

Stock Annex: Greater silver smelt (*Argentina silus*) in Subareas 1, 2, and 4, and in Division 3.a (Northeast Arctic, North Sea, Skagerrak and Kattegat)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Greater silver smelt
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A. General

A.1 Stock definition

Gr. silver smelt (*Argentina silus*) in Subareas 1, 2, 4 and Division 3.a is from 2015 onwards treated as one management unit/stock.

The current perception is based on the historical and present separation of fisheries targeting greater silver smelt into distinctive subareas of the North Atlantic. Target fisheries developed in these distinct subareas because aggregations of spawners were discovered, facilitating aimed benthopelagic trawling.

In the Norwegian Sea and North Sea-Skagerrak the distribution is continuous from the Skagerrak along the Norwegian Deep northwards along the Norwegian shelf to the entrance to the Barents Sea. Documented spawning areas are deep shelf troughs and upper slope waters off of mid-Norway and deeper parts of the Skagerrak, but it is likely that the species also spawns in deep Norwegian fjords. Studies of population genetics have not been conducted in the relevant areas.

A.2 Fishery

Minor target fisheries first developed in the Norwegian Deep in the Skagerrak (Division 3.a) in the 1970s (Thorsen, 1979) and was soon after followed by the currently major fishery in deep-shelf troughs and along the shelf break off of mid-Norway (ICES Division 2.a) (Monstad and Johannessen, 2003; Johannessen and Monstad, 2003). In addition, the species was always a bycatch in the industrial fisheries for Norway pout and blue whiting along the western and southern slope of the Norwegian Deep in Division 4.a and to a lesser extent 3.a, as well as in *Pandalus borealis* fishery in the same area (Lahn-Johannessen *et al.*, 1978; ICES, 2007, 201). Bycatches are landed for reduction, while target fisheries land most catches for human consumption. Discards are small.

Figure 1 illustrates typical geographical distribution of Norwegian catches in recent years, illustrated with data from 2015. All landings come from within EEZs.

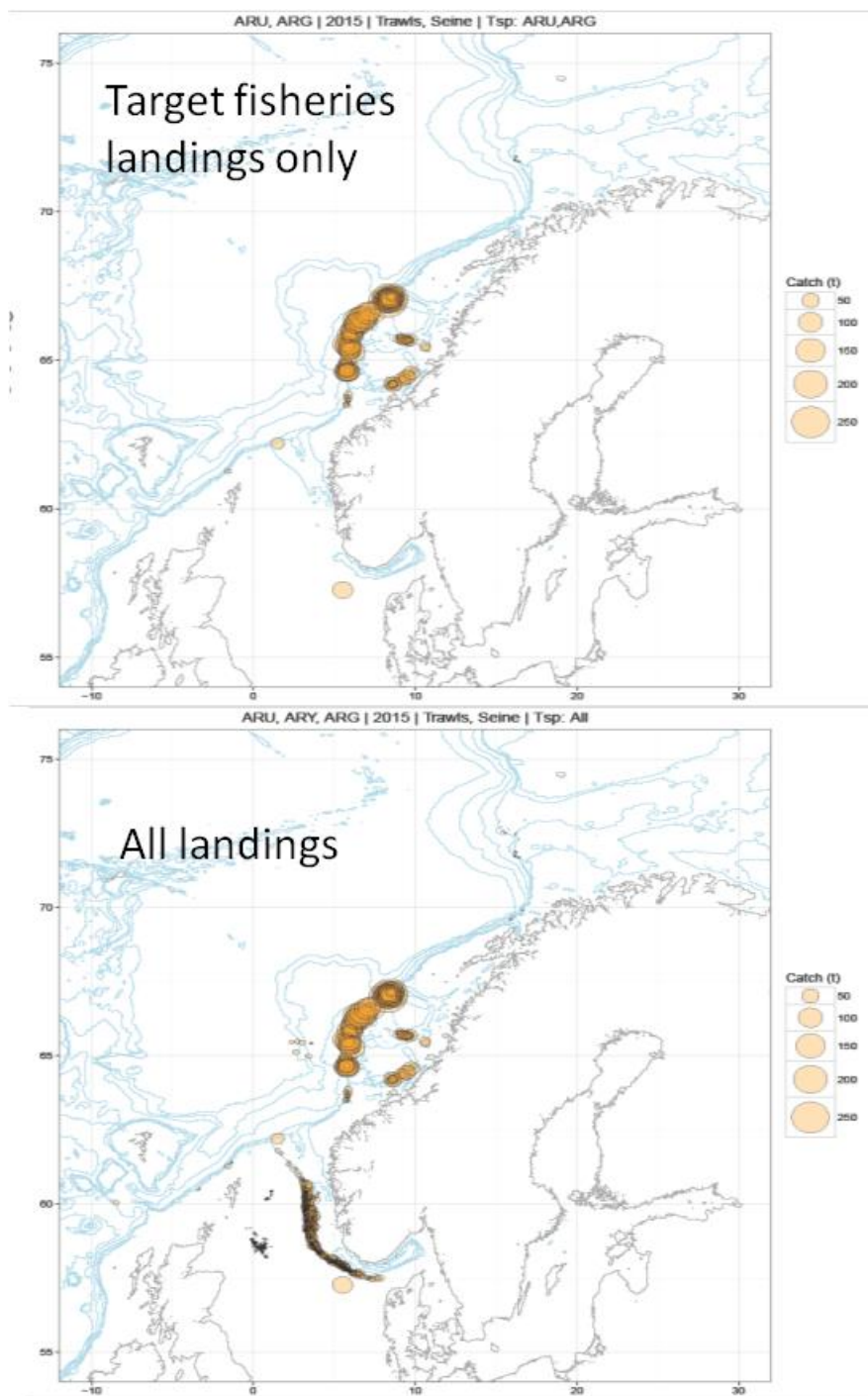


Figure 1. Norwegian greater silver smelt landings in 2015 distributed on fishing areas in the Norwegian Sea and North Sea-Skagerrak.

A.3 Ecosystem aspects

The significance of greater silver smelt in fish assemblages as well as its diets and food-web linkages were analysed in studies in the Norwegian Deep in the 1980s (Bergstad, 1990; Bergstad *et al.*, 2003).

B. Data

B.1 Commercial catch

Landings from Division 3.a have been reported to WGDEEP since 1966, from the North Sea (Subarea 4) from 1970, and from Subareas 1 and 2 since 1988 (Figure 2). Norwegian landings were always dominant.

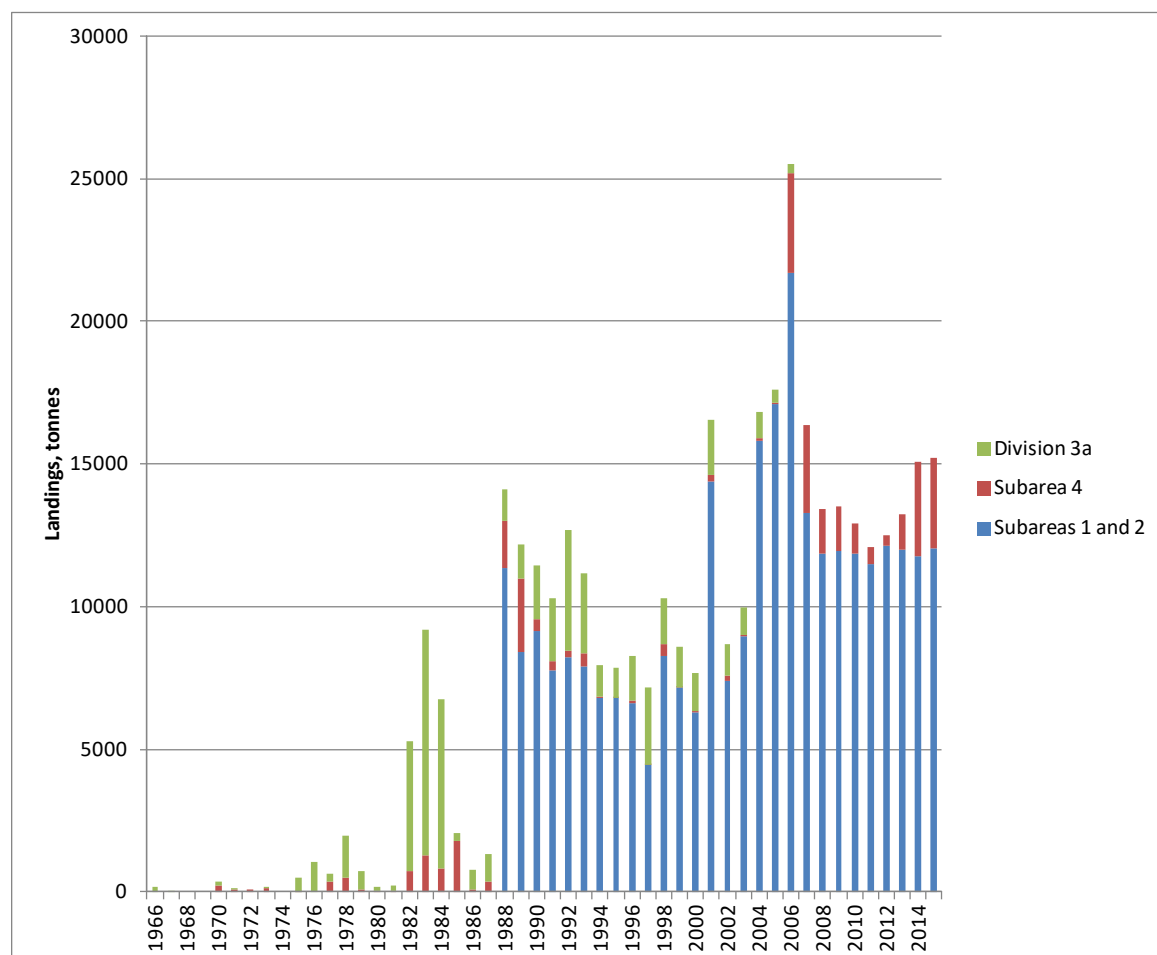


Figure 2. Landings of greater silver smelt for Subareas 1, 2, 4, and Division 3.a as reported to ICES.

B.2 Biological

A number of theses, publications and reports deal with biology and ecology of greater silver smelt in the relevant area. The first study related to fisheries was the thesis by Thorsen (1979). The distribution and biology of the species in the Norwegian Deep was described in Bergstad (1990; 1993), and occurrence of eggs and larvae in the Skagerrak by Bergstad and Gordon (1994). Bergstad (1993) showed how the species dispersed into wider areas as juveniles and during the summer and autumn. Studies from the 1980s showed that in deeper parts of the 3.a (depth >300 m), *Argentina silus* dominated the fish community together with roundnose grenadier (*Coryphaenoides rupestris*) (Bergstad, 1990; Bergstad *et al.*, 2003). Extensive trawl and acoustics mapping and biological studies were also conducted in Subareas 1 and 2 in the 1980s and 1990s and published by Monstad and Johannessen (2003) and Johannessen and Monstad (2003).

Age determination methods were developed in Norway and described by Bergstad

(1993), and this formed the basis for studies of age distributions, growth, maturity ogives, and derivation of age-length keys. Such data are available for both the North Sea Skagerrak and the Norwegian Sea distribution areas.

B.3 Surveys

B.3.1 Norwegian biennial trawl-acoustic survey (Subareas 1 and 2)

The series was initiated in 2009, and surveys have been conducted in 2012, 2014 and 2016. Acoustic properties of greater silver smelt, survey and biomass estimation method was described in a working document at the last ICES benchmark on the species (Harbitz, 2010).

Distribution maps, abundance and biomass indices based on all available survey data (including sporadic surveys included in Section B.3.1.3) from Division 2 after 2003 are summarised in Figures 5 and 6.

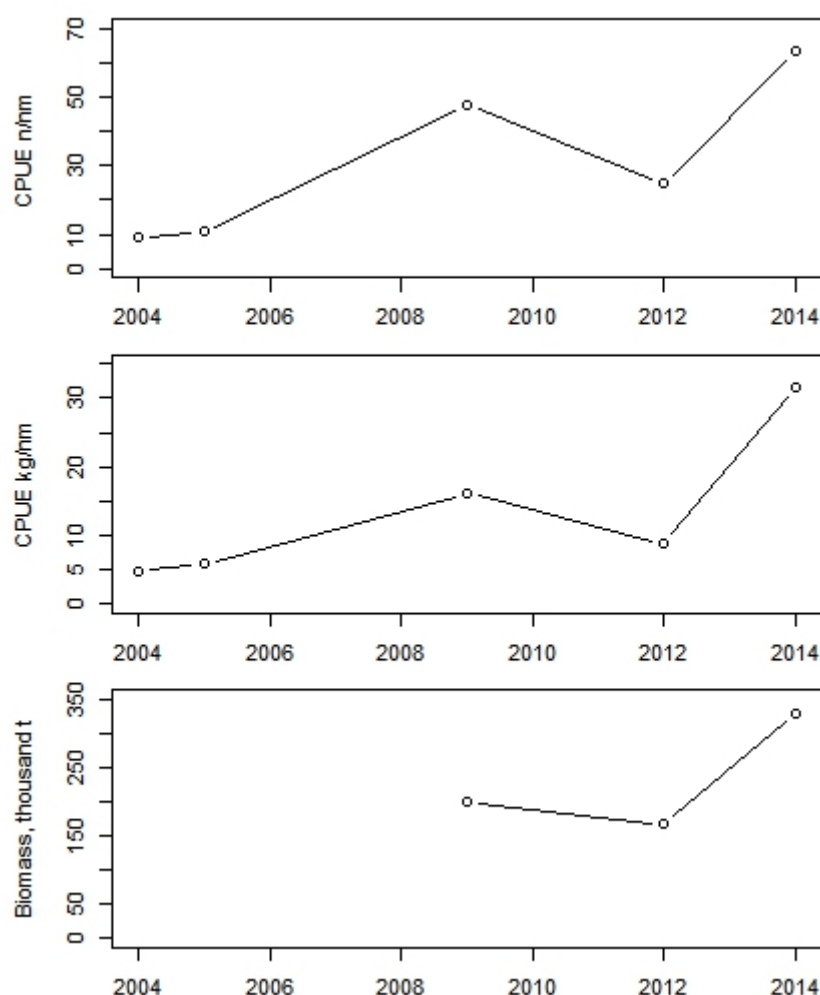


Figure 5. Abundance and biomass indices for greater silver smelt in Norwegian slope surveys (Division 2a) in March/April 2004, 2005, 2009, 2012 and 2014. The lower graph shows acoustic biomass estimates from the surveys in 2009, 2012 and 2014.

B.3.2 Norwegian shrimp survey (Division 3.a and south-eastern Division 4.a)

This series of annual bottom trawl surveys was initiated in 1984. It is a depth-stratified shrimp trawl survey with approximately 25% of the stations deeper than 300 m (depth

range 110–520 m) covering all depths and areas relevant for greater silver smelt. The trawl used has small meshes overall and a 6 mm codend liner and retains all sizes of greater silver smelt. The stations were initially placed at random within strata and sub-areas, and the same sites are sampled every year. Although some changes occurred over the years, the overall standardization was maintained throughout the time-series (Bergstad *et al.*, 2014). The survey conducted in 1984 was omitted because the first survey was not yet fully standardized.

Catch rates in terms of biomass and abundance are derived (Stations with zero catches were included, and the catches at non-zero stations were standardized by tow duration).

B.3.3 Other survey data

More sporadic surveys have been conducted to map greater silver smelt, i.e. in the 1980s and 1990s (Bergstad, 1993; Monstad and Johannessen, 2003; Johannessen and Monstad, 2003). Further surveys were conducted in Division 2.a in 2003–2005. Data from these surveys were included in Figures 5 and 6.

Based on multiple surveys in the 2000s, seasonal cpue estimates were derived (Figure 7).

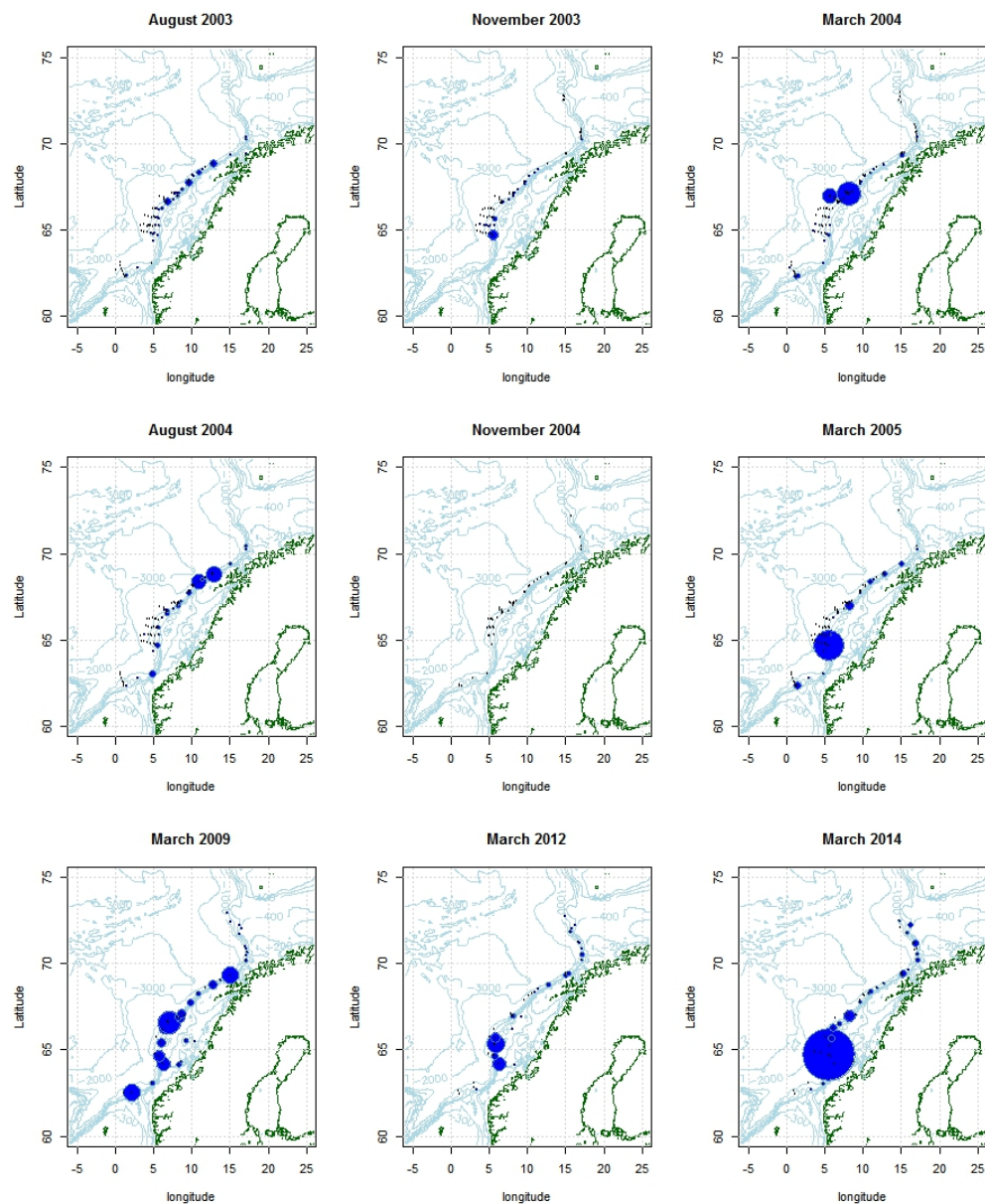


Figure 6. Norwegian survey data, greater silver smelt, 2003–2014. The three last years are included in a standardized biennial series continued in 2016.

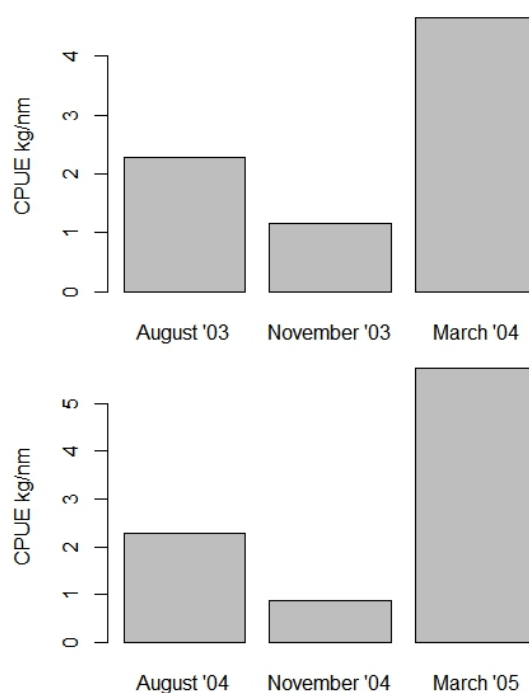


Figure 7. GSS in IIa. Trawl cpue by month in Norwegian slope surveys in 2003–2005.

B.4 Commercial cpue

No data available. The target fishery producing the bulk of the landings is targeting aggregations, to a large extent using benthopelagic trawls. Commercial cpue may not provide reliable indices of abundance.

B.5 Other relevant data

C. Assessment: data and method

Model used: Survey trends. Norwegian biennial survey for Division 2, and shrimp survey for Division 3.a.

Software used:

Model Options chosen:

Input data types and characteristics:

TYPE	NAME	YEAR RANGE	SPLIT ON COUNTRIES	VARIABLE FROM YEAR TO YEAR
				YES/NO
Trawl-Acoustic survey	Norw. Slope survey Subareas 1 and 2	2009–2016	Norway only	Yes (biennial)
Shrimp trawl survey	Norw. Shrimp survey, Division 3.a and 4.a	1985–2016	Norway only	No

In 2015 WGDEEP applied the ICES framework for category 3 stocks (ICES, 2012), and

the Norwegian acoustic survey in Subarea 2 was applied as an index for the stock development. The advice was based on a comparison of the two latest index values (index A) with the three preceding values (index B), combined with average catches in recent years. For years, where index values were not available, the values were obtained by interpolation (Figure 8).

Index A (2013–2014)	288 173	
Index B (2010–2012)	189 705	
Index ratio (A/B)	1.52	
Uncertainty cap	Applied	1.2
Average catches (2012, 2013, 2014)	13 591	
Discard rate	Negligible	
Precautionary buffer	Applied	0.8
catch advice*	13 047	

* (average catches × cap × buffer).

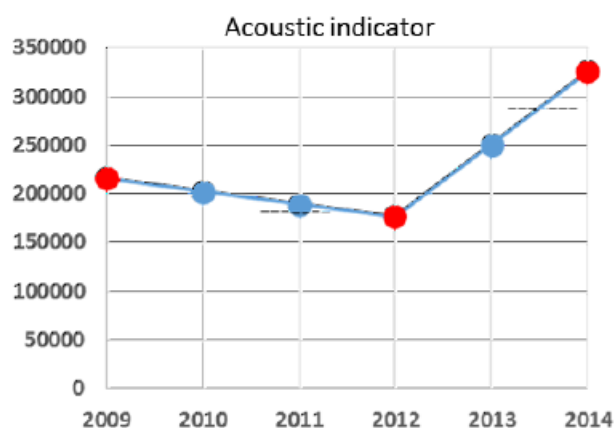


Figure 8. Acoustic indicator based on Norwegian slope surveys. Blue points were derived by interpolation.

D. Short-term projection

E. Medium-term projections

F. Long-term projections

G. Biological reference points

H. Other issues

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