Perennial algal communities (excluding kelp) on Baltic infralittoral rock and mixed substrata (predominantly hard)

Summary

This is a benthic habitat in the photic zone where the predominant substrate is rock. It has a widespread distribution in the Baltic Sea where the substrate is suitable although some of the characteristic species, such as *Fucus* spp. and *Furcellaria lumbricalis*, are missing from areas with very low salinity. The algae provide a surface for attachment for many epiphytic species and shelter for epibenthic species making this one of the most species-rich habitats in the Baltic. The depth zone occupied is determined by light penetration.

Eutrophication is one of the principal causes of the changes in this habitat because of its effects on the macroalgae. The higher nutrient levels (N, P, organic matter) can increase turbidity and lead to smothering of macroalgae by supporting more epiphytic growth. There may also be a change in the dominant species. For example the kelp *Saccharina latissima* which is adapted to lower light levels can move into shallow depths and out-compete *Fucus*.

Improvements in water quality (reduction of nutrient inputs) are considered to have been a major factor in the recovery of this habitat as this has led to improved light penetration through the water column and reduction in the scope for rapid and blanketing smothering of the canopy-forming species by epiphytic annual algae. Controls on coastal and offshore construction to avoid increasing turbidity and on the direct removal and damage to infralittoral rock surfaces would be beneficial conservation measures.

Synthesis

The most well studied species associated with this habitat, *Fucus vesiculosus*, has been documented to decline and there are similar declines reported in some other species (e.g. *Furcellaria*). Taken together this is likely to be representative for the habitat overall, which has shown significant declines in the extent (up to 50% in places) as well as in the depth zone occupied by the associated algal communities. There has also been some recovery in recent years but a small further reduction of extent is predicted for the coming 50 years.

Reduction in habitat quality has also been apparent in some areas as changes in the algal and faunal species composition. This has been reported as an increase of abundance of smothering and fast growing filamentous annual macroalgae. There are concerns about possible future declines in extent and quality of this habitat. For example it has been suggested that if trends in temperature, total phosphorus concentration and chlorophyll a continue, water quality in the Bothnian Sea will deteriorate within 2-3 decades and reach levels that may lead to major losses of *F. vesiculosis.*

The overall assessment for this EUNIS level 4 habitat has been based on the HELCOM (2013) assessments for the associated HELCOM HUB biotopes. Draft assessments were derived using a weighted approach whereby the HELCOM assessment outcomes were assigned a score. This was averaged across the relevant biotopes. The outcomes were reviewed by Baltic experts to reach a final conclusion.HELCOM (2013) assessed the eight relevant Baltic biotopes to be of Least Concern (based on criterion A1). With no additional information on changes in extent or quality of this habitat, a restricted distribution, and less than a 25% decline in quantity over the last 50 years, current expert opinion is that this habitat should be assessed as Least Concern for both the EU 28 and EU 28+.

Overall Category & Criteria	
EU 28	EU 28+

Overall Category & Criteria			
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Least Concern	-	Least Concern	-

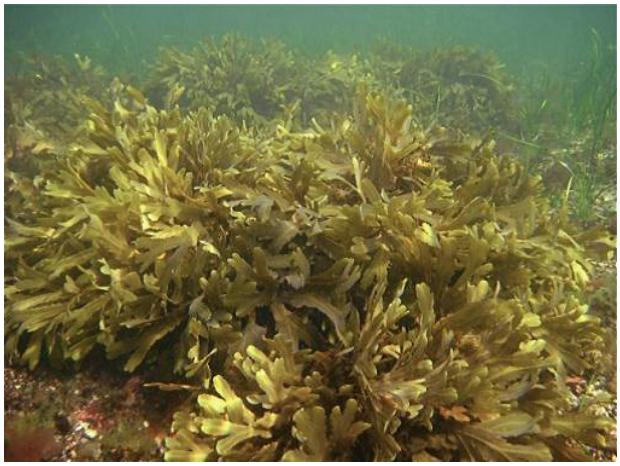
Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

Perennial algal communities (excluding kelp) on Baltic infralittoral rock and mixed substrata (predominantly hard)



Perennial algae community dominated by *Fucus serratus*. (© K.Fürhaupter, MariLim Aquatic Research GmbH).

Perennial algae on boulder habitats (© K.Fürhaupter, MariLim Aquatic Research GmbH).

Habitat description

This is a Baltic Sea benthic habitat in the photic zone where at least 90% of the substrate is rock, boulders or stones and mixed (predominantly hard) substrates according to the HELCOM HUB classification. Perennial attached algae such as *Fucus* spp., or perennial red algae cover at least 10% of the seabed and more than other perennial attached erect groups. It is most common in areas exposed to wave action and typically occurs to depths of around 0.5 m.

Eight associated biotopes with different dominant species of algae have been described by HELCOM. ‘Baltic photic rock and boulders/mixed substrata dominated by *Fucus* spp.’ (AA.A1C1/AAM1C1) such as *Fucus radicans, F. serratus* or *F. vesiculosus,* is found in depths of 0.5–5m and in salinities over 4 psu. ‘Baltic photic rock and boulders/mixed substrata dominated by perennial non-filamentous corticated red algae’ (AA.A1C2/AA.M1C2) such as *Furcellaria lumbricalis* occurs at a depths of 2–10 m in similar salinities. These four biotopes are present in all the Baltic Sea sub-basins and are widely distributed, although not Bothnian Bay nor the most eastern part of the Gulf of Finland. ‘Baltic photic rock and boulders/mixed substrata dominated by perennial foliose red algae’ (AA.A1C3/AA.M1C3) such as *Coccotylus* spp., *Phyllophora* spp. and *Delesseria* spp. is typically found in depths of 2–10 m and in salinities over 4 psu. They are present in all the Baltic Sea sub-basins and are also widely distributed although also not in the Bothnian Bay nor the eastern half of the Gulf of Finland. ‘Baltic photic rock and boulders/mixed substrata dominated by perennial filamentous algae’ (AA.A1C5/AA.M1C5) such as *Polysiphonia* spp, *Aegagrophila linnaei, Cladophora rupestris* is found at depths of 0.5–10 m, in all the

Baltic Sea sub-basins.

Indicators of quality:

Both biotic and abiotic indicators have been used to describe marine habitat quality. These include: the presence of characteristic species as well as those which are sensitive to the pressures the habitat may face; water quality parameters; levels of exposure to particular pressure, and more integrated indices which describe habitat structure and function, such as trophic index, or successional stages of development in habitats that have a natural cycle of change over time.

There are no commonly agreed indicators of quality for this habitat, although particular parameters may have been set in certain situations e.g. protected features within Natura 2000 sites, where reference values have been determined and applied on a location-specific basis

The lower depth limit of algae, especially *Fucus* spp. where applicable, and the amount of epiphytic algae are potential indicators of quality of this habitat.

Characteristic species:

Fucus spp., *Furcellaria lumbricalis, Coccotylus truncatus, Phyllophora* spp., *Delesseria sanguinea, Polysiphonia* spp., *Cladophora rupestris, Sphacelaria* spp.

Classification

EUNIS:

The closest corresponsence in EUNIS (2004) level 4 is A3.4 Baltic exposed infralittoral rock, A3.5 Baltic moderately exposed infralittoral rock and A3.6 Baltic sheltered infralittoral rock

Annex 1:

The relationship between HUB biotopes and Annex 1 habitats has not yet been mapped by HELCOM, however this habitat may occur in the following Annex 1 habitats:

1160 Large shallow inlets and bays

1170 Reefs

1650 Boreal Baltic narrow inlets

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral rock and biogenic reef

EUSeaMap:

Shallow photic rock or biogenic reef

IUCN:

9.2 Subtidal rock and rocky reefs

Other relationships

Level 5 of the HELCOM HUB classification (2013).

This habitat has eight biotopes on HUB level 6;

AA.A1C1 Baltic photic rock and boulders dominated by *Fucus* spp

AA.A1C2 Baltic photic rock and boulders dominated by perennial non-filamentous corticated red algae

AA.A1C3 Baltic photic rock and boulders dominated by perennial foliose red algae

AA.A1C5 Baltic photic rock and boulders dominated by perennial filamentous algae

A further 4 biotopes described by HELCOM but on mixed substrata (predominantly hard) are also part of this habitat type (AA.M1C1, AA.M1C2, AA.M1C3, AA.M1C5).

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Yes

Regions
Baltic

Justification
This habitat occupies the major part of photic hard substrate in the entire Baltic Sea. The species composition is very characteristic of the shallower waters of the Baltic. *Fucus* spp. and *Furcellaria lumbricalis* are typically the dominating species, although where salinity decreases they are replaced by perennial green algae. The permanently submerged nature of the *Fucus* and *Furcellaria* is unusual (in other regional seas these are typical of an intertidal zone), and the gradation to domination by perennial green algae is unique to the Baltic Sea. The low species diversity of macroalgae, with the communities typically made up of a small number of species is also unique to the Baltic Sea.

Geographic occurrence and trends

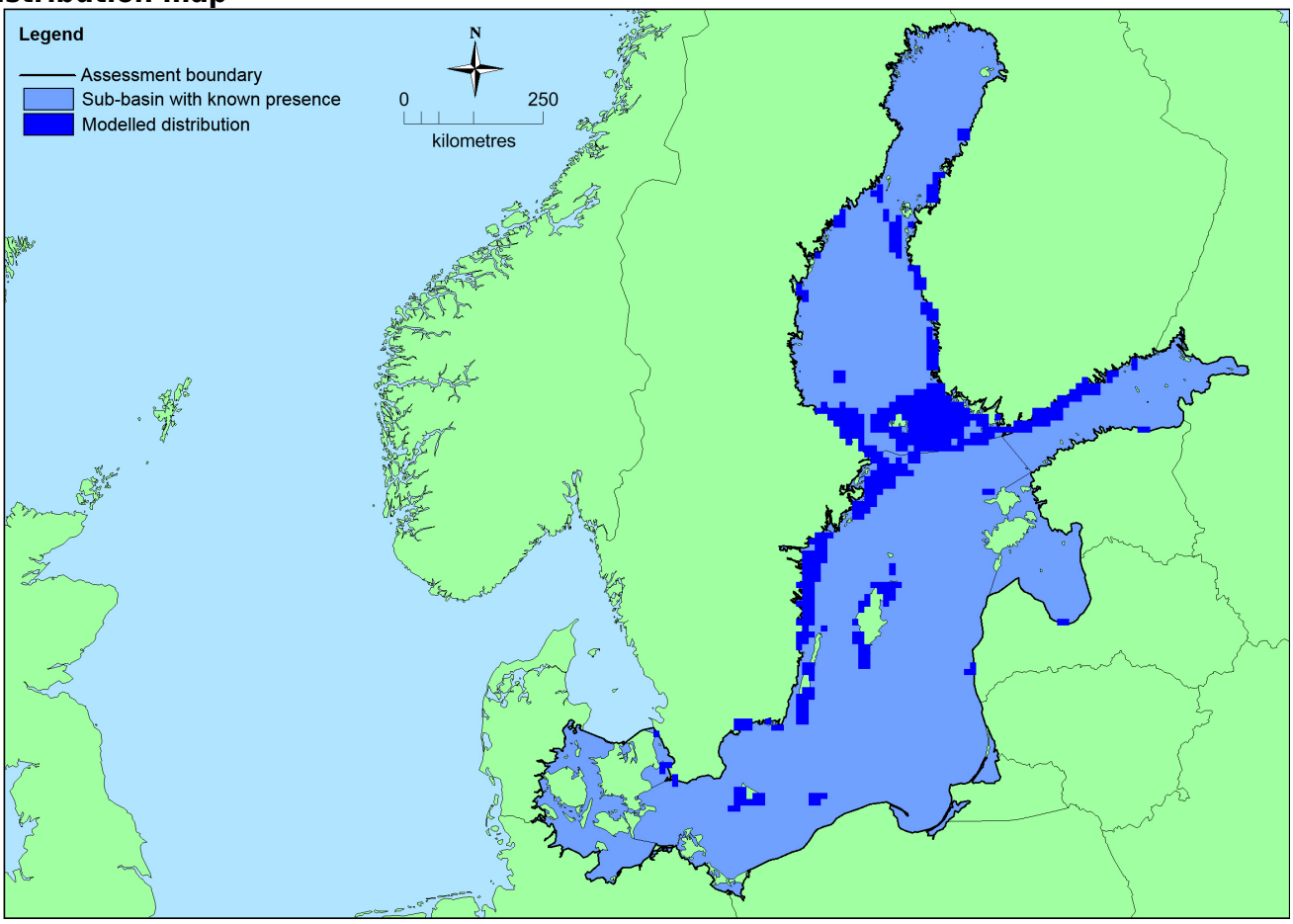
Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Baltic Sea	Baltic Proper: Present Belt Sea: Present Gulf of Bothnia: Present Gulf of Finland: Present Gulf of Riga: Present The Sound: Present	Unknown Km^2	Decreasing	Unknown

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	>50,000 Km^2	>50	Unknown Km^2	Present in all the Baltic sub-basins

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28+	>50,000 Km^2	>50	Unknown Km^2	Present in all the Baltic sub-basins

Distribution map



There is insufficient data to provide a comprehensive accurate map of the distribution of this habitat. This map has therefore been generated using the modelled data available on EMODnet for EUNIS level 3 habitats in the Baltic Sea (EMODnet, 2010). As such it indicates potential areas in which this habitat may occur according to the model, not its actual distribution.

How much of the current distribution of the habitat type lies within the EU 28?

This habitat occurs in the EU 28+ (Russia). The percentage hosted by EU 28 would be less than 100% but there is insufficient information to establish the proportion.

Trends in quantity

Significant changes in extent of this habitat, most particularly in its depth distribution, have been reported over the last 60 years. *Fucus vesiculosus* dominated areas in the Bothnian Sea, for example were six times more common and grew deeper and denser in the 1970s'. In the Gulf of Finland, bladder wrack belts in some areas are now growing to depths of 5-7 m whereas before the 1970s', single plants were even reported from 10 m. There has been some recovery since then. Macroalgae dominated habitats in many parts of the Baltic are now in good condition although inhabiting a narrower depth band but in some areas, such as Puck Bay and the Gulf of Riga, the *Fucus* dominated habitat is no longer present. Similar changes took place in *F. lumbricalis* beds between the 1940s and 1960s with declines in the maximum depth of the species and an increase in abundance of filamentous annual macroalgae.

The decrease in extent of this habitat throughout the Baltic over the last 50 years. has been attributed to

reduction in water clarity. The consequences have been changes in depth distribution, reduction in the occupied depth band, and disappearance of the associated *Fucus* from some locations (e.g. Gulf of Riga). In some areas the habitat is believed to have declined in extent by up to 50% in the last 50 years but some recovery has also been seen. On the scale of the whole Baltic Sea the decline is believed to have been less than 25%. A small further reduction of extent is predicted for the coming 50 years.

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  No
  Justification
  This habitat occurs in all the Baltic sub-basins so does not have a small natural range.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  This habitat occurs in all the Baltic sub-basins so does not have a small natural range.

Trends in quality

The average and lower depth limit of the macroalgae belt in the Baltic has decreased over the last 50 years. There have also been changes in the algal and faunal species composition such as an increase of abundance of filamentous annual macroalgae in some areas (e.g. Puck Lagoon, the Gulf of Riga and the Gulf of Finland). There is insufficient information to determine trends in quality over the last 50 years.

- Average current trend in quality
  EU 28: Unknown
  EU 28+: Unknown

Pressures and threats

Decreased light levels or increased epiphytic growth as a result of eutrophication (nutrient enrichment) are believed to be the main pressures resulting in the changes in the extent and quality of this habitat over the last 50 years. There are a number of pathways for such effects. Increased nutrient levels stimulate the growth of phytoplankton, which increases the concentration of particles in water and reduces the penetration of light within the water column. As nutrients are available in sufficient amounts for longer times throughout the year, phytoplankton blooms also last longer and occur more often during the season. This shortens the optimal growth periods for macrophytes. The reduced light can also confine the vertical distribution of vegetation communities as well as the biomass of algae. Increased nutrient levels stimulate the growth of opportunistic macrophytes. Their small size with fine, highly branched filamentous structure, provides a high surface to volume ratio and therefore a high rate of nutrient uptake. This enables such species to grow rapidly if abiotic conditions (light, temperature) are also favourable. The effects of eutrophication on this habitat have been most apparent through a reduced width of the depth zone occupied by the characteristic species.

Activities which increase turbidity or remove substrate, such as offshore constructions and stone fishing, are additional known pressures as is localised pollution, for example in the Stockholm archipelago, Tallinn Bay and Gulf of Riga. Changes in sea temperature, ice cover/scour and salinity associated with climate change will add to these pressures. For example, although *F. lumbricalis* is known for its wide tolerance range for salinity, sexual reproduction is curtailed below 7 psu where regeneration occurs via asexual reproduction. This can reduce genetic diversity and therefore make populations vulnerable to sudden environmental changes. Furthermore, as the salinity declines, a larger part of the shallow benthic primary production on hard bottom will be taken over by species tolerant of lower salinity such as green algal

species like gut weed (*Enteromorpha intestinalis)* and *Cladophora* spp.

List of pressures and threats

Mining, extraction of materials and energy production

Mining and quarrying
Renewable abiotic energy use

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
Nutrient enrichment (N, P, organic matter)
Input of contaminants (synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, acute events

Natural System modifications

Human induced changes in hydraulic conditions
Siltation rate changes, dumping, depositing of dredged deposits

Climate change

Changes in abiotic conditions
Temperature changes (e.g. rise of temperature & extremes)
Habitat shifting and alteration

Conservation and management

Improvements in water quality (reduction of nutrient inputs) are considered to have been a major factor in the recovery of the perennial macroalgal habitat in the Baltic as this has increased light penetration and reduced the scope for rapid and blanketing smothering of the canopy-forming species by ephiphytic annual algae. Controls on coastal and offshore constructions to avoid increasing turbidity and direct removal or damage to the habitat are also important conservation and management measures.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality

Measures related to marine habitats

Other marine-related measures

Measures related to spatial planning

Establish protected areas/sites

Conservation status

Annex 1:

1160: MBAL U2

1170: MBAL U1

1650: MBAL U2.

HELCOM (2013) assessments:

1160: VU C1

1650: VU C1

1170: VU C1

HELCOM (2013) assessments of all the associated biotopes was LC (A1)

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

The characteristic species *Fucus vesiculosus* and *Furcellaria lumbricalis* have a short natural reproduction cycle of up to 5 years therefore if environmental conditions are favorable and there is a seed population available, the habitat can recover over timescales of a few years to a decade. Boulders are common in areas composed of lag deposits covering boulder clay of Pleistocene origin. Such areas have the potential for hard-bottom regeneration by natural abrasion where 'stone fishing' has removed the substrate. In other situations artificial reef creation may be an option.

Effort required

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	<25 %	Unknown %	Unknown %	Unknown %
EU 28+	<25 %	Unknown %	Unknown %	Unknown %

Changes in extent of this habitat have been reported in studies undertaken since the 1940s' and these reveal that *Fucus* and *Furcellaria* beds have declined and now occupy a narrower depth band in many places. In some areas it is estimated that up to 50% of the extent has been lost but on the whole Baltic Sea scale the reduction is believed to be less than 25%. In recent years some beds have also become re-established in places where they became absent in the 1990s'. A small further reduction of extent is predicted for the coming 50 years.

Expert opinion is that overall this habitat has not declined by more than 25% over the last 50 years. Likely future trends in quantity have not been determined although a small future reduction is predicted over the next 50 years. This habitat has therefore been assessed as Least Concern under Criteria A for the EU 28 and EU 28+.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km^2	Yes	Unknown	No	>50	Yes	Unknown	No	No
EU 28+	>50,000 Km^2	Yes	Unknown	No	>50	Yes	Unknown	No	No

The distribution of some of the characteristic species associated with this habitat are well known but comprehensive quantitative data on its extent and area are not available. There are trend data from some locations (e.g. since 1943 in the outer Oregrund archipelago in the southern Bothnian Sea) and country specific data (e.g. estimated coverage of at least 52 km^2 in Estonia and a maximum of 1 km^2 in Lithuania), however the precise extent of this habitat is unknown. Likely future trends in quantity have not been determined although a small future reduction is predicted over the next 50 years. For example it has been suggested that if trends in temperature, total phosphorus concentration and chlorophyll a continue, water quality in the Bothnian Sea will deteriorate within 2-3 decades and reach levels that may lead to

major losses of *F. vesiculosis.*

Expert opinion is that although there are shortcomings with the data used to calculate EOO and AOO, because this habitat is known to be present in all the Baltic Sea sub-basins, does not have a restricted geographic distribution, and the associated threats are not limited to a few locations it should be assessed as Least Concern under Criteria B for both the EU 28 and EU 28+.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %
EU 28+	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %
EU 28+	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %	Unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	Unknown %	Unknown%	Unknown %	Unknown%	Unknown %	Unknown%
EU 28+	Unknown %	Unknown%	Unknown %	Unknown%	Unknown %	Unknown%

There has been some reduction in the quality of this habitat, indicated by smothering of macroalgae by epiphytes and reduction in the occupied depth zone but also some improvement in recent years. Experts consider there to be insufficient data on which to quantify this reduction and are therefore unable to make an assessment under criteria C/D for both the EU 28 and EU 28+.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	Unknown
EU 28+	Unknown

There is no quantitative analysis available to estimate the probability of collapse of this habitat type.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	LC	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	LC	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Least Concern	-	Least Concern	-

Confidence in the assessment
Low (mainly based on uncertain or indirect information, inferred and suspected data values, and/or limited expert knowledge)

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Contributors
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Reviewers
S. A. Wikström.

Date of assessment
03/07/2015

Date of review
30/12/2015

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