0.197	0.303	0.191	0.217	0.046	0.063	0.020						
2006	0.002	0.016	0.115	0.444	0.349	0.539	0.593	0.690	0.235	0.228							
2007	0.000	0.043	0.441	0.596	0.773	0.702	0.570	0.304	0.018	0.098		0.062					
2008	0.005	0.029	0.267	0.769	0.764	1.071	0.406	0.398	0.238	0.136	0.090	0.065	0.044				
2009	0.004	0.011	0.170	0.533	0.960	0.627	0.563	0.151	0.546	0.349	0.078	0.036	0.073		0.087		
2010	0.001	0.041	0.235	0.479	0.870	1.313	0.628	0.657	0.022	0.069	0.125	0.075	0.007	0.034			
2011	0.002	0.116	0.366	1.045	1.418	1.285	0.589	0.044	0.460	0.088	0.020	0.082	0.281				
2012	0.000	0.123	0.306	0.376	0.619	1.033	0.304	0.183	0.053	0.374	0.039	0.059	0.013	0.030			0.012
2013	0.004	0.057	0.181	0.513	0.672	1.361	0.465	0.215	0.043	0.022	0.034	0.007	0.014				
2014	0.104	0.146	0.187	0.825	0.341	0.532	0.133	0.382	0.228	0.150	0.013		0.036	0.005			
2015	0.001	0.171	0.344	1.006	1.628	1.025	0.628	0.287	0.086	0.570	0.091	0.013	0.029		0.018		
2016	0.001	0.029	0.184	0.169	0.426	0.759	0.499	0.470	0.269	0.526	0.040	0.053		0.043			
2017		0.003	0.130	0.280	0.213	0.393	0.283	0.228	0.453	0.208	0.025	0.017	0.005	0.021			
2018	0.000	0.014	0.073	0.172	0.226	0.287	0.295	0.238	0.173	0.047	0.050	0.019	0.012	0.020			
2019	0.004	0.028	0.063	0.373	0.598	0.565	0.158	0.309	0.074	0.152	0.083	0.068	0.007				

Table B.3.4. Length at age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	10.00	19.86	34.38	40.64	47.42	56.53	63.37	66.45	68.28	64.26		61.05					
2004	9.00	22.14	35.01	43.03	54.24	56.32	61.95	65.45	63.70	72.18	120.83						
2005	10.63	20.97	31.37	39.79	50.01	58.34	62.15	64.65	63.88	64.78	108.00						
2006	11.67	24.94	35.74	44.65	49.84	55.38	61.70	69.45	81.23	80.26							
2007	9.97	25.38	34.29	43.01	52.39	60.32	65.77	74.05	91.00	60.77		58.38					
2008	11.68	21.15	37.10	50.48	57.89	65.43	69.66	65.79	65.10	70.71	72.87	70.87	69.97				
2009	11.49	21.64	32.15	47.96	54.65	61.33	66.52	63.82	70.60	80.70	65.61	59.17	67.40		70.00		
2010	12.00	19.44	35.12	44.92	56.90	61.39	64.88	75.02	61.25	66.95	81.66	60.93	60.01	62.00			
2011	9.83	20.16	30.42	43.37	55.75	61.78	64.03	65.15	87.65	60.71	69.19	62.05	102.00				
2012	10.65	22.32	31.60	42.93	54.93	67.05	67.09	68.26	73.69	93.93	74.17	78.31	73.00	74.94			79.00
2013	11.44	17.74	30.70	42.83	52.60	61.46	62.94	65.93	76.37	76.09	63.67	69.00	74.70				
2014	10.73	20.46	38.23	42.69	46.62	58.93	67.47	77.68	75.01	74.64	81.28		71.69	75.00			
2015	10.88	20.51	29.80	46.53	54.35	60.63	60.50	70.40	71.33	85.50	74.51	76.85	75.82		95.00		
2016	10.35	20.58	31.65	39.51	52.06	60.54	64.65	66.41	77.25	97.35	75.60	83.76		73.00			
2017		22.16	36.00	47.14	56.71	62.37	70.89	69.08	87.12	88.21	76.19	76.05	78.00	99.00			
2018	10.66	15.21	32.88	45.33	53.87	61.84	66.36	73.71	77.41	78.04	78.23	75.19	98.00	80.87			
2019	10.62	20.29	29.52	47.40	58.30	62.36	65.12	71.49	68.09	73.51	73.95	86.65	76.97				

Table B.3.5. Weight at age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003	10	69	383	667	1070	1831	2592	2876	3172	2627		2033					
2004	6	107	440	772	1737	1823	2484	2861	2519	3396	19004						
2005	14	85	329	617	1278	1964	2527	2941	2671	2873	12140						
2006	13	139	457	887	1257	1693	2336	4269	5914	5353							
2007	7	160	422	806	1518	2250	3138	4143	6804	2281		1485					
2008	11	85	526	1322	2058	2916	3785	3412	2749	4571	3955	3716	2737				
2009	14	86	354	1152	1734	2474	2848	2605	3606	6205	3050	2022	3084		3122		
2010	14	69	445	978	1973	2469	2793	4551	2362	2856	4925	2825	2285	1915			
2011	9	75	285	818	1683	2361	2681	2839	9183	2343	3580	2440	10116				
2012	9	100	311	736	1555	2912	2804	3312	4149	9801	4212	4856	3745	4318			4630
2013	12	52	272	760	1460	2193	2240	2739	4584	4326	2554	3425	4262				
2014	10	86	534	739	973	2161	2876	4915	4475	4035	4659		3635	3340			
2015	19	77	263	1000	1554	2278	2241	3392	3418	7843	3516	4276	4335		7785		
2016	9	84	294	661	1411	2376	2678	3003	4680	10566	4579	5951		3425			
2017		92	444	1020	1844	2366	3567	3390	6677	7467	4049	4314	3935	10610			
2018	5	40	327	1010	1585	2468	2987	4217	4882	4988	4720	3535	8695	6416			
2019	11	77	267	1100	2005	2497	2973	3577	3220	4252	4282	6269	4317				

Table B.3.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
2003		1.650	0.655
2004		1.965	0.651
2005		0.949	0.377
2006		1.826	0.508
2007		2.673	2.045
2008		2.215	0.620
2009		2.171	0.888
2010		2.406	0.727
2011		4.092	2.531
2012		2.500	0.574
2013		2.745	0.718
2014		2.170	0.680
2015		4.262	1.573
2016		1.982	0.561
2017		1.088	0.270
2018		0.883	0.233
2019		1.323	0.401

11.4 – Subarea C: Between 62°N and 65°N

Table B.4.1. Abundance indices (millions)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003		0.011	0.058	0.260	0.284	0.429	0.254	0.077	0.055	0.042	0.029	0.002					
2004	0.069	0.065	0.074	0.235	0.781	0.355	0.161	0.110	0.005	0.010	0.018						
2005		0.213	0.107	0.230	0.285	0.122	0.135	0.071	0.024		0.002						
2006	0.881	0.007	0.115	0.130	0.157	0.324	0.073	0.024	0.080								
2007	0.013	0.076	0.148	0.198	0.150	0.155	0.031	0.083	0.025	0.009							
2008	4.158	0.537	0.350	0.199	0.291	0.125	0.031	0.061	0.016	0.014	0.010	0.009					
2009		0.083	0.226	0.289	0.340	0.217	0.091	0.054	0.011	0.006	0.046	0.011	0.061				
2010	0.791	0.451	0.092	0.306	0.286	0.235	0.035	0.007	0.007	0.051	0.010		0.003				
2011		0.047	0.120	0.241	0.286	0.327	0.174	0.083	0.082	0.046	0.004						
2012		0.083	0.308	0.374	0.261	0.229	0.231	0.077	0.104	0.004	0.009	0.012	0.003	0.007			0.003
2013	0.196	0.319	0.183	0.120	0.087	0.408	0.470	0.552	0.116	0.005	0.002	0.002	0.003				
2014	0.157	0.355	0.217	0.302	0.260	0.411	0.126	0.110	0.038	0.060	0.003	0.044	0.011	0.001		0.030	
2015		0.088	0.841	0.184	0.250	0.099	0.095	0.005	0.024	0.027	0.022	0.003	0.006		0.002		
2016	0.017	0.147	0.122	0.393	0.197	0.196	0.074	0.070	0.074	0.022	0.035	0.009					
2017		0.108	0.163	0.107	0.143	0.143	0.124	0.068	0.007	0.004	0.006	0.004	0.001	0.002			
2018		0.120	0.082	0.068	0.113	0.259	0.193	0.042	0.049	0.040	0.011	0.006	0.001	0.004			
2019	0.044	0.018	0.084	0.183	0.177	0.296	0.256	0.271	0.064	0.061	0.016	0.013	0.007	0.032			

Table B.4.2. CV abundance indices

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003		0.636	0.779	0.483	0.829	0.529	0.715	0.860	0.934	0.805	0.544	0.384					
2004	1.002	0.988	0.463	0.415	0.407	0.389	0.429	0.544	0.897	0.635	0.171						
2005		0.508	0.609	0.530	0.448	0.570	0.478	0.624	0.713		0.421						
2006	0.579	0.360	0.387	0.503	0.394	0.548	0.571	0.615	0.507								
2007	0.505	0.602	0.468	0.403	0.546	0.475	0.342	0.674	0.633	0.394							
2008	0.501	0.750	0.452	0.475	0.491	0.435	0.514	0.683	0.396	0.478	0.267	0.474					
2009		0.465	0.289	0.611	0.588	0.780	0.833	0.707	1.817	2.171	0.501	0.542	0.393				
2010	0.485	0.530	0.216	0.520	0.592	0.549	0.409	0.337	0.507	0.829	0.342		0.335				
2011		0.185	0.575	0.459	0.452	0.448	0.504	0.474	0.452	0.482	0.419						
2012		0.287	0.636	0.361	0.496	0.694	0.577	0.534	0.818	0.371	0.337	0.613	0.301	0.392			0.273
2013	0.405	0.863	0.418	0.491	0.574	0.843	0.713	0.677	0.556	0.382	0.356	0.361	0.334				
2014	1.132	0.838	0.464	0.571	0.690	0.580	0.502	0.698	0.613	0.619	0.438	0.483	0.736	0.343			
2015		0.824	0.557	0.447	0.479	0.539	0.656	0.870	0.652	0.587	0.554	0.358	0.102		0.408		
2016	0.408	0.414	0.549	0.406	0.429	0.346	0.436	0.547	0.483	0.574	0.675	0.351					
2017		0.719	0.416	0.417	0.493	0.378	0.457	0.406	0.222	0.341	0.608	0.198	0.258	0.364			
2018		0.416	0.629	0.384	0.454	0.370	0.355	0.259	0.422	0.710	0.469	0.535	0.429	0.596			
2019	0.500	0.391	0.371	0.406	0.659	0.733	0.548	0.563	0.905	0.692	1.523	1.493	1.904	0.503			

Table B.4.3. Biomass indices (kilotonnes)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003		0.000	0.028	0.299	0.469	1.401	0.872	0.424	0.274	0.383	0.180	0.003					
2004	0.000	0.004	0.019	0.308	2.092	1.227	0.853	0.598	0.010	0.087	0.045						
2005		0.038	0.043	0.525	0.966	0.611	0.538	0.574	0.075		0.020						
2006	0.007	0.001	0.085	0.228	0.408	1.043	0.235	0.138	0.541								
2007	0.000	0.012	0.221	0.495	0.583	0.490	0.116	0.273	0.170	0.064							
2008	0.028	0.058	0.428	0.448	1.036	0.471	0.129	0.369	0.037	0.032	0.025	0.090					
2009		0.009	0.158	0.480	0.969	0.715	0.436	0.327	0.029	0.018	0.126	0.090	0.176				
2010	0.003	0.048	0.016	0.523	0.720	0.741	0.210	0.021	0.019	0.340	0.052		0.006				
2011		0.003	0.061	0.488	0.973	1.302	1.518	0.808	0.185	0.570	0.015						
2012		0.008	0.121	0.555	0.687	0.995	0.905	0.339	0.976	0.017	0.037	0.059	0.013	0.030			0.012
2013	0.003	0.050	0.064	0.125	0.213	1.277	3.744	2.677	1.283	0.022	0.005	0.007	0.014				
2014	0.002	0.024	0.202	0.632	0.569	1.326	0.489	0.593	0.150	0.276	0.013	0.107	0.039	0.005		0.132	
2015		0.010	0.486	0.283	0.533	0.377	0.192	0.022	0.103	0.110	0.084	0.012	0.025		0.018		
2016	0.000	0.012	0.064	0.754	0.331	0.811	0.272	0.253	0.528	0.197	0.132	0.053					
2017		0.009	0.128	0.248	0.301	0.522	0.446	0.211	0.026	0.017	0.025	0.017	0.005	0.021			
2018		0.007	0.026	0.067	0.282	1.054	0.773	0.182	0.297	0.169	0.050	0.019	0.012	0.020			
2019	0.001	0.001	0.016	0.439	0.726	1.185	1.232	1.298	0.295	0.523	0.073	0.077	0.032	0.171			

Table B.4.4. Length at age (cm)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003		17.31	33.13	44.67	52.18	66.76	68.29	75.08	77.81	93.01	84.42	61.04					
2004	9.16	16.91	28.55	48.68	63.18	66.87	77.57	79.22	62.80	88.52	63.44						
2005		26.78	33.20	59.22	68.01	74.51	72.93	81.79	66.42		108.00						
2006	9.98	21.96	41.84	53.82	60.92	66.50	68.23	66.22	86.82								
2007	9.97	23.65	50.34	60.55	68.31	69.03	67.63	70.49	91.31	89.00							
2008	8.33	21.34	48.25	60.00	68.10	70.79	71.94	78.57	61.38	59.05	62.00	87.89					
2009		22.22	38.04	51.59	61.81	70.70	75.86	79.22	62.77	62.25	66.95	91.73	67.00				
2010	8.02	20.70	27.14	50.94	59.27	63.95	78.94	66.91	61.27	81.12	79.67		60.00				
2011		20.51	34.19	56.06	68.10	70.66	89.96	95.59	63.83	106.00	69.52						
2012		21.72	33.95	51.94	63.37	70.99	72.63	74.78	90.09	71.36	74.33	78.31	73.00	74.94			79.00
2013	11.00	24.25	32.75	44.82	55.34	71.04	88.43	79.79	95.79	76.09	63.00	69.00	74.70				
2014	11.70	21.12	43.63	58.48	59.96	67.83	73.87	79.82	74.50	77.93	81.28	61.71	71.66	75.00		70.00	
2015		22.25	38.86	53.28	57.32	70.80	61.01	71.05	75.34	76.42	74.87	77.00	76.15		95.00		
2016	10.00	21.14	36.26	56.79	54.97	72.89	71.14	69.90	84.50	97.40	74.29	83.76					
2017		21.85	40.91	58.32	61.16	68.15	70.64	66.42	73.92	81.74	76.19	76.05	78.00	99.00			
2018		19.52	32.19	45.60	63.57	74.71	72.80	74.12	82.67	75.60	78.26	75.22	98.00	80.88			
2019	11.83	19.97	28.09	59.05	70.49	71.02	78.73	77.01	76.47	90.06	77.19	92.56	76.89	81.69			

Table B.4.5. Weight at age (gram)

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
2003		40	365	1101	1436	3168	3272	5072	5062	8818	6215	2033					
2004	7	48	254	1247	2604	3510	5123	5797	2414	7569	2473						
2005		188	402	2201	3380	4439	3947	6824	2778		12140						
2006	8	81	718	1798	2558	3228	3171	4489	7765								
2007	7	169	1478	2435	3582	3182	3570	3952	7115	7500							
2008	7	99	1169	2282	3468	3720	4226	5348	2369	2334	2475	9590					
2009		99	663	1468	2691	3455	4183	5423	2703	2687	2746	7945	2870				
2010	4	95	175	1551	2360	3011	5553	3154	2369	5343	5091		2285				
2011		65	423	1909	3336	3730	8552	9298	2319	12482	3640						
2012		93	424	1487	2530	3851	3712	4126	7459	3729	4235	4856	3745	4318			4630
2013	13	129	330	923	1976	3183	7125	4835	10222	4326	2400	3425	4262				
2014	14	74	905	2078	2133	3194	4110	5267	3894	4804	4659	2441	3634	3340		4400	
2015		97	629	1491	2113	3576	2284	3228	4368	4328	3560	4310	4395		7785		
2016	9	83	452	1899	1624	4040	3585	3558	6659	9035	3961	5951					
2017		90	758	2215	2137	3506	3509	3183	3885	4583	4049	4314	3935	10610			
2018		61	305	953	2558	4136	3965	4332	5991	4510	4724	3539	8695	6419			
2019	23	67	195	2364	4053	3666	4952	4771	4592	8250	4122	7605	4331	5340			

Table B.4.6. Abundance index, standard deviation (SD) and Coefficient of variation (CV) for sum of age 2+ fish

	Index_2plus	SD_2plus	CV_2plus
2003		1.461	0.550
2004		1.728	0.341
2005		0.970	0.369
2006		0.880	0.308
2007		0.792	0.321
2008		1.060	0.341
2009		1.227	0.562
2010		1.029	0.417
2011		1.336	0.364
2012		1.616	0.385
2013		1.940	0.533
2014		1.533	0.482
2015		1.553	0.428
2016		1.191	0.239
2017		0.771	0.284
2018		0.864	0.283
2019		1.426	0.491

12 - Appendix C

```
# Creating time series for coastal cod abundance indices from acoutics

# from Bootstrap output from StoX

#####

# harald@hi.no and johanna.fall@hi.no Sept-December 2020

# Based on a script by espen.johnsen@hi.no, for Barents Sea Haddock

# All non-coastal cod (otolithtype > 2) are stripped from the dataset, so that all output is for coastal cod only

rm(list=ls())

library(data.table)

library(Hmisc)

library(Rstox)

library(xlsx)

path1 <- "//delphi/Felles/421-Bunnfisk/Kysttorsk/Akustikk stox/Varanger Stad cod acoustic index in autumn "

path2 <- "//delphi/Felles/421-Bunnfisk/Kysttorsk/Acoustics/Tot/"

out <- list()

for(y in 1:25){

year <- 1994+y

print(year)

load(paste0(path1,year," N67\\output\\r\\data\\bootstrapImpute.RData"))

bootstrapVariable.out <- eval(parse(text="bootstrapImpute"))

DT <- rbindlist(bootstrapVariable.out[[2]],idcol=TRUE)

DT <- DT[DT$otolithtype <= 2] # Only coastal cod (otolithtype 1 and 2) included

## Some SuperIND may miss weight. Generate weight from a length weight relation

id1 <- DT$weight > 0

lm.wl <- lm(log(DT$weight[id1]) ~ log(DT$length[id1]))

a <- exp(as.numeric(lm.wl$coeff[1]))

b <- as.numeric(lm.wl$coeff[2])

DT$weight[is.na(DT$weight) | DT$weight == 0] <- a*(DT$length[is.na(DT$weight) | DT$weight == 0])^b

#plot(DT$weight ~ DT$length)

## Output by age and by sum over age 2 to maxage
```

```
strata <- unique(DT[,c("Stratum", "includeintotal")])

# strata.incl <- strata[strata$includeintotal=="TRUE",]

#manually remove strata so we only have area N67 left

#strata.incl <- strata[!Stratum %in% c("Helgeland indre", "Helgeland ytre",
# "Stad Halten indre", "Stad Halten ytre",
# "Vestfjord ost"),]

#manually remove strata so we only have area 6567 left

#strata.incl <- strata[!Stratum %in% c("Alta", "Andfjord Vaagsfjord",
# "Fugloybanken", "Hjelmsøy indre",
# "Hjelmsøy Loppa", "Kvenangen",
# "Laksefjord", "Malangen", "Osthavet",
# "Porsangen", "Soroya indre",
# "Stad Halten indre", "Stad Halten ytre",
# "Tana", "Ullsfjord Lyngen", "Varangerfjord",
# "Vesteralen", "Vestfjord indre", "Vestfjord ost",
# "Vestfjord vest"),]

#manually remove strata so we only have area S65 left

#strata.incl <- strata[!Stratum %in% c("Alta", "Andfjord Vaagsfjord",
# "Fugloybanken", "Helgeland indre",
# "Helgeland ytre", "Hjelmsøy indre",
# "Hjelmsøy Loppa", "Kvenangen",
# "Laksefjord", "Malangen", "Osthavet",
# "Porsangen", "Soroya indre",
# "Tana", "Ullsfjord Lyngen", "Varangerfjord",
# "Vesteralen", "Vestfjord indre", "Vestfjord ost",
# "Vestfjord vest"),]

#manually remove strata so we have Total area left

strata.incl <- strata[!Stratum %in% c("Vestfjord ost"),]

byGrp1 <- c(".id")

byGrp2 <- c("age", ".id")
```

```
tmp1 <- DT[!age %in% c(0,1) & Stratum %in% strata.incl$Stratum,.(Ab.Sum =sum(Abundance)),by=byGrp1]
tmp2 <- DT[Stratum %in% strata.incl$Stratum,.(Ab.Sum =sum(Abundance)),by=byGrp2]
tmp3 <- DT[Stratum %in% strata.incl$Stratum,.(Tonnes =sum(Abundance * (weight))/1000000),by=byGrp2] # Tonnes
tmp4 <- DT[Stratum %in% strata.incl$Stratum,.(ind.weight = weighted.mean(weight,Abundance)),by=byGrp2]
tmp5 <- DT[Stratum %in% strata.incl$Stratum,.(ind.length = weighted.mean(length,Abundance)),by=byGrp2]
tsnTotWithout01 <- tmp1[, .("Ab.Sum.5%" = quantile(Ab.Sum, probs = .05),
"Ab.Sum.50%" = quantile(Ab.Sum, probs = .50),
"Ab.Sum.95%" = quantile(Ab.Sum, probs = .95),
Ab.Sum.mean = mean(Ab.Sum),
Ab.Sum.sd = sd(Ab.Sum),
Ab.Sum.cv = sd(Ab.Sum)/mean(Ab.Sum))]
tsnByAge <- tmp2[, .("Ab.Sum.5%" = quantile(Ab.Sum, probs = .05),
"Ab.Sum.50%" = quantile(Ab.Sum, probs = .50),
"Ab.Sum.95%" = quantile(Ab.Sum, probs = .95),
Ab.Sum.mean = mean(Ab.Sum),
Ab.Sum.sd = sd(Ab.Sum),
Ab.Sum.cv = sd(Ab.Sum)/mean(Ab.Sum))
, by = c("age")]
tsbByAge <- tmp3[, .("Ton.5%" = quantile(Tonnes, probs = .05),
"Ton.50%" = quantile(Tonnes, probs = .50),
"Ton.95%" = quantile(Tonnes, probs = .95),
Ton.mean = mean(Tonnes),
Ton.sd = sd(Tonnes),
Ton.cv = sd(Tonnes)/mean(Tonnes))
, by = c("age")]
ind.weight.by.age <- tmp4[, .("Ind.weight.age.5%" = quantile(ind.weight, probs = .05,na.rm=T),
"Ind.weight.age.50%" = quantile(ind.weight, probs = .50,na.rm=T),
"ind.weight.age.95%" = quantile(ind.weight, probs = .95,na.rm=T),
ind.weight.age.mean = mean(ind.weight,na.rm=T),
ind.weight.age = sd(ind.weight,na.rm=T),
```

```
ind.weight.age.cv = sd(ind.weight,na.rm=T)/mean(ind.weight,na.rm=T))
, by = c("age")]

ind.length.by.age <- tmp5[, .("Ind.length.age.5%" = quantile(ind.length, probs = .05,na.rm=T),
"Ind.length.age.50%" = quantile(ind.length, probs = .50,na.rm=T),
"ind.length.age.95%" = quantile(ind.length, probs = .95,na.rm=T),
ind.length.age.mean = mean(ind.length,na.rm=T),
ind.length.age = sd(ind.length,na.rm=T),
ind.length.age.cv = sd(ind.length,na.rm=T)/mean(ind.length,na.rm=T))
, by = c("age")]

## Output by stratum----

byGrp3 <- c("Stratum", ".id")

tmp2 <- DT[, .(Ab.Sum =sum(Abundance)),by=byGrp3]

tmp3 <- DT[, .(Tonnes =sum(Abundance * (weight))/1000000),by=byGrp3] # Tonnes

tsnByStratum <- tmp2[, .("Ab.Sum.5%" = quantile(Ab.Sum, probs = .05),
"Ab.Sum.50%" = quantile(Ab.Sum, probs = .50),
"Ab.Sum.95%" = quantile(Ab.Sum, probs = .95),
Ab.Sum.mean = mean(Ab.Sum),
Ab.Sum.sd = sd(Ab.Sum),
Ab.Sum.cv = sd(Ab.Sum)/mean(Ab.Sum))
, by = c("Stratum")]

tsbByStratum <- tmp3[, .("Ton.5%" = quantile(Tonnes, probs = .05),
"Ton.50%" = quantile(Tonnes, probs = .50),
"Ton.95%" = quantile(Tonnes, probs = .95),
Ton.mean = mean(Tonnes),
Ton.sd = sd(Tonnes),
Ton.cv = sd(Tonnes)/mean(Tonnes))
, by = c("Stratum")]

#

out[[y]] <- list(year=year,
a = a,
```

```
b = b,  
tsnByAge = tsnByAge,  
tsnTotWithout01 = tsnTotWithout01,  
ind.weight.by.age = ind.weight.by.age,  
ind.length.by.age = ind.length.by.age,  
tsbByAge = tsbByAge,  
tsbByStratum = tsbByStratum,  
tsnByStratum = tsnByStratum)  
}  
save(out, file = (paste0(path2,"ProduceAllFiguresCoastalCod_12-03-filtfromN.Rdata")))  
out.acu <- out # Rename the object, as the "out" is in conflict with results of other codes  
## Figures to be made  
# Figure 1: Number by age in time series: Age1-Age17. Age 17 is the oldest observed coastal cod.  
## Tables to be made  
# Table 1: Abundance indices (mean bootstrap)  
# Table 2: CV of abundance indices  
# Table 3: Biomass indices (mean bootstrap)  
# Table 4: Mean length by age (cm)  
# Table 5: Mean weight by age (g)  
# Table 6: Abundance and CV of abundance for sum over ages 2+  
## Number by age in time series For Table 1 and Figure 1  
mat.num <- matrix(NA,ncol=18,nrow=length(1995:2019))  
colnames(mat.num) <- 0:17  
rownames(mat.num) <- 1995:2019  
for(y in 1:25){  
tmp <- (as.data.frame(out.acu[[y]]$tsnByAge)[,c("age","Ab.Sum.mean")])  
for(a in 1:18){  
age <- a-1  
if(!any(tmp$age[!is.na(tmp$age)] == age)) {  
next
```

```
}  
mat.num[y,a] <- tmp$`Ab.Sum.mean`[tmp$age == age & !is.na(tmp$age)]  
}  
}  
  
## Biomass by age in time series. For Table 3  
mat.biom <- matrix(NA,ncol=18,nrow=length(1995:2019))  
colnames(mat.biom) <- 0:17  
rownames(mat.biom) <- 1995:2019  
for(y in 1:25){  
  tmp <- (as.data.frame(out.acu[[y]]$tsbByAge)[,c("age","Ton.mean")])  
  for(a in 1:18){  
    age <- a-1  
    if(!any(tmp$age[!is.na(tmp$age)] == age)) {  
      next  
    }  
    mat.biom[y,a] <- tmp$`Ton.mean`[tmp$age == age & !is.na(tmp$age)]  
  }  
}  
  
## Figure 1: Number by age in time series ----  
plot.cohort.year <- function(mat, age=1:17, survey.year=1995:2019, start.coh = 1995, stop.coh=2015,col1=1,col2=1,  
addPlot=F){  
  ## Define first cohort: start.co  
  ## Does the matrix include year and age information? Add if not  
  mat <- mat[ ,colnames(mat) %in% age]  
  mat[mat == 1] <- NA  
  if(!is.null(rownames(mat))) survey.year <- as.numeric(rownames(mat))  
  mat <- mat[row.names(mat) %in% survey.year,]  
  age.mat <- matrix(age,nrow=nrow(mat),ncol=ncol(mat), byrow=T)  
  sur.mat <- matrix(survey.year,nrow=nrow(mat),ncol=ncol(mat), byrow=F)  
  coh.mat <- sur.mat - age.mat ###  
  if(addPlot == F) plot(sur.mat, mat, type="n", xlab="Survey year", ylab = "Log10 (abundance index)")
```

```
for(i.y in start.coh:stop.coh){  
  
lines(sur.mat[coh.mat== i.y], mat[coh.mat == i.y], col=i.y, lwd=1.5)  
  
text(sur.mat[coh.mat== i.y], mat[coh.mat == i.y], age.mat[coh.mat == i.y], col=i.y) ## M? skrive inn alder  
  
}  
  
}  
  
## Plot cohort  
  
fil1 <- paste0(path2,"Figure_1_Log10Number_by_age_in_time_series_CoastalCod.jpg")  
  
jpeg(filename = fil1 , width = 18, height = 12, units = "cm",res=300)  
  
plot.cohort.year(log10(mat.num), survey.year =1995:2019, age=1:17, start.coh=1995,stop.coh=2015)  
  
dev.off()  
  
# End  
  
# Table 1: Abundance indices (mean bootstrap) ----  
  
mat1.num <- as.data.frame(mat.num/(1e+6))  
  
names(mat1.num) <- paste("Age", 0:(ncol(mat1.num)-1))  
  
write.xlsx(mat1.num, file=paste0(path2,"Table_1_Abundance_indices_Coastal cod_Tot_millions.xlsx" ))  
  
# # Table 2: CV of abundance indices ----  
  
mat.cv <- matrix(NA,ncol=18,nrow=length(1995:2019))  
  
colnames(mat.cv) <- 0:17  
  
rownames(mat.cv) <- 1995:2019  
  
for(y in 1:25){  
  
tmp <- (as.data.frame(out.acu[[y]]$tsnByAge)[,c("age","Ab.Sum.cv")])  
  
for(a in 1:18){  
  
age <- a-1  
  
if(!any(tmp$age[!is.na(tmp$age)] == age)) {  
  
next  
  
}  
  
mat.cv[y,a] <- tmp$`Ab.Sum.cv`[tmp$age == age & !is.na(tmp$age)]  
  
}  
  
}  
  
mat.cv1 <- as.data.frame(mat.cv)
```

```
names(mat.cv1) <- paste("Age", 0:(ncol(mat.cv1)-1))

write.xlsx(mat.cv1, file=paste0(path2,"Table_2_CV_Abundance_CoastalCod.xlsx" ))

# Table 3: Biomass indices (mean bootstrap) ----

mat1.tonn <- as.data.frame(mat.biom/(1e+3))

names(mat1.tonn) <- paste("Age", 0:(ncol(mat1.tonn)-1))

write.xlsx(mat1.tonn, file=paste0(path2,"Table_3_Biomass_indices_CoastalCod_kilotonnes.xlsx" ))

# Table 4: Mean length by age (cm)

mat.len.age <- matrix(NA,ncol=18,nrow=length(1995:2019))

colnames(mat.len.age) <- 0:17

rownames(mat.len.age) <- 1995:2019

for(y in 1:25){

tmp <- (as.data.frame(out.acu[[y]]$ind.length.by.age)[,c("age","ind.length.age.mean")])

for(a in 1:18){

age <- a-1

if(!any(tmp$age[!is.na(tmp$age)] == age)) {

next

}

mat.len.age[y,a] <- tmp$`ind.length.age.mean`[tmp$age == age & !is.na(tmp$age)]

}

}

mat.len.age1 <- as.data.frame(mat.len.age)

names(mat.len.age1) <- paste("Age", 0:(ncol(mat.len.age1)-1))

write.xlsx(mat.len.age1, file=paste0(path2,"Table_4_Length_By_Age_By_Survey_CoastalCod.xlsx" ))

# Table 5: Mean weight by age (g)

mat.weight.age <- matrix(NA,ncol=18,nrow=length(1995:2019))

colnames(mat.weight.age) <- 0:17

rownames(mat.weight.age) <- 1995:2019

for(y in 1:25){

tmp <- (as.data.frame(out.acu[[y]]$ind.weight.by.age)[,c("age","ind.weight.age.mean")])

for(a in 1:18){
```



```
age <- a-1

if(!any(tmp$age[!is.na(tmp$age)] == age)) {

next

}

mat.weight.age[y,a] <- tmp$`ind.weight.age.mean`[tmp$age == age & !is.na(tmp$age)]

}

}

mat.weight.age1 <- as.data.frame(mat.weight.age)

names(mat.weight.age1) <- paste("Age", 0:(ncol(mat.weight.age1)-1))

write.xlsx(mat.weight.age1, file=paste0(path2,"Table_5_Weight_By_Age_By_Survey_CoastalCod.xlsx" ))

#Table 6

mat.age2plus <- matrix(NA, ncol=3,nrow=length(1995:2019))

colnames(mat.age2plus) <- c("Index_2plus", "SD_2plus", "CV_2plus")

rownames(mat.age2plus) <- 1995:2019

for(y in 1:25){

mat.age2plus[y,1] <- (as.data.frame(out.acu[[y]]$tsnTotWithout01)[,"Ab.Sum.mean"])/(1e+6)

mat.age2plus[y,2] <- (as.data.frame(out.acu[[y]]$tsnTotWithout01)[,"Ab.Sum.sd"])/(1e+6)

mat.age2plus[y,3] <- (as.data.frame(out.acu[[y]]$tsnTotWithout01)[,"Ab.Sum.cv"])

}

write.xlsx(mat.age2plus, file=paste0(path2,"Table_6_Index2+_w_sd-and-sv_CoastalCod.xlsx" ))

## End
```



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