HRL 2018 look & feel verification report for Small Woody Features (SWF) status 2015 Finland

I. Administrative part

HRL	Small Woody Features status 2015
Verified area, region	Finland, in national projection clipped to country area.
Institution carrying out the work	SYKE
Overall visual checking done by (name, position and e-mail)	Minna Kallio, coordinator, minna.kallio@syke.fi
Look & feel verification done by (name, position and e-mail)	Minna Kallio, coordinator, minna.kallio@syke.fi Iida Autio, coordinator, iida.autio@syke.fi
In situ data used. *Replace Data-x with the full name of the dataset. Mention quality issues if relevant.*	Laser scanning, Canopy surface model years 2014-2016. The data on these years covers only parts of Finland.
	Laser scanning, Tree cover density TCD years 2014-2016. The data covers only parts of Finland.
	National High Resolution CORINE Land Cover 2018 raster Resolution of 20x20 m Reference year: 2018
	Colour infrared (CIR) ortho-imagery years 2014-2016, 2018
	Topographic database (buildings) years 2016
Reporting done by (name, position and e-mail)	Minna Kallio, coordinator, minna.kallio@syke.fi
Date and place of writing the report	30th June, 2021

II.   General overview of the verified data

Finland is generally covered with forests, and the SWF dataset is large containing over 1,3 million features. The sum area of the dataset is 4372 km^2 (Table 1).

Finnish landscapes have meaningful small woody features only on larger agricultural areas. In natural areas the vegetation has uniformly distributed gradients from open ground to vegetation cover and forest mosaic. Many natural and semi natural landscapes show more uniformly distributed gradients from open ground to vegetation cover as noted in the metadata of the product.

The outlook of homogeneous agricultural and artificial landscapes is more suitable for this kind of patchy, detailed data. In archipelagos of the Baltic Sea and in complex lake structures the small forests form patches, but the distances between them vary and the rules of the SWF data formation do not catch this variety.

The general overview of the data show that the geometric accuracy is often very good where forest patches or lines of trees can be observed. The geometric rules used in the interpretation of this product do not fit the northern landscape which limits the usability of the product.

It is beneficial that the member states received the EO data that the product is based on. Vegetation surface models based on national laser scanning can be a beneficial source for creating SWF products, where needed. In general, present SWF data are meaningless in forested mosaic landscapes.

The dataset covers all the country except lake areas and some areas in Lappland. Additional woody features are dominant in most places (Figure 1).
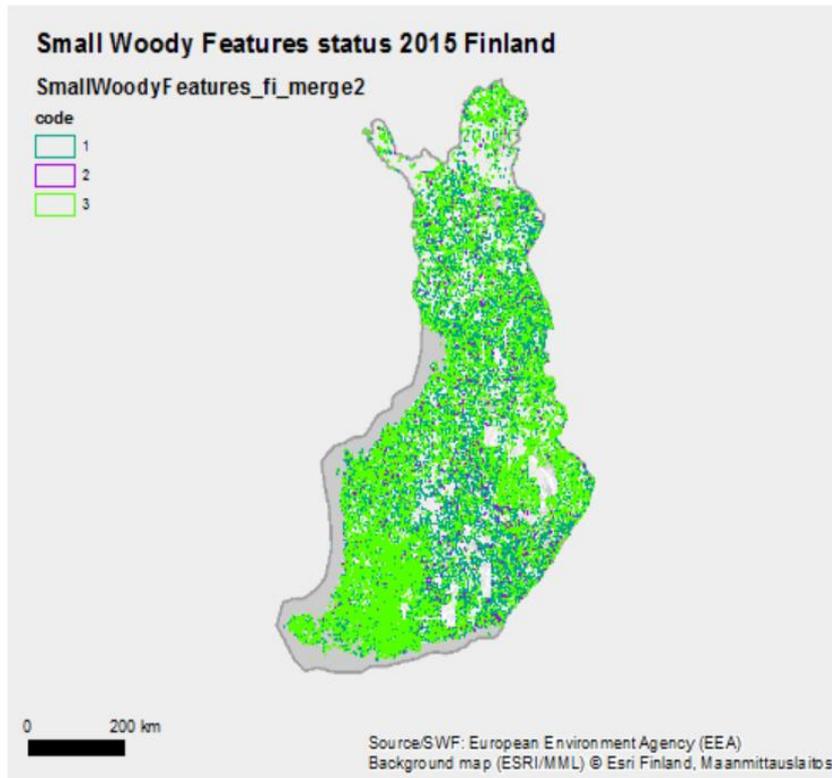
Figure 1: Overview map of Small Woody Features status 2015 Finland. The class values are: 1: Linear structures of trees, hedges, bushes and scrub; 2: Patchy structures of trees, hedges, bushes and scrub; 3: Additional woody features

Most of the area in SWF dataset belongs to the class Additional woody features. These   partly falls into forested land cover, which is dominating Finland (73%). The count of the features is highest in the class Linear structures of trees, hedges, bushes and scrub. The classification of the data into linear, patchy and additional woody features is not very informative in the Finnish landscape structure.

Table 1: Overview statistics - Small Woody Features status 2015 Finland

SWF 2015 Finland	Value	Area, km2	Area, %	Count, features
Linear structures of trees, hedges, bushes and scrub	1	1492	34	917 948
Patchy structures of trees, hedges, bushes and scrub	2	94	2	104 769
Additional woody features	3	2786	64	336 990
Total		4372	100	1 359 707

Compared to the National High Resolution CORINE Land Cover 2018 (later HR CLC2018) raster (resolution of 20x20 m), most of the area of linear features and patches (64-72 %) belongs to Forests and semi-natural areas (Table 2). The amount of the HR CLC2018 classes other than

forests and semi-natural areas falling inside the woody patches is partly due to different scales of the original data and partly to errors.

Table 2. Comparison of the HR CLC2018 (resolution of 20x20 m) in level 1 classes and SWF Linear and patchy structures.

National HR CLC 2018	SWF 2015 Finland, %		
Level 1	Linear structures	Patchy structures	Additional woody features
Artificial surfaces	18	14	9
Agricultural areas	10	8	6
Forests and semi-natural areas	64	72	79
Wetlands	5	3	4
Water bodies	2	3	2
Total	100	100	100

The artificial areas are generalized to some degree in the HR CLC2018 (resolution of 20x20 m), which explains the SWFs often fall inside built-up areas. Additional woody features are necessary to link the linear and patchy features to forests in Finnish landscape, but the figures that are formed beside big forest areas are not meaningful themselves (Figure 2).
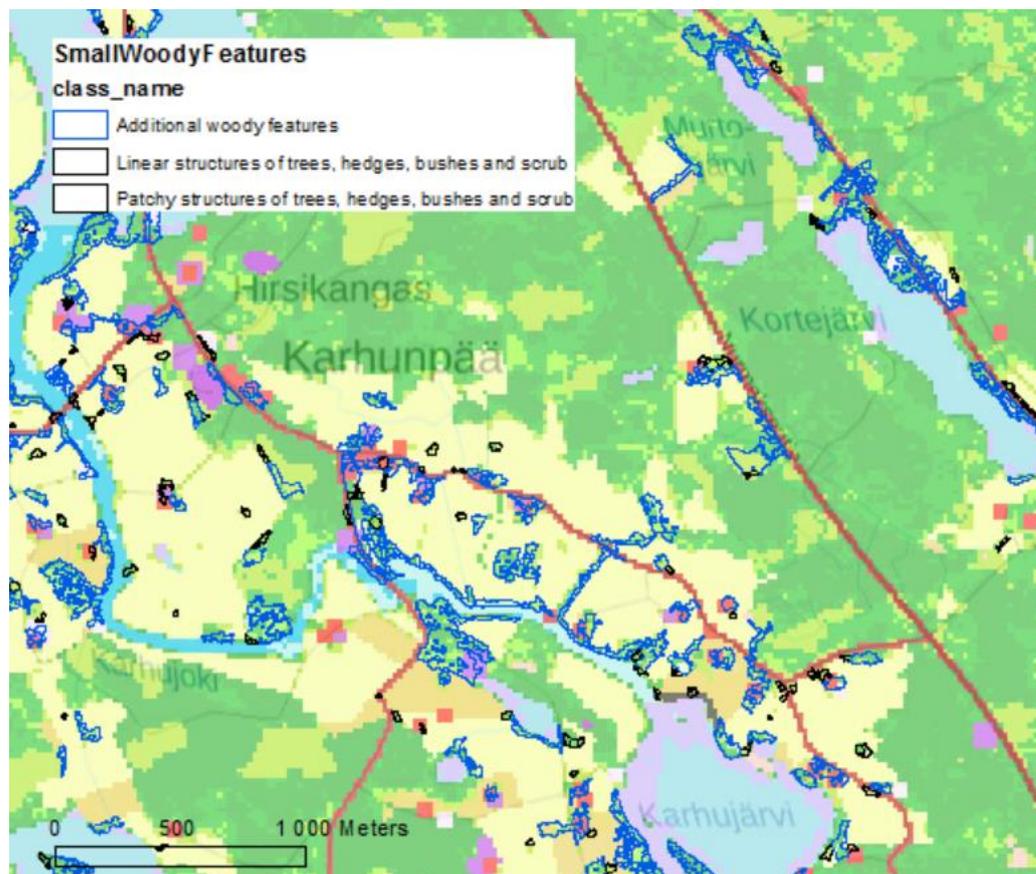

Figure 2. SWF polygons on the high resolution (20m x 20m) HR CLC2018 raster data. The artificial classes are drawn with red and purple, fields with yellow, forests with green and water with light blue colour. Centre point x 5250110, y 4627819.(ETRS-Laea)

Method used in the look and feel verification

For each stratum, 10 examples on 1:5000 were selected representing dominant LEVEL1 classes using the HR CLC2018 raster data. The screens were compared to Orthophotos and Vegetation height based on LAS where available, and the screens were evaluated from Excellent to Poor. The same screens were used to illustrate both commission and omission errors.
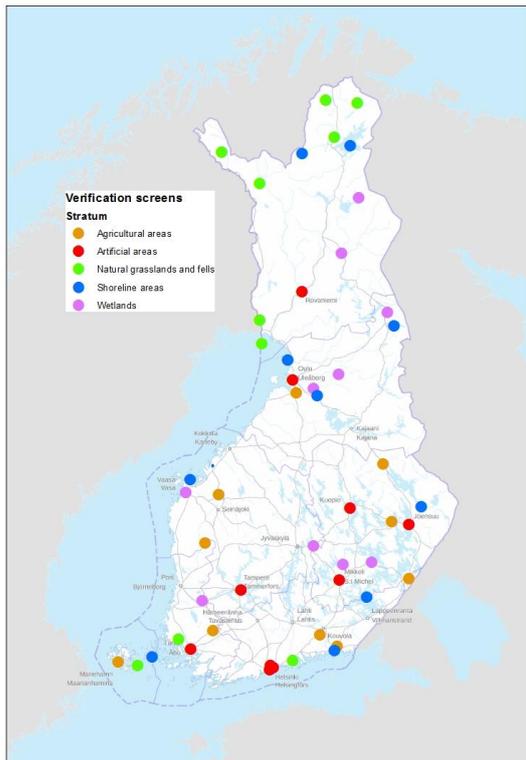

Figure 3: Verification screens for strata. Background map MML/ WMTS 06/20221.

In each stratum both omission and commission errors were found. Mostly the errors were due to the unsuitability of SWF to determine the landscape structure properly. This is also mentioned in the tables with remark: unsuitable. These evaluated examples are in file SWF02015_QuantitativeSamples_FI.shp. In section V the suitability of the SWF data in the Finnish landscape structure is demonstrated with examples.

Datasets including typical exampels of commission errors were created. On verification screens buildings and roads in Topographic database were intersected with SWF features. These examples are deliverd as shapefile SWF02015_Commission_grey_FI.shp.

For agricultural landscapes examples of errors was produced covering all over the country. The best national data available for finding the open areas inside the forest patches is Laser scanning CSM. Firstly, linear and patchy features were selected in areas dominated by agriculture, where laser data 2014-2016 and SWF data were available. The features were compared to vegetation height and those features, where over 50% was open, were separated. This means there is erroneous open space inside the features, or sometimes the result is a little shifted (Figure 4). Also, in some cases the temporal incompatibility can explain the result, although only data scanned

years 2014-2016 was used. No intersection was made, the shapes contain the whole figure with open parts.The dataset SWF02015_Commission_agri_FI is attached to the report.

Figure 4. SWF overlayed with CSM on agricultural landscapes. Source: Vegetation height - average, Laser scanning (8m) Source: SYKE (based on MML data). Centre point x 5050054, y 4844743.

III.   Overall visual checking

Positional accuracy			
Relative positional accuracy	Quick visual comparison of HRL data with Colour infrared (CIR) ortho-imagery identifying large positional errors)	*OK / correct* *NOK / not correct*	In most areas positional accuracy is excellent. There is positional error in Northern Finland due to incorrect projection (see section V).
Thematic accuracy			
Classification correctness	Simple look & feel thematic check (identifying basic thematic mistakes)	*NOK / not correct*	The quick visual comparison of the HRL SWF15 data with national orthophoto images indicate that the HRL SWF15 feature layer represents the forest patches and linear features accurately only in open agricultural landscapes.

IV.   Look & feel verification results

Details of look & feel verification

1.Included elements, possible OMISSIONS

Stratum	Name of the stratum (see proposed strata in Tables 5.2.2.x.b)	Number of samples verified	*Results of the verification by strata (excellent, good, acceptable, insufficient, very poor): see chapter 5.2 of the guidelines*
1	Artificial areas	10	*insufficient / not suitable*
2	Agricultural areas	10	*acceptable*
3	Natural grasslands and fells	10	*insufficient / not suitable*
4	Wetlands	10	*insufficient / not suitable*
5	Shoreline areas (sea, lake, river)	10	*acceptable / not suitable*
Overall evaluation			*Acceptable/ Not suitable. The method can find patches in artificial, open agricultural and shoreline areas. However, the features are applicaple only open agricultural areas. There are a lot of missing patches in the artificial areas.*
Comments, overview of results			*Most of landscapes in Finland are dominated by forests or mosaic of forests and other land cover. In these areas SWF is not a useful dataset. The data can be unsuitable even when a specific stratum is regarded here as good in terms of omission or commisson .*

2. Excluded elements, possible COMMISSIONS

Stratum	Name of the stratum (see proposed strata in Tables 5.2.2.x.c)	Number of samples verified	*Results of the verification by strata (excellent, good, acceptable, insufficient, very poor): see chapter 6.3 of the guidelines*
1	Stone walls	0	There are no significant stone walls in Finnish landscapes.
2	Drainage ditches	10	acceptable
3	Grass margins	10	good
4	Field boundaries without hedgerows or trees	10	good
5	Any kind of 'grey' infrastructure such as roads	20	acceptable
6	Artificial tree rows like olive	0	There are no significant plantation rows in Finnish landscapes.

tree planta-tions, vine-yards and or-chards		
Overall evaluation		Good. Grass margins and Field boundaries without hedgerows or trees were accurately interpreted. A common error is that the SWF includes drainage ditches. Grey infrastructure was better excluded in ag-ricultural screenshots than in artificial ones.
Comments, overview of results		The data were verified on agricultural areas and grey infrastructure also on artificial landscapes. Therefore, the results reflect only those landscape types.

V.   Documentation of errors and critical findings

The positional error in Northern Finland

There is a positional error in Northern Finland in the original tile swf_2015_005m_vec_FI_31287_128_full. The projection of the data is MGI_Austria_Lambert. The data was reprojected into Finnish coordinate system for the verification of SWF in the natural grassland and fell areas.
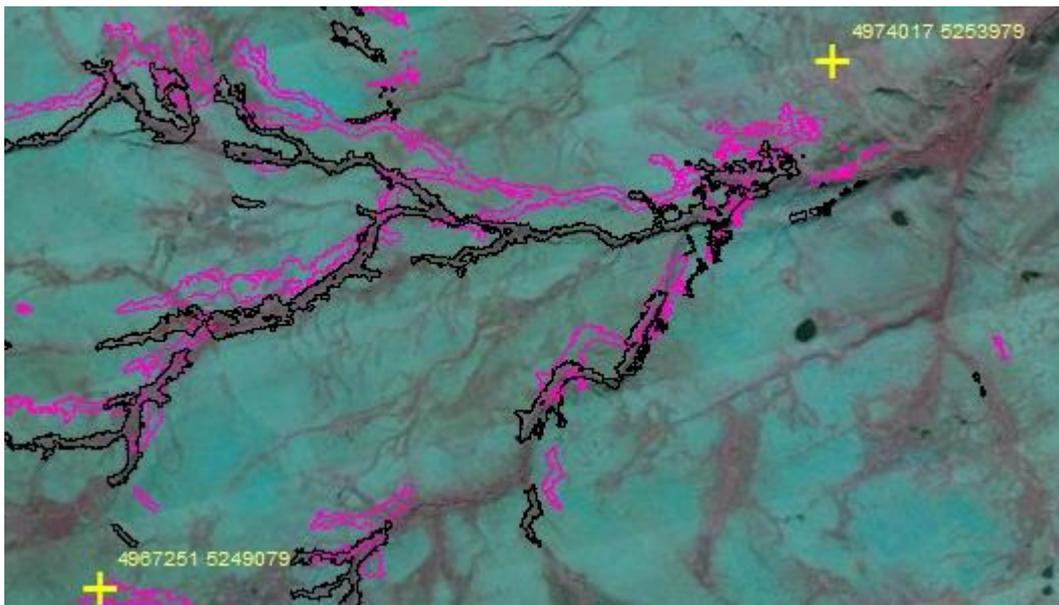

Figure 5. SWF layer originally (magenta) and with corrected projection (black) on Orthophoto (Source MML/Oct2020) in Northern Finland. Coordinates ETRS Laea; scale 1: 70 000.

There are also gaps in the data. Most of them were separated in the raster files with value 254, but also some other gaps were found. Some observed gap examples were roughly digitized and attached to the report as shapefile (SWF02015_FI_Gaps.shp)

The suitability of the SWF data in the Finnish landscape structure

Our overall analysis of SWF data in Finland shows that it is the most applicaple in landscapes with intensive agriculture. Screenshots of examples of data suitability or unsuitability were taken of each landscape type. The scale on screen was 1:5000 at the evaluation process. In most cases it is difficult to distinguish the optimal patch size and vegetation density in landscapes that have no such structures in nature. Also, the purpose of the dataset as an indicator of ecological stepping stones is questionable in forest dominated landscapes.

Artificial areas

Mostly Finnish cities are quite green. Only the very centres of bigger cities contain small parks (Figure 6 a). In most artificial areas vegetated areas contain mostly additional woody features and plain forests in the SWF classification (Figure 6 b).

Figure 6 a.

Figure 6 b.
Figures 6 a and 6 b: Small parks in continuous urban fabric are better suitable for small woody features than more common large green areas and discontinous urban fabric: delineation of patches and missing areas.
SWF product on artificial areas and Orthophoto as a background. With red outline: Linear and hedges, bushes Patchy structures of trees, hedges, bushes and scrub With blue outline: Additional woody features. Screen width 820 m.
a Centre point x 5145266 ; y 4205894
*b Centre point x 4994294; y 4207821*

Agricultural areas

On larger agricultural areas in southern Finland and in the west coast of Finland, the SWF data succeeds to catch the small woody parts inside the field areas.

Figure 7. Example of suitable small woody features inside the field areas in Southern Finland. SWF product on agricultural areas and Orthophoto as a background. With red outline: Linear and hedges, bushes Patchy structures of trees, hedges, bushes and scrub With blue outline: Additional woody features. Screen width 820 m.
Screen width 820 m. Centre point x 4969889, y4405252

Natural grasslands and fell areas

Forest areas are sparse and moisture variations are too high to determine any forest or bush patterns in the fell areas. Therefore SWF data is mostly incorrect in these areas.
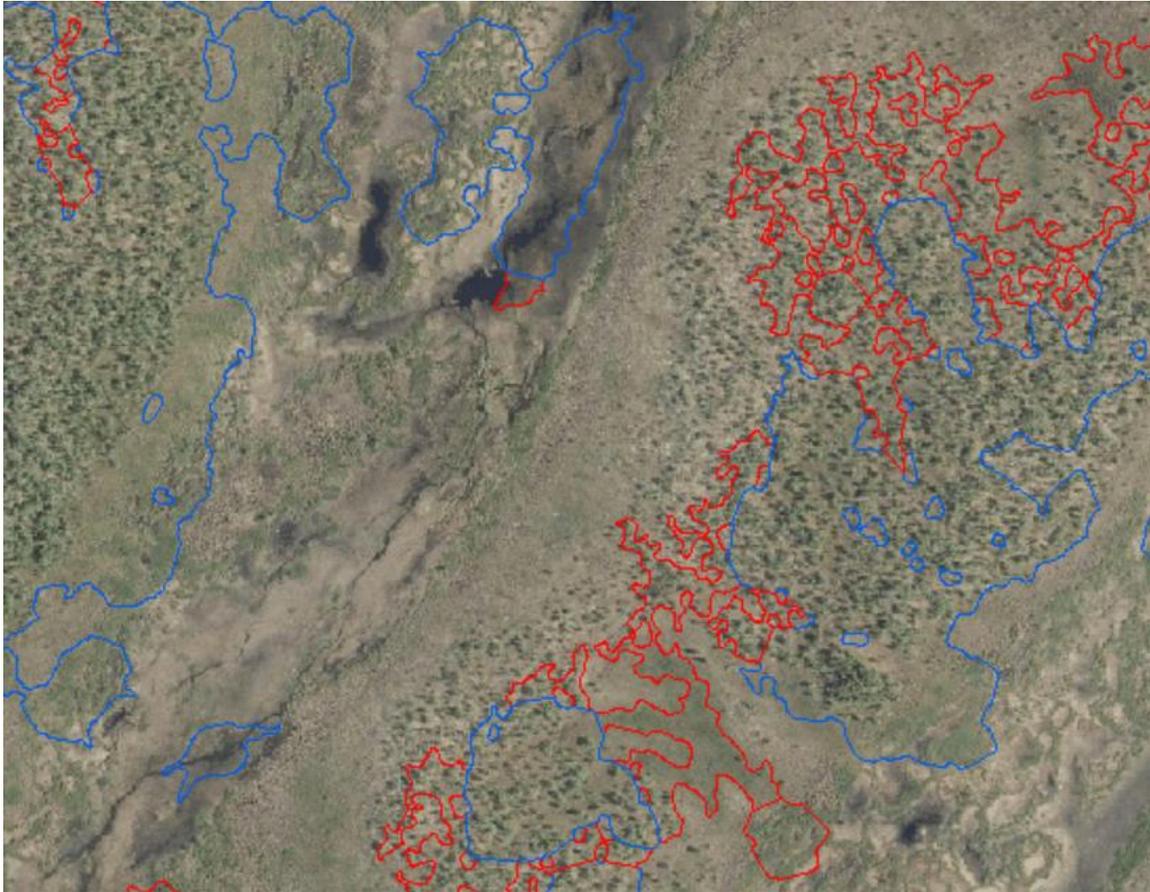
Figure 8: Example of small woody features inside the fell areas in Northern Finland: mosaic forest unsuitability and wet areas as SWF.
SWF product on fell areas and Orthophoto as a background. With red outline: Linear and hedges, bushes Patchy structures of trees, hedges, bushes and scrub With blue outline: Additional woody features. Screen width 820 m.
Centre point x 5027139, y 5262948

Wetlands

Forest areas are mosaic and moisture variations are too high to determine any forest or bush patterns in wetlands. Therefore SWF data is mostly incorrect in these areas.

Figure 8: Example of small woody features inside the wetland areas in Southern Finland: wet areas as SWF.
SWF product on wetland areas and Orthophoto as a background. With red outline: Linear and hedges, bushes Patchy structures of trees, hedges, bushes and scrub With blue outline: Additional woody features. Screen width 820 m.
point x 5185351, y 4902087

Shoreline areas (sea, lake, river)

On shoreline areas the clear woody or bushy shore itself can be distinguished from the water in the data. However, the usability of the data is not very high on these landscapes because smaller islands are not reached if the distance between the patches is too high.

Figure 9a.

Figure 9b.

Figure 9 a and 9 b: Examples of small woody features inside the shoreline areas. Some areas are missing near the shoreline. Unsuitaility of the landscape structure: small islands too far from the mainland
SWF product on wetland areas and Orthophoto as a background. With red outline: Linear and hedges, bushes Patchy structures of trees, hedges, bushes and scrub With blue outline: Addi-tional woody features. Screen width 820 m.
a Centre point x 5029664, y 4771738
b Centre point x 4912063, y 4512248

Attachments: SWF02015_QuantitativeSamples_FI.shp, SWF02015_Commission_Grey_FI.shp, SWF02015_Commission_agri_FI.shp, SWF02015_Gaps_FI.shp