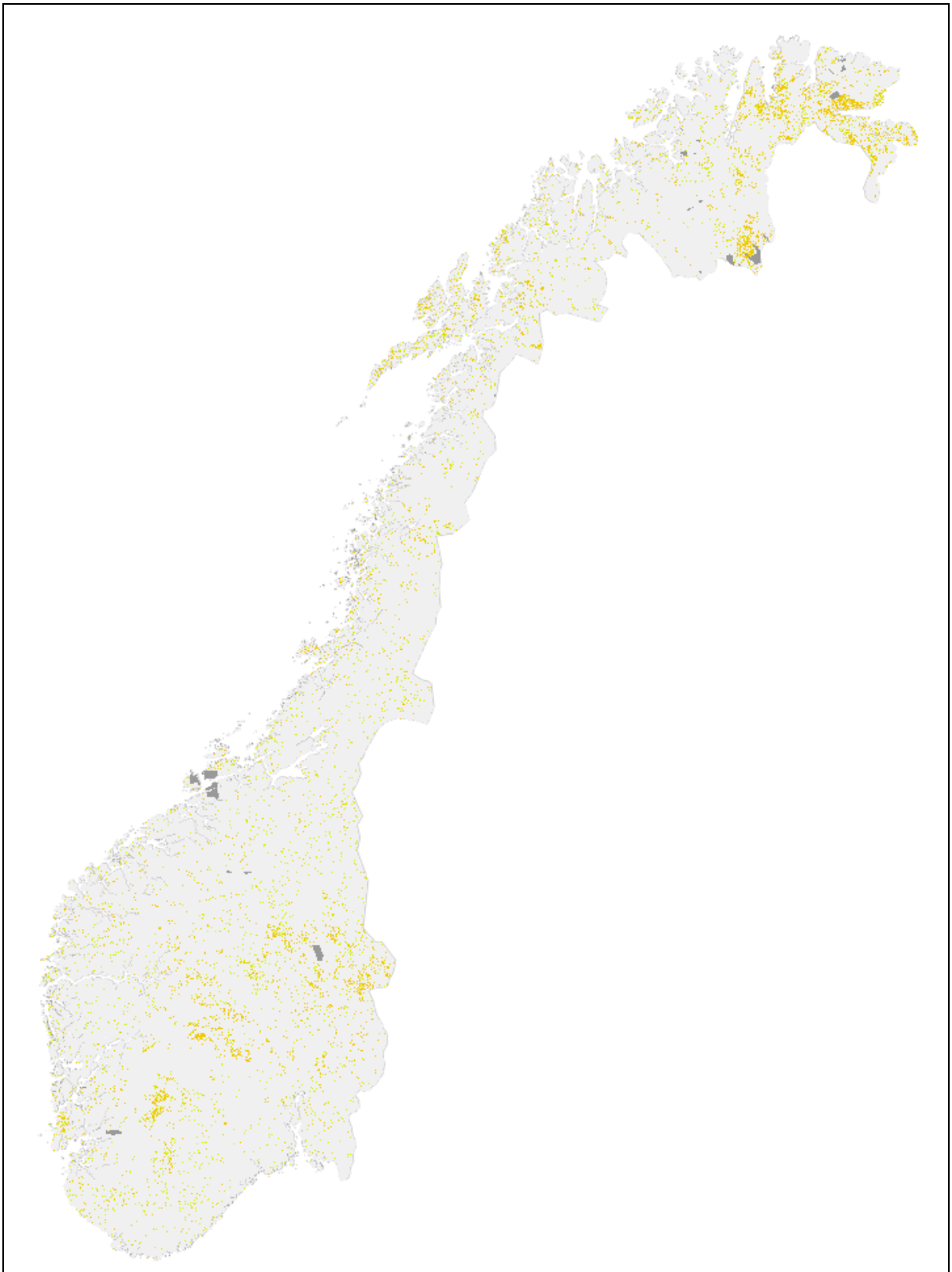
HRL 2018 look & feel verification report for

Small Woody Features (2015) Norway

I. Administrative part

HRL	*Small Woody Features 2015*
Verified area, region	*Norway*
Institution carrying out the work	*NIBIO Survey and statistics*
Overall visual checking done by (name, position and e-mail)	*Frode Bentzen, Senior Engineer Frode.Bentzen@nibio.no*
Look & feel verification done by (name, position and e-mail)	*Frode Bentzen, Senior Engineer Frode.Bentzen@nibio.no*
In situ data used..	*National ortophoto database Norge-i-bilder Ref: http://www.norgeibilder.no*
	National spatial data infrastructure Ref: http://kilden.nibio.no
	Ortophoto, topographic and thematic maps available as wms services were integrated with the HRL data using qGIS
Reporting done by (name, position and e-mail)	*Frode Bentzen, Senior Engineer, Frode.Bentzen@nibio.no Geir-H Strand, Director R&D, ghs@nibio.no*
Date and place of writing the report	*Ås 28.03.2021*

II. General overview of the verified data



SWF2015 Norway.

Statistical overview

Class	Value	Haa	%
Non SWF	*0*	*30 430 700*	*93,98 %*
SWF Area	*1*	*737 900*	*2,28 %*
Additional wooded feature	*3*	*1 052 900*	*3,25 %*
Unclassified	*254*	*159 600*	*0,49 %*
Total		***32 380 900***	***100,00%***

National statistics for small woody features are only available for agricultural landscapes. Statistics is not available for urban or natural areas.

III. Overall visual checking

Positional accuracy			
Relative positional accuracy	Quick visual comparison of HRL data with available EO imagery (identifying large positional errors)	*OK / correct,*	*The positional accuracy was checked by comparing the HRL and orthophoto for small woody features with crisp outlines. Checks were carried out at several latitudes and the positional accuracy is OK (also in the far northern part of the country)*
Thematic accuracy			
Classification correctness	Simple look & feel thematic check (identifying basic thematic mistakes)	*OK / correct,* *NOK / not correct*	*The overall impression is that small woody features in agricultural landscapes are quite correct. The results inside urban areas are also good, but with omission errors when grass is abundant in the understory. The mapping of small woody features in natural areas (forest, open lowlands, mire and mountains) is inconsistent. Class 3 (additional wooded features) is not interpretable. Large areas with mire and heath in the far north are assigned to this class.*

IV. Look & feel verification results

Look and feel was only carried out for class 1 SWF area. We did not carry out any look and feel assessment for class 3 Additional wooded features

1.Included elements, possible OMISSIONS

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).
1	Artificial areas	17	*Good* *SWF in artificial areas are often included, but also sometimes omitted. May depend on the species?*
2	Cropland	7	*Excellent* *SWF in cropland is usually included. Both linear structures along and between fields and patches (grave mounts and outcrops with trees) inside the fields are usually included*
3	Managed grassland	14	*Excellent* *SWF in managed grassland is usually included. Both linear structures along and between fields and patches (gravemounts and outcrops with trees) inside the fields are usually included.*
4	Mire/Wetland	11	*Insufficient* *SWF appears as isolated patches and linear elements along streams in mire and wetland. These are some times, but for from consistently mapped as SWF*
5	Rivers/lakes	11	*Acceptable. SWF along rivers and lakes are usually, but not consistently included*
Overall evaluation (based on look-and-feel)			*Excellent (for SWF areas) when attention is mainly on the built-up areas (urban, industrial, commercial, transport, quarries, mines) and good for agricultural areas.* *The classification in natural areas is highly variable*
Comments			*Omissions appear randomly in urban areas as well as in agricultural areas.*

2. Excluded elements, possible COMMISSIONS

Stratum	Name of the stratum	Number of samples verified	Results of the verification by strata (using qualitative evaluation as: Excellent, good, acceptable, insufficient, very poor).
0	Outfields	3 and scanned large areas	*Poor* *Although most natural areas without SWF are mapped as 0 (No SWF), there are also areas incorrectly mapped as SWF.*
1	Artificial areas	17	*Excellent* *Few if any commission errors in artificial areas*
2	Cropland	7	*Excellent* *Few if any commission errors on cropland (except for fruit trees, but these are evaluated as stratum 11 below)*
3	Managed grassland	14	*Good* *Few commission errors on managed grassland.*
4	Mire/Wetland	11	*Insufficient* *Mires are some times (randomly) classified as SWF*
5	Rivers/lakes	11	*Acceptable. SWF along rivers and lakes are usually, but not consistently included*
6	Stone walls	10	*Excellent* *No commission errors along stone walls. Stone walls with trees are usually correctly classified as SWF*
7	Drainage ditch	11	*Undetermined* *Drainage ditches are not common. The ditches we found were lined with trees and correctly mapped as SWF*
9	Field boundaries	7	*Excellent* *Field boundaries without trees are not mapped as SWF. Field boundaries with trees are mapped as SWF*
10	Railways	11	*Excellent* *Railways are not mapped as SWF except when lined by trees*
11	Plantations	10	*Insufficient* *Plantations (fruit trees) are often included as SWF*
Overall evaluation (based on look-and-feel)			*Excellent in built-up and agricultural areas* *Insufficient and variable in natural areas*
Comments			*The highly variable tree cover in many natural areas are not suitable for SWF-assessment. Users will probably focus on SWF in the built-up and agricultural areas.*

V. Documentation of errors and critical findings

Please include detailed descriptions, meaningful examples and screenshots of errors, critical findings. Please make sure the nature, location and frequency of the issue is described in some detail. Screenshots should contain ETRS1989 LAEA coordinates.

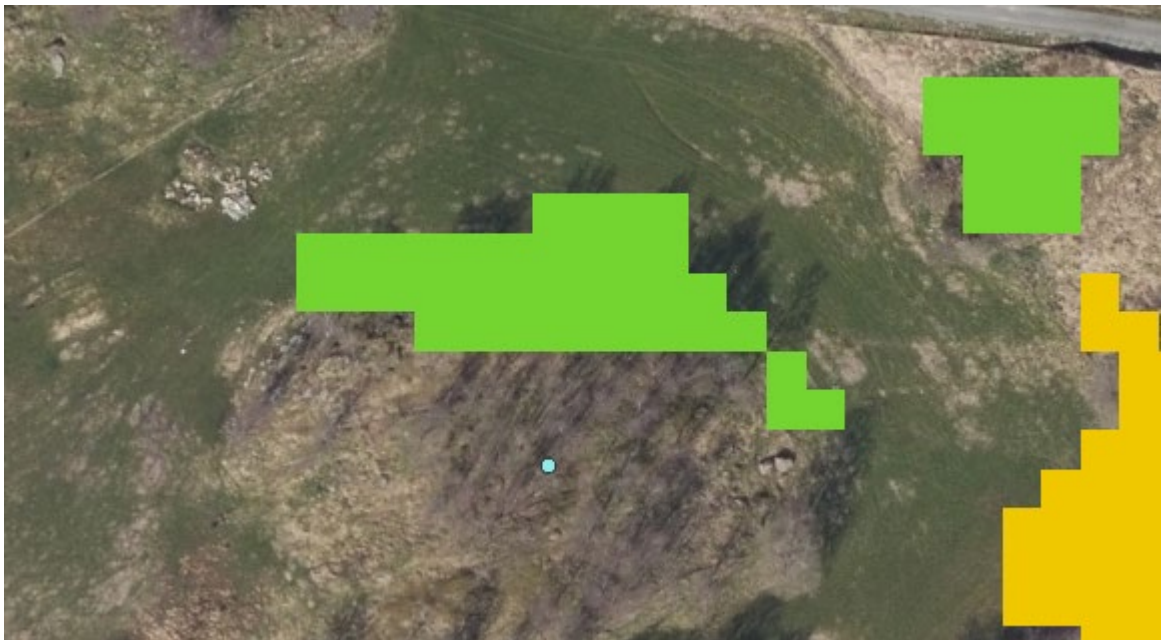
Good example of class 1 in outfield aareas. Cluster of treess correctly classified as SWF in a large wetland/mire area [4497094, 4575592]

Good example of class 1. Small forest between agricultural land and water correctly classified as SWF [4217710, 4077217]

Good example of class 1. Strip of trees between an agricultural field and the river, correctly classified as SWF [4393566, 4513207]

Good example of class 1. Strip of trees separating two agricultural fields, correctly classified as SWF. [4555794, 5108523]

Inaccurate classification of SWF. The two rows of trees along the river Orkla are correctly classified as SWF. The forested island in the middle of the river is classified as AWF. The error is the large patch of agricultural land (at the end of the arrow) that is agricultural land used for grass production [4334135, 4388952]



Inaccurate delineation of SWF. Only the northernmostt part of the forest patch is classified as SWF, but the patch extends southward to include the area around the small blue point [- 4086622, 4010375]

The area around the yellow dot is incorrectly classified as SWF. This is a patch of dwarf shrub heath inside an area otherwise dominated by lichen [4924961, 5121030]

Peatland with shrub incorrectly classified as SWF next to the small pond. [5085620, 5271799]

Dwarf shrub heath between rock outcrops, incorrectly classsified as SWF. [4168402, 4194578]

Dwarf shrub heath between rock outcrops, incorrectly classsified as SWF. [4572883, 4933646]

Dwarf shrub heathsurrounded by lichen heths. The dwarf shrub heath is incorrectly mapped as SWF [4900077, 5133518]

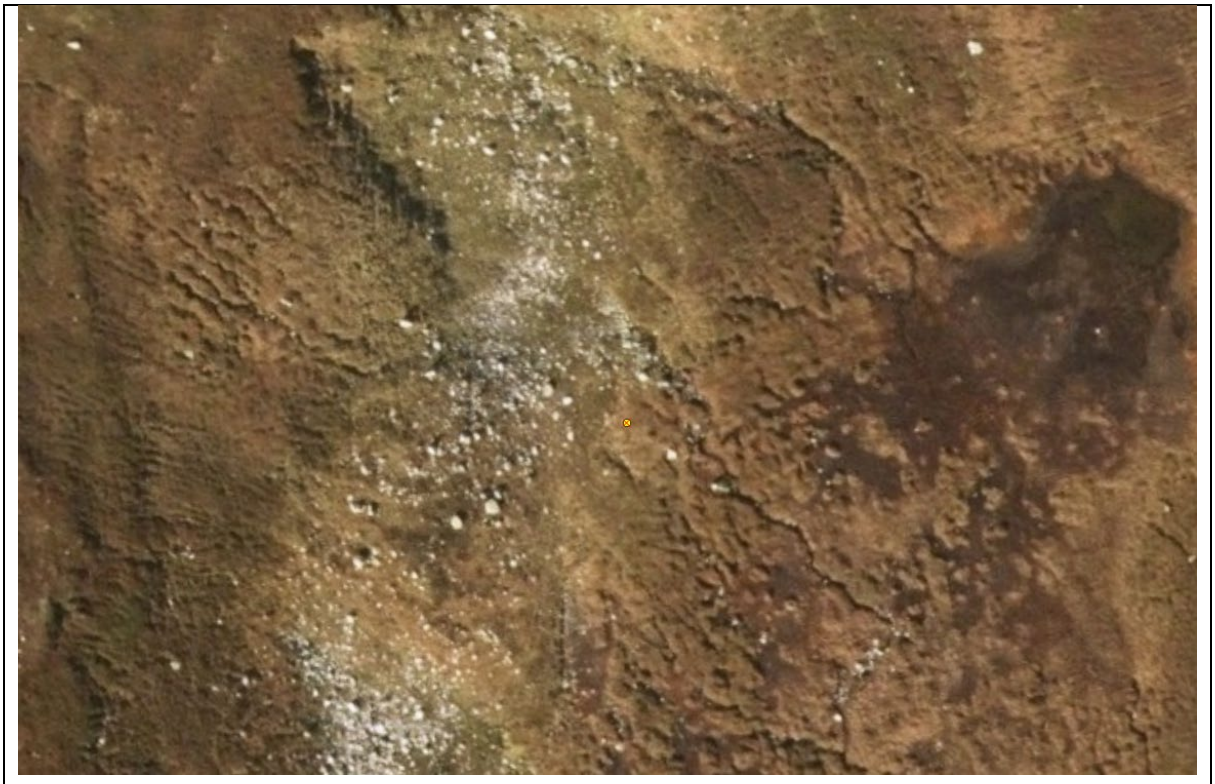
Mire/wetland with shrubs uncorrectly classified as SWF [4363716, 4412465]

Bare rock in deep shadow along the shoreline (ocean) is incorrectly mapped as SWF. [4274899, 4499758]

The shadow cast by the houses is incorrectly classified as SWF. [4116315, 4388680]

Imprecise delineation of SWF along a river. The shadows reaching approximately 11 meters into the agricultural field are included in the SWF area. [4254494, 4306107]

Agricultural field incorrectly classified as SWF [4369426, 4013026]



Mire and dwarf shrub heath incorrectly classified as SWF [4293743, 4130143]

Mire incorrectly classified as Additional woody feature [4907283, 5171885]

Muddy swamp incorrectly classified as Additional woody feature [4186806, 4078724]

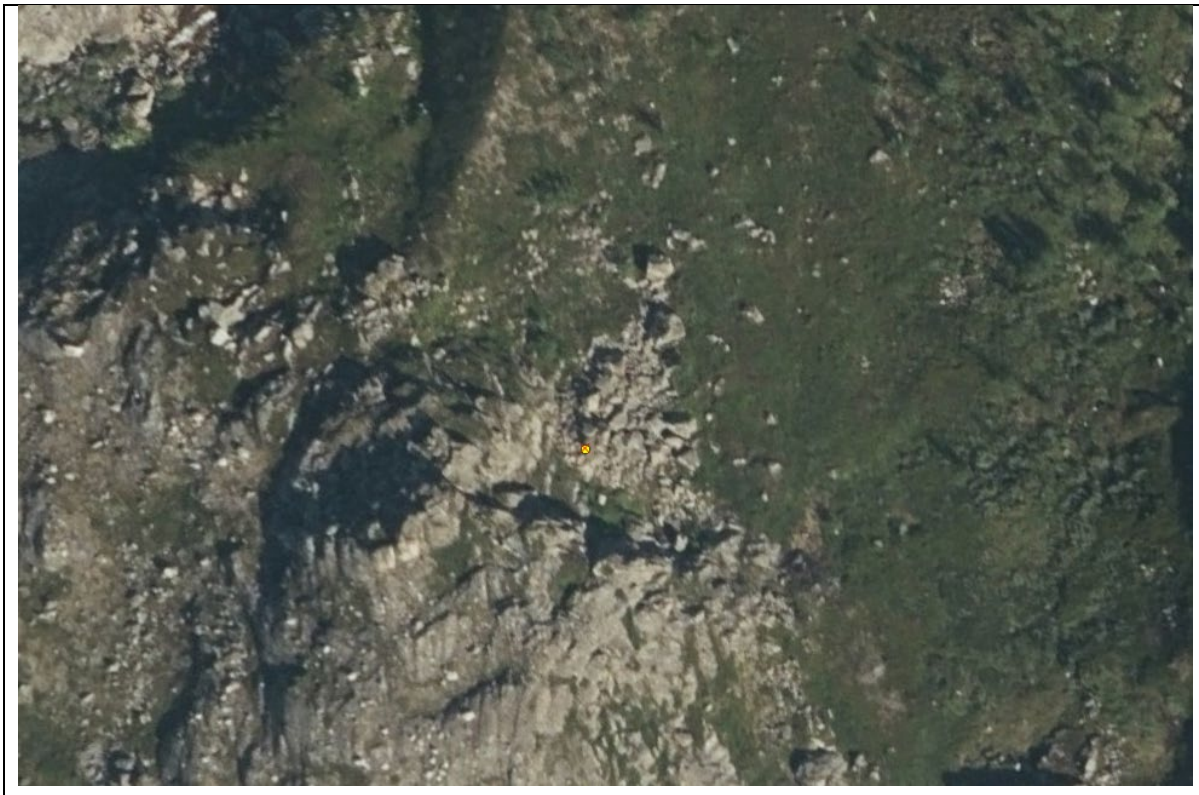
Patch of trees incorrectly classified as Additional woody feature. Sholuld be classified as SWF [4387678, 4176710]

Line of trees along the shore incorrectly classified as Additional woody feature. Sholuld be classified as SWF. [4426249, 4783133]

Patch of trees incorrectly classified as Additional woody feature. Should be classified as SWF [4366886, 4484394]

Patch of trees in a heath and mire mosaic incorrectly classified as Additional woody feature. Sholuld be classified as SWF [4580407, 4994952]

Imprecise delineation of Additional woody feature. The boundary is drawn 10-13 meters inside the mire (class 0). [4826898, 5231376]



Bare rock and dwarf shrub heath incorrectly classified as Additional woody feature. Sholuld be classified as class 0 [5120983, 5295658]

Patch of trees incorrectly classified as Additional woody feature. Sholuld be classified as SWF [4645752, 5182672]

Mire/swamp with bushes incorrectly classified as Additional wooded feature. [4982006, 5317946]

Lichen heath incorrectly classified as Additional wooded feature. [4400196, 4275125]

Open mountain forest classified as Additional wooded feature [4922346, 5156221]

Dwarf shrub heath with shrubs incorrectly classified as Additional woody feature. Sholuld be classified as class 0 [4781232, 5312672

VI. **Statistical verification** (optional)

Description of methodology and software	*Samples were obtained by stratified random sampling using the HRL as strata. The sampling sizes is found in the table below.* *Each sample point was examined on topographic maps and recent orthophoto using qGIS.* *Accuracy was calculated following standard methodology using SPSS*
Stratification	*0: Not SWF* *1: SWF Feature (linear or area)* *3: Additional wooded feature*
Comments	*The interpretation of ground truth was conservative. The HRL was accepted as correct when the analyst was in doubt. Misclassification was only recorded when the analyst was confident that an error was present.* *Class 0 was only considered as wrong when it clearly should have been classified as SWF. Class 3 was not considered as an option.* *Class 1 was considered as wrong when it clearly should not have been classified as SWF. It was classified as 3 when wooded, otherwise as 0-* *Class 3 was considered as wrong when it clearly should have been classified as SW (class 1) or did not contain any wooded features (class 0).*

Please copy here the (weighted) confusion matrix and main accuracy parameters and provide the corresponding Excel file in attachment.

SWF2015 Verification strata sizes

		Haa	%
HRL	**0**	30 430 700	93,98
	1	737 900	2,28
	3	1 052 900	3,25
	254	159 600	0,49
	Total	**32 381 100**	**100,00**

SWF2015 Verification raw data confusion matrix

		Ground truth			
		0	**1**	**3**	**Total**
HRL	**0**	392	8	0	**400**
	1	81	87	27	**195**
	3	72	16	111	**199**
Total		**545**	**111**	**138**	**794**

SWF2015 Verification weighted confusion matrix

		Ground truth			
		0	**1**	**2**	**Total**
HRL	**0**	0,921	0,019	0,000	**0,940**
	1	0,009	0,010	0,003	**0,023**
	2	0,012	0,003	0,018	**0,033**
Total		**0,942**	**0,032**	**0,021**	0,995

SWF2015 Verification Overall accuracy

Accuracy	95% CI	Lower	Upper
94,9 %	1,3 %	93,6 %	96,2 %

SWF2015 Verification User's accuracy

		Accuracy	95% CI	Lower	Upper
HRL	**0**	98,0 %	1,4 %	96,6 %	99,4 %
	1	44,6 %	7,0 %	37,6 %	51,6 %
	2	55,8 %	6,9 %	48,9 %	62,7 %

SWF2015 Verification Producer's accuracy

		Accuracy	95% CI	Lower	Upper
HRL	**0**	97,8 %	0,3 %	97,5 %	98,1 %
	1	32,2 %	14,0 %	18,2 %	46,2 %
	2	85,2 %	4,8 %	80,4 %	90,0 %