ORCHARD CONSERVATION REPORT

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Conservarea biodiversităţii şi dezvoltare comunitară în Transilvania
Biodiversity conservation and community development in Transylvania

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Fundaţia ADEPT Transilvania
2016

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Biodiversity conservation and community development in Transylvania

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Introduction

Fruit trees play a key role in the Transylvanian landscape. Besides being used as food source they were also used to mark parcel boundaries and to provide shadow for sheep herders or farmers. As such these trees can be found not only in the form of established orchards but also in small patches along roads, between fields or playing a key role in the establishment of a wood-pasture.

The old fruit trees play a key role in the agro-biodiversity chain and thus the need to protect them is high. Currently they are under threat. Some of them have been cut down and there are not new ones planted.

The current document refers to the methological steps used in order to identify the target area for the project and also includes some conservation issues and legal aspects.

For the identification of target areas the steps were:

-preliminary identification using satellite data
-integration of the satellite phase with ortophoto imagery and parameters such as slope and aspect
-development of an occurrence model for the remote identification of target areas
-field check of the model
-final selection of target areas

PART A. Identification and analysis. Developing a model for target areas

1. Satellite data

1.1 Processing remote sensing data

The satellite data used is represented by WorldView2 multispectral and panchromatic images, 2 meters spatial resolution. These images were analyzed in the GIS environment in order to select an optimum band combination for the purpose of the project.

This step involved the following stages:

-selection of best band combination in order to identify target areas
-identification of spectral signatures for different orchards
-satellite data interpretation using specific software and algorithms
-result validation
-presentation of the final result in this step

The first stage included the delimitation of the project interest area and selection of satellite data bands to be integrated and interpreted

The satellite images used were the ones with minimal errors (the errors were further addressed in the process), referring mostly to cloud formations.

The WorldView2 bands are:

a.Coastal Blue (0.40 - 0.45 µm)

• Chlorophyll absorption, blue light scattering, water depth

• Supports coastline water depth studies.
• Subject to atmospheric scattering
b. Blue (0.45 - 0.51 μm)
• Blue band is designed for water body penetration
•Useful for soil/vegetation discrimination, forest type mapping and cultural feature identification.
c.Green (0.51 -0.58 μm)
• Green Band is useful for measuring green reflectance of vegetation.
• Can be used for cultural feature identification.
d.Yellow (0.585 - 0.625 μm)
• Important for vegetation and turbidity applications.
• Useful for vegetation and material feature identification.
e.Red (0.63 -0.69 μm)
• Red is sensitive to chlorophyll absorption region.
• Useful for vegetation analysis and differentiate plant types.
• Useful for cultural feature identification.
f.Red Edge (0.705 - 0.745 μm)
• Aids in the analysis of vegetation and vegetative condition.
• Directly related to plant health revealed through chlorophyll status
g.Near Infrared (NIR1) (0.77 -0.895 μm)
• NIR band is useful for determining vegetation types, vigor and biomass survey, delineating water bodies, and for soil moisture discrimination.
h.NIR2 (0.86 – 1.04 μm) • Overlaps the NIR1 band,
• Supports vegetation analysis, materials differentiation and biomass studies;
• Has water vapor influence.

Table 1. Band combinations analyzed

Band combinations	***Applicability***	***Tested/Not***
532	Natural	tested
763	Forest areas	tested
573	Natural vegetation	tested
678	Pastures and build areas	tested
352	Deforestation	tested
532	Natural color	tested
753	Fake color	tested
732	Altered fake color	tested
765	Vegetation II	tested
841	Land use models	tested
876	Vegetation, water, build up areas	tested

After the testing of these band combinations, the most suitable was selected (573 combination). The band combination was the best in order to identify land use types and features like old orchards with aged trees.

Besides this combination the analyses includes also some other band combinations, used to refine the first results.

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Some examples of tested band combinations are:

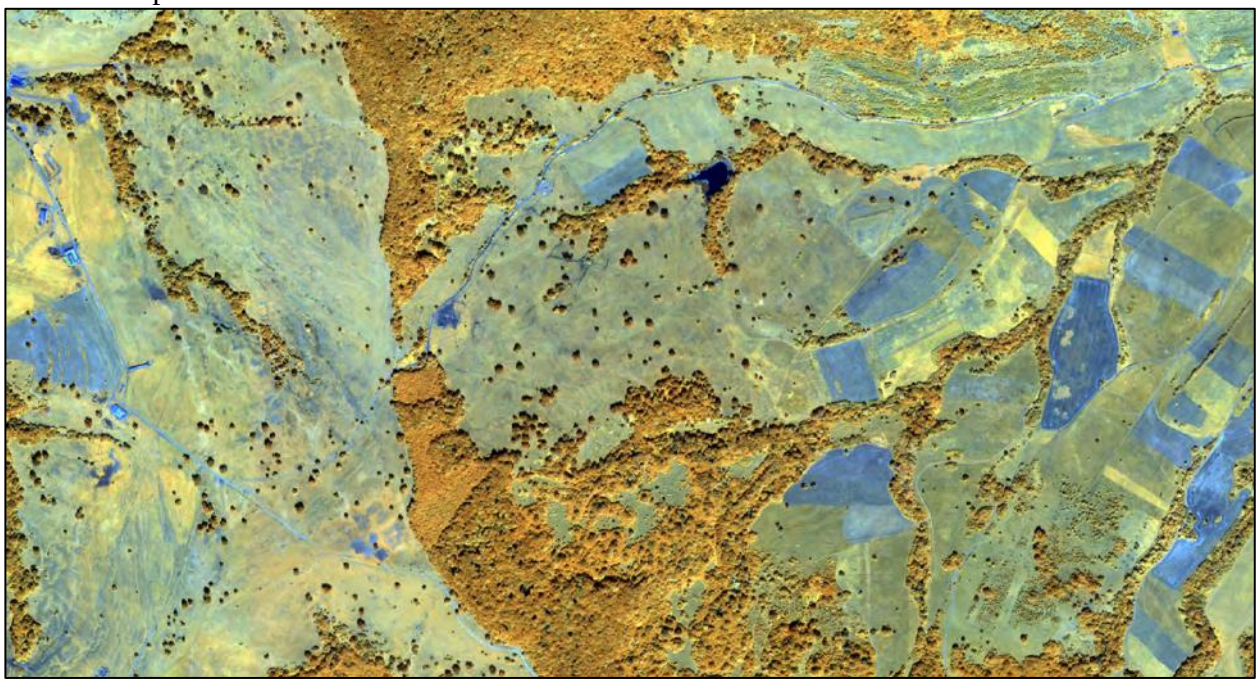

Fig. 1 Combination of bands 7,6 and 3 useful for forest area delimitation

Fig. 2 Combination of bands 5,3 and 2 useful for natural area identification

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1.1.1 Spectral signature file

The band combination being selected we moved to the next stage that is the identification of spectral signatures for orchards. This was done by the expert using field data and expert judgment. There were selected 21 samples.The selection was validated by using statistical methods, creating scatter-plots and histograms. The result of this stage was a spectral signature file.

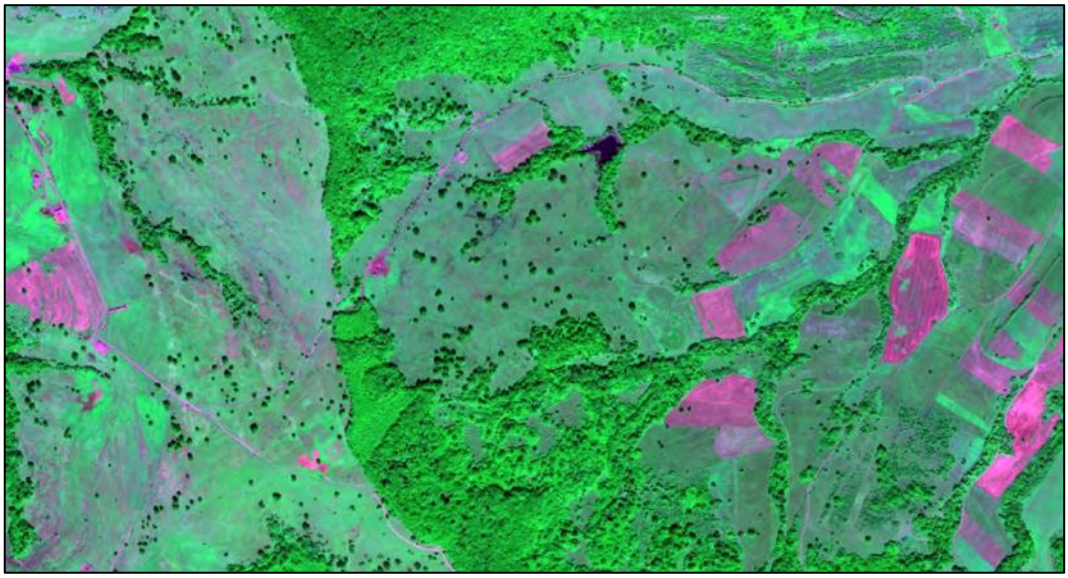

Fig. 3 Combination of bands 5,7 and 3, useful for natural vegetation identification

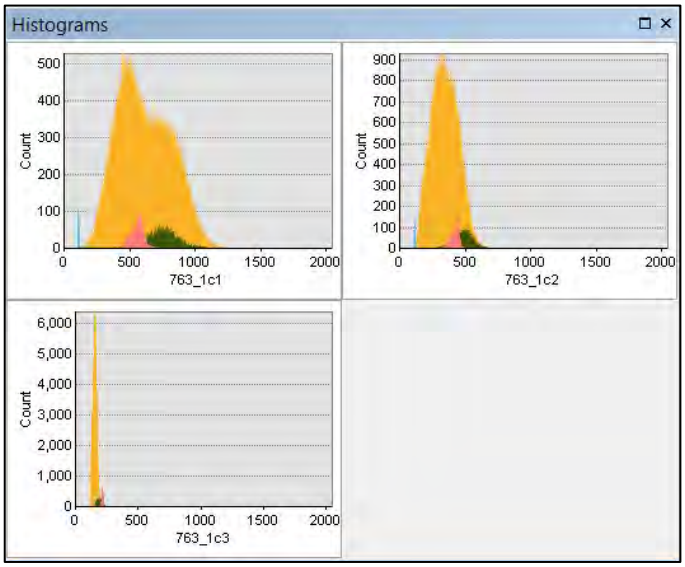

Fig. 4 Histogram used in the validation of spectral signatures

1.1.2 Classification

The final part involved the usage of classification techniques like Maximun Likelihood Classification, error elimination and genealisation, by using techniques like filtering, smoothing and generalizing.

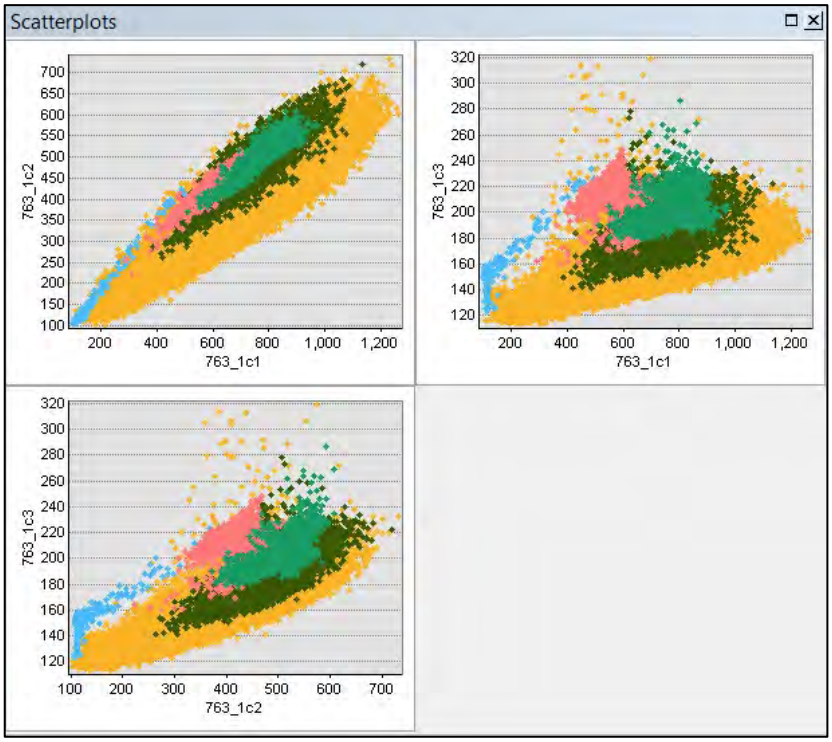

Fig. 5 Scatter plots

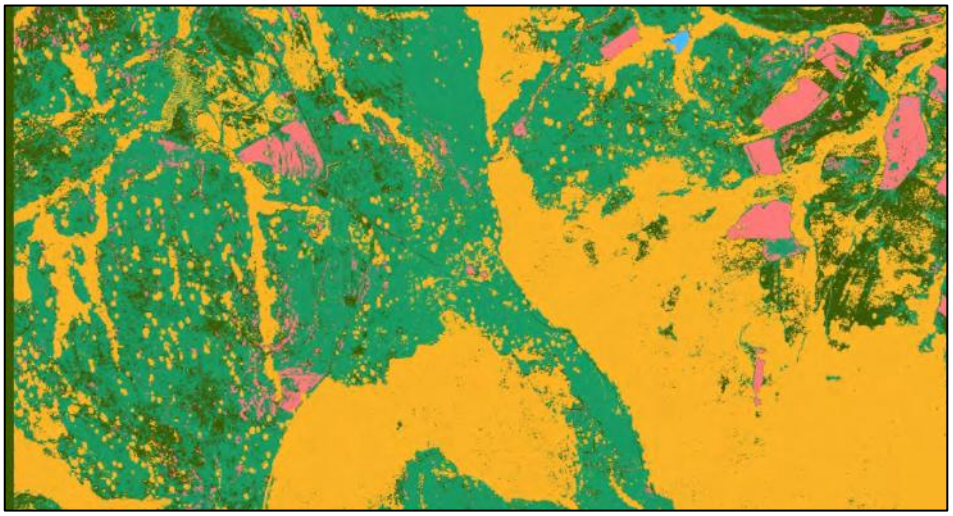

Fig. 6 The classified image

1.1.3 Image processing

In order to preliminary identify the interest areas the classified image was processed in GIS environment. The purpuse is to extract target areas by identifying (on the classified image) areas with scaterred trees. The classes used in order to deliniate land use types were: forest/trees (orange colouring see ***Figure 6*** for this and other classes), arable/barren land (pink), water (blue), pasture (green), tall herbs/scrub (dark green).

This development in the model was necesarry because of the difficulty in identifing directly the old trees from orchards. Their spectral signature is pretty similar to that of other trees so direct identification was not fessible.

As a result we developed a model centered on identifying patterns in the forested areas, by forested areas understanding all vegetation types composed of trees.

The model is based on the classified image obtained after the satellite data processsing and on the expert assesment stating that old fruit trees are found in clusters on flat or almost flat plateaus used as pastures for centuries. This asumption was fied tested and it proved to be correct.

First the classified image was cleaned using the Majority Filter tool. This tooll removed the single, misclassified cells in the classified image. The input requirement were: usage of the four neighboorhood cells and a majority of cells with the same values (three out of four method).

The resulting image shows groups of scattered plots. The small misclassified pixels are removed.

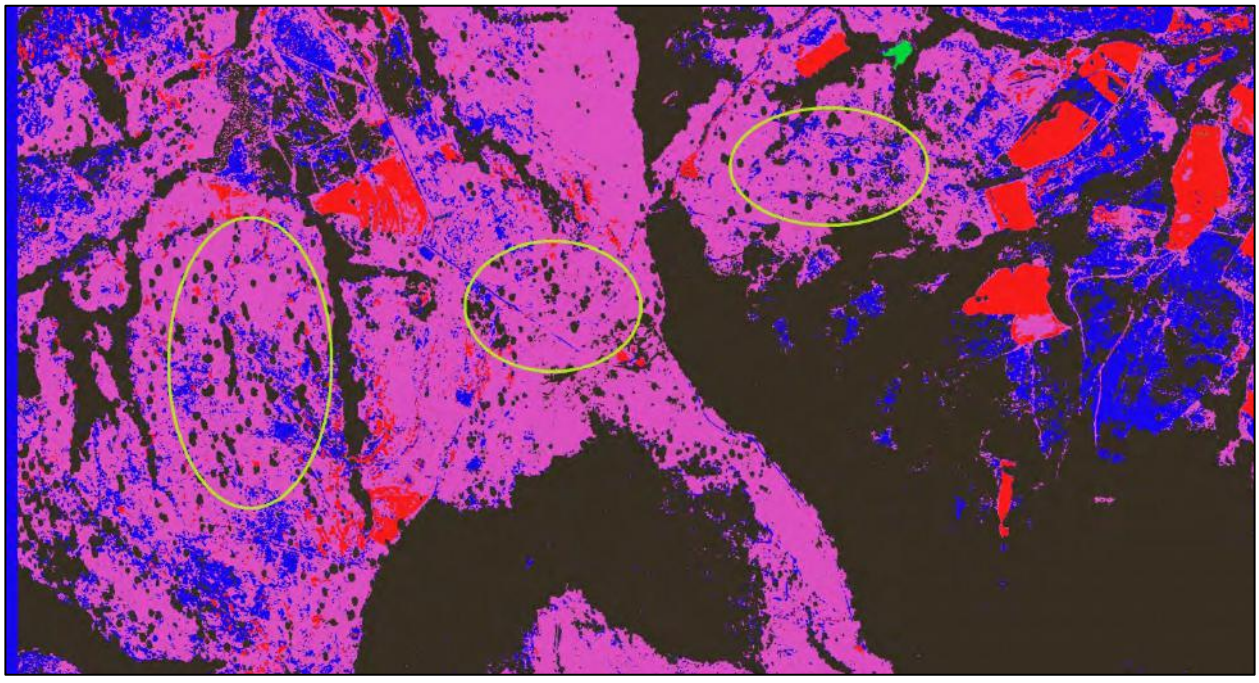

Fig. 7 Majority Filter result showing groups of trees

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In order to further improve the result the Boundary Clean tool was used. The specific input requirements were to expand small areas into larger neghbouring ones. This requirement specifficaly adress the isue of small group of trees, the aim being to delineate them better.

The result shows better delineated patterns in the image data, with better defined groups of trees. Almost all pixels previously missclassified are removed.

The Majority Filter and Boundary Clean tools will only process out the single or very small clusters of a few misclassified cells by assigning them to the value that appears most frequently in the immediate neighborhood. This is also the purpose of the proposed model. Ussualy in order to clean up small areas under a a certain size threshold some other processing techniques are required. By the purpose of the model we want to precisely identify well delineated clusters of trees. This requires removal of small areas and aldo defining the so called regions (clusters with the same land use type).

In order to do this the Region Group tool is applied. This tool assigns a unique identifier code to each region in the classified image. A region is defined as being any contiguous group of cells of the same value.

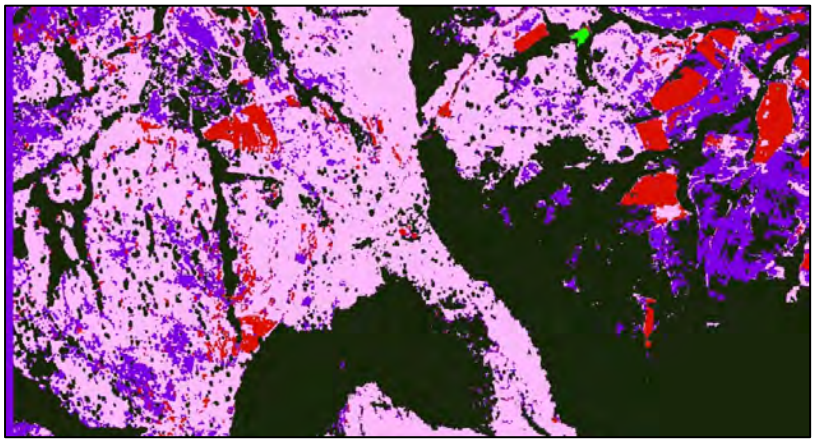

Fig. 8 Boundary Clean output

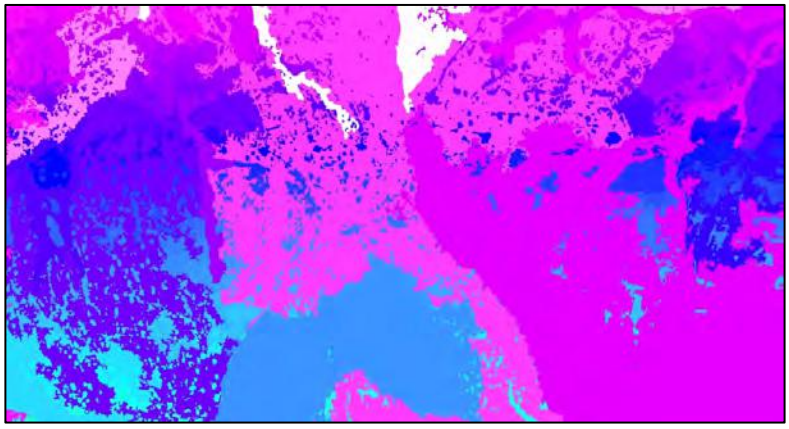

Fig. 9 Region Group output

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After this processing we have obtained well defined regions with unique identifier codes. Now we can extract these region by using a area (number of pixels) threshold. This is done by using the Extract by Attributes tool. The higher threshold COUNT used was 500 pixels. This is based on direct measurement on the image and field checks that prove the thresold as meaningfull.

It needs to be mentioned also that in these step all classes not identified as forest were removed from the data in order to limits the output only to tree covered areas.

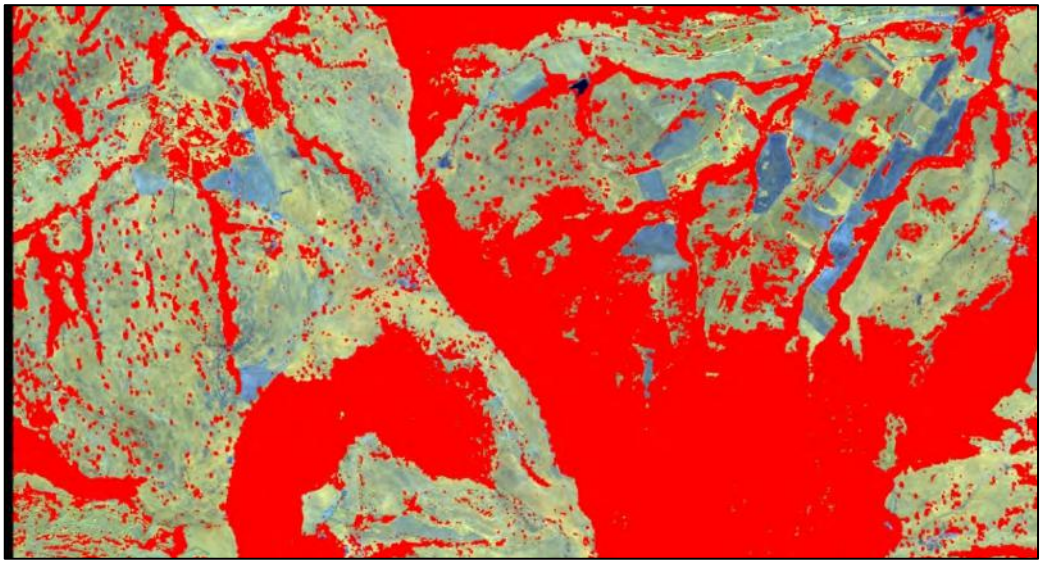

Fig. 10 Removal of non-forested areas (forest areas shown in red)

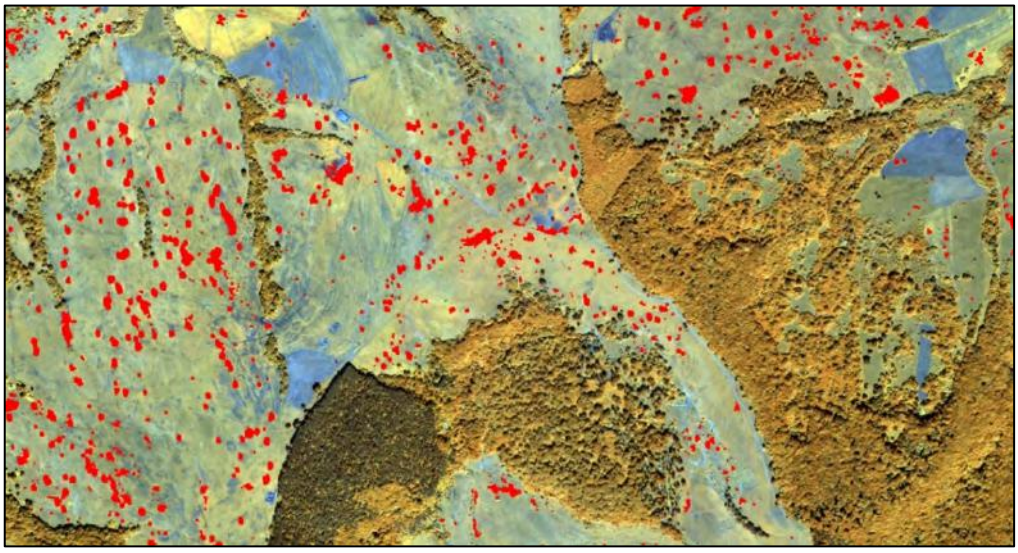

Fig. 11 Trees patches identified (marked with red, to be compared with the previous image)

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1.2 GIS Spatial Analysis

In the following stage the results obtained by interpreting satellite data were integrated with ortophoto data and parameters such as slope and aspect. The landforms parameters were obtained in the GIS environment by using a DEM (digital elevation model) with a five meter spatial resolution.

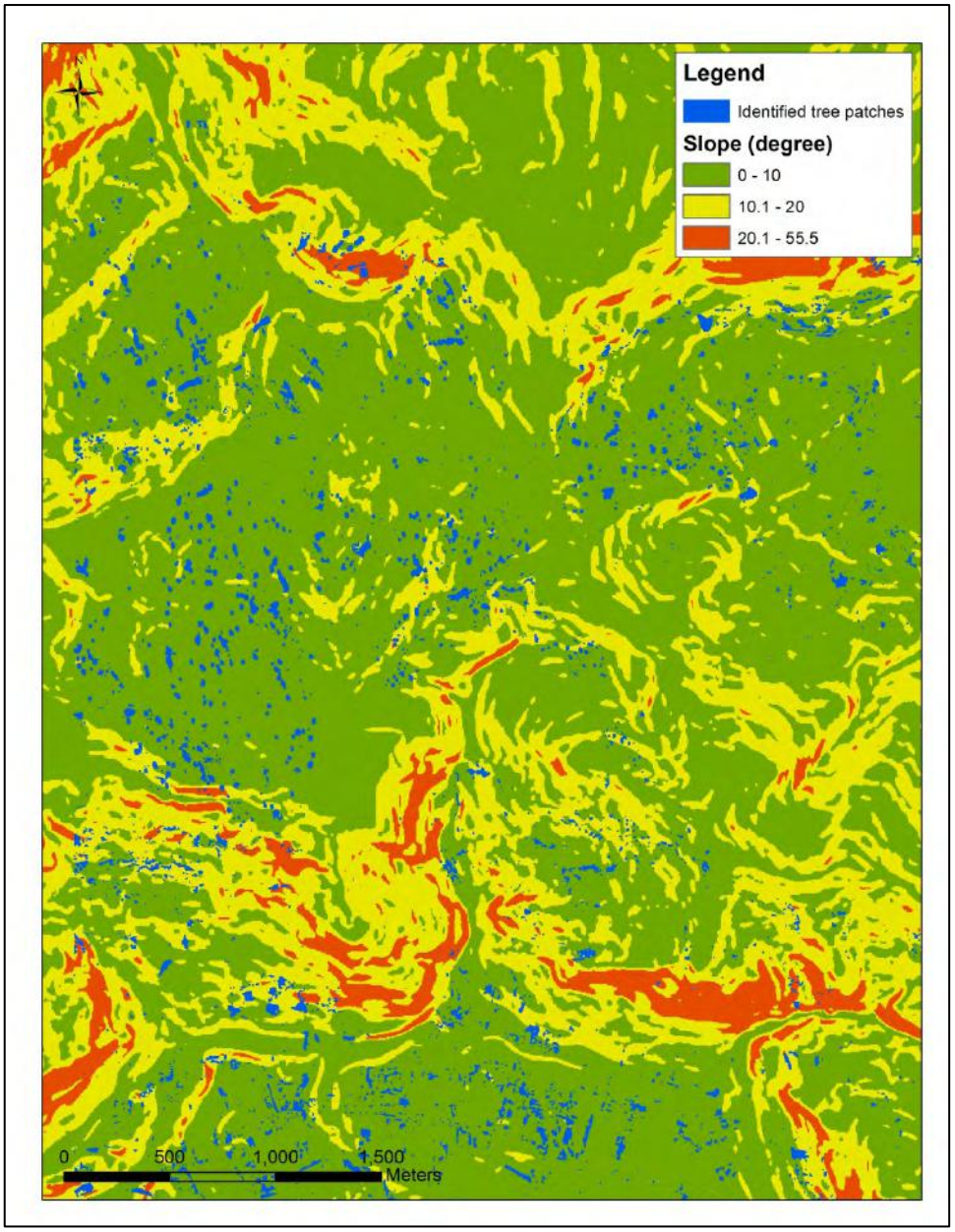

Fig. 12 Identified tree patches compared to slope classes

Our field measurements showed that aold trees are to be found almost all the time on slopes lower than 10 degrees.

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The tree patches obtained previously were compared against the slope and aspect. Based on this the slope and aspect values charaterizing orchard areas were identified. As a general rule the orchard sites are more likely to apper near villages, on moderate slopes no more then 10 degrees with south, south-est or south-west exposition.

The aspect paramerter was not considered significant in the final processing and all patches were compared to the slope classes. The paches being found on slopes lower than 10 degrees were extracted.

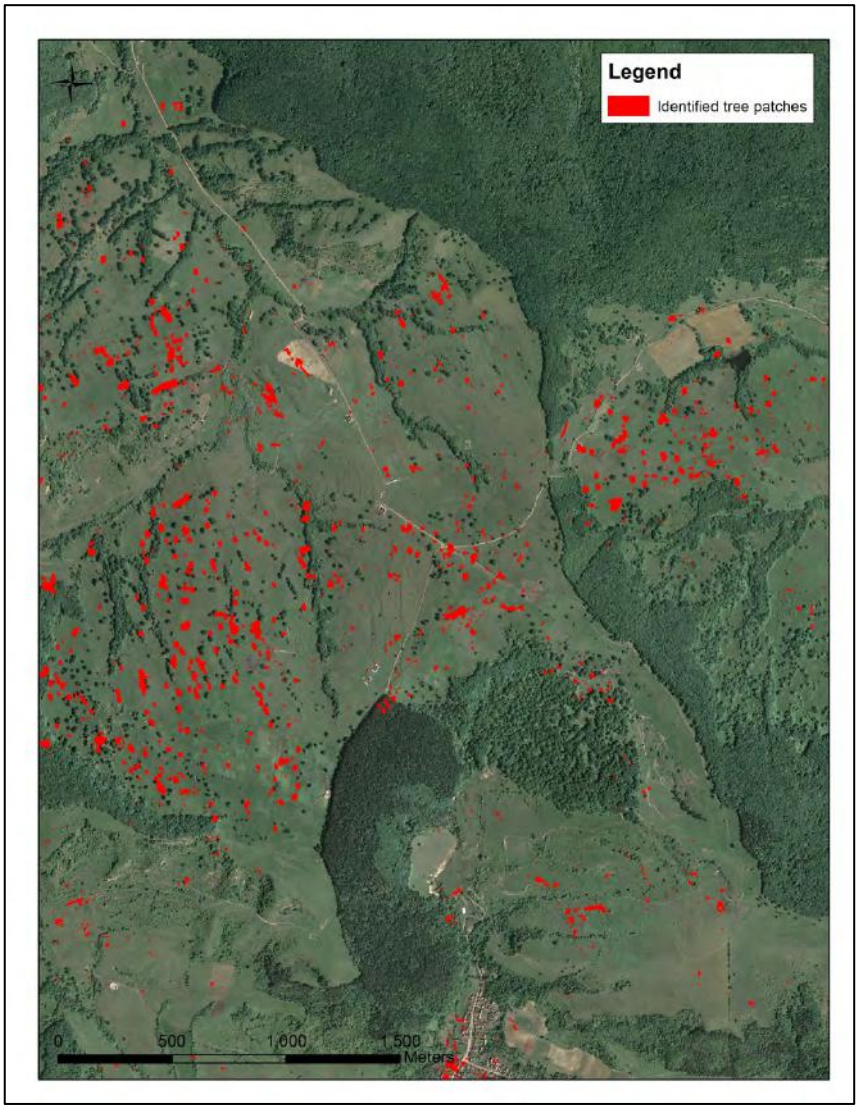

Fig. 13 Final patches of trees obtained from sattelite and DEM data processing

The model was validated using linear regression statistical methods and proved to be sufficiently accurate.

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After patch delineation we searched for patterns in the data. In order to do this all patces (as polygons) were converted to point data and processed using spatial statistic techniques.

In this step we can not evaluate all patces as being aold trees. In order to refine the result point density analysis was caried out.

The results are showed in *Figure 14.*

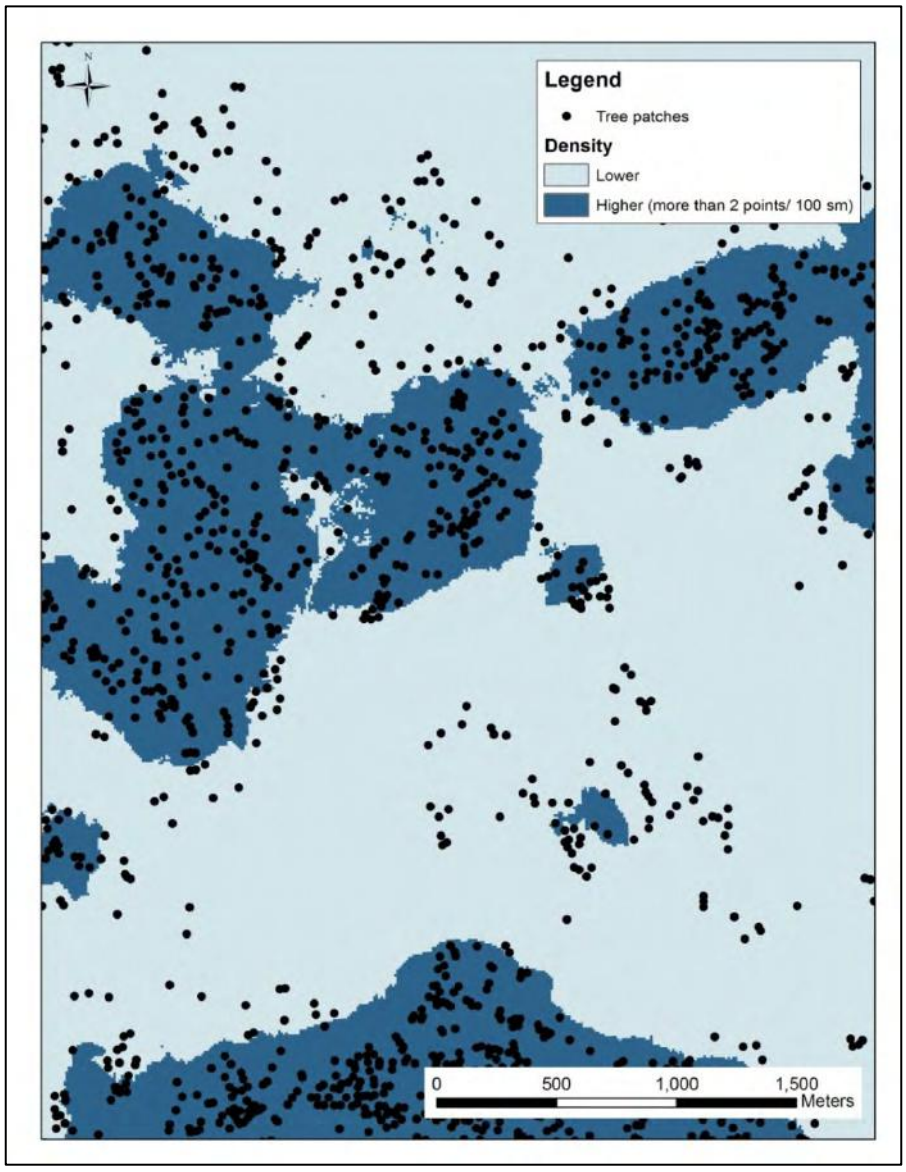

Fig. 14 Point density analisys

The areas identified as possible orchards areas (dark blue) were further analysed in the next stages.

2. Field data

After the model was validated and we had a list of possible target sites came the field check of the model, including field visits and data gathering for the preliminarry identified sites.

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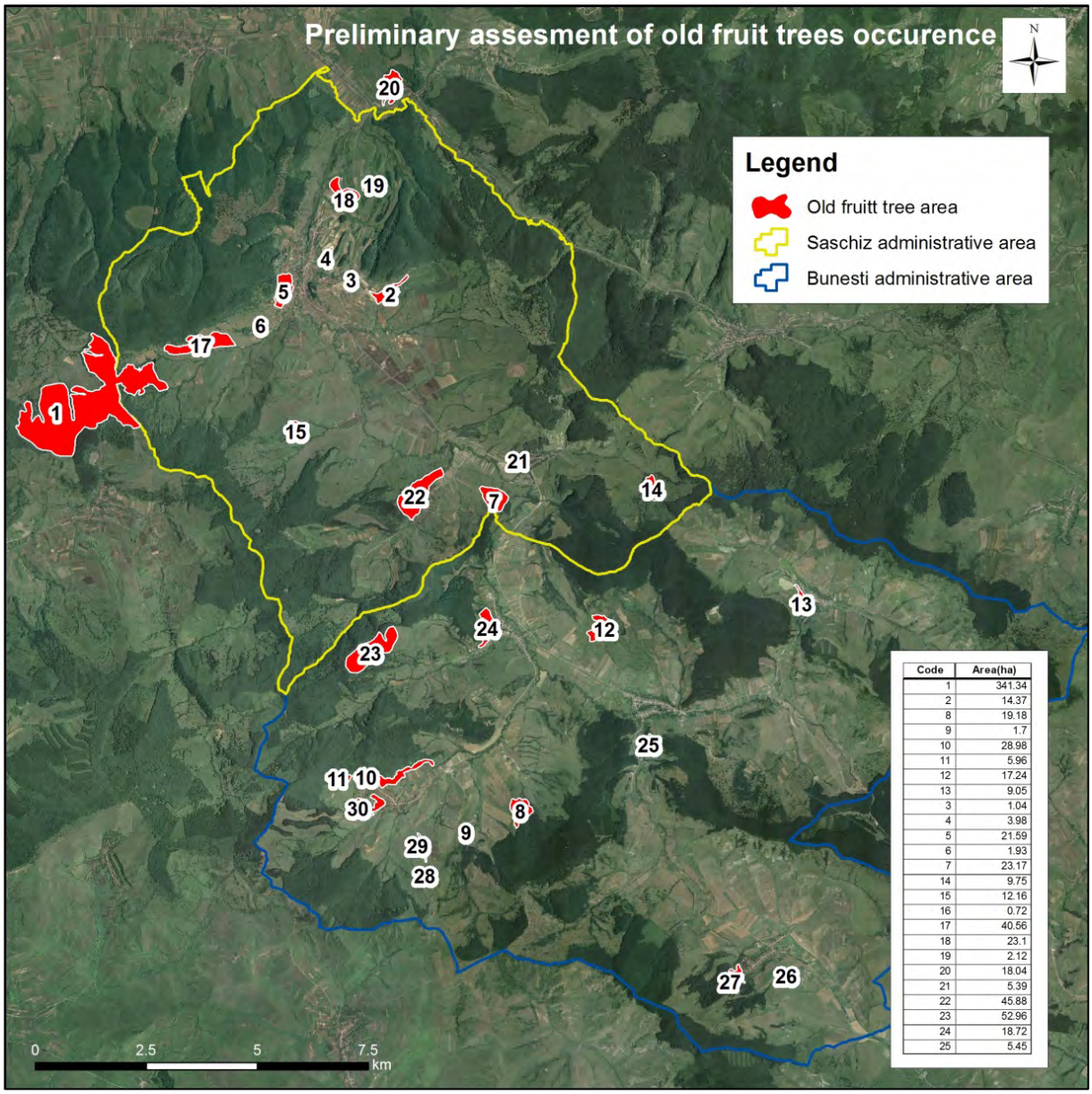

Code	Area(ha)
1	341.34
2	14.37
8	19.18
9	1.7
10	28.98
11	5.96
12	17.24
13	9.05
3	1.04
4	3.98
5	21.59
6	1.93
7	23.17
14	9.75
15	12.16
16	0.72
17	40.56
18	23.1
19	2.12
20	18.04
21	5.39
22	45.88
23	52.96
24	18.72
25	5.45

Fig. 15 Preliminary selected sites

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2.1 Sites description

By studying the fruit trees in the project area we found that these orchards can be divided into chategories as follows:

1. Old fruit trees found between other trees in wood-pasture sites (Wood-pasture type)
2. Small tree patches specifically found on large scale landslides (Landslide type)
3. Traditional orchards to be found near villages (Village type)
4. Industrial scale orchards (Industrial type)
5. Scattered fruit trees on the hillsides (Scattered type)

Site 1. Apold-Saschiz plateau (type 1)

This site is the larger of all mapped sites. It was easily identified because it fits very well in the concept of the preliminary identification model. The total area is about 340 hectares, situated at the border between Apold and Saschiz administrative units. It is not easily reachable, being located pretty far from the villages. It is a wood-pasture area, currently grazed by sheep. The main trees to be found are pedunculate oak, sessile oak and hornbeam but there are also some remacable individuals of pear and apple. The trees here are very old (over 100-200 years) as this area was probably used as a pig pasture in medieval times. The trees were a food source for the pigs and also provided shadow. Considering the age of the trees and the landscape and cultural value this site is one of the most important in the Saschiz-Bunești area.

Sites 2,3,4,18,19 Saschiz east (type 2)

Fig. 16 Plum trees on a hummock (Saschiz landslide, site no. 4)

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A group of small patches situated west of Saschiz. Although scattered the patches are consistent in the term of tree composition. The main species presented is plum, with a few apples. With the exception of site no.2 which is larger all other sites are small patches of trees situated between arable and pasture land.

Site no.2 is somehow larger but basically is composed of the same species.

As opposed to wood pasture sites these were specifically planted for fruits. Besides group no.2 which is a little bit outside the main landslide area all other patches are situated on the main body of the Saschiz landslide. Such small patches of fruit trees are frequent on the large landslides in the Saschiz-Bunești area. They are planted near on even on the large hummock formations, which are not suitable for other type of cultivation and are usually used for pastures.

Some of these trees are old but there are also some younger ones. Usually these small patches of trees are not managed.

Sites 5,6 Saschiz west (type 3)

This group, situated to the south-west of Saschiz village is represented by managed orchards, mainly composed of apple and plum trees. These are specific near-village orchards. The trees are managed, cut regurarly and planted in rows. However these are not large industrial orchards but more traditional family type. The areas are historically used as orchards although the trees are not old and are replanted regularly. The approximate age of the trees is 40 years old.

As a result the orchards are composed of several species (mainly apple and plum but also pear), in opposition to intensive orchard types which are mono-specific.

Fig. 17 Typical near village orchards (site no.5 near Saschiz)

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Site 17 Saschiz west (type 4)

This site is characteristic for large scale orchards. It is a managed orchard dating from the communist period. It is mainly composed of apple trees. The trees are all the same age (around 40 years) and are not managed anymore.

It is a large orchard of around 40 ha, including all the facilities characteristic for this type of industrial scale orchards, like storage and sorting facilities.

However the site is left unmanaged for at least 10 years.

Sites 7,14,15,21,22 Saschiz south (type 5)

These sites are mainly composed of other types of trees but with some scattered fruit trees. They are not organized and maintained as orchards and the presence of fruit trees is somehow incidental.

The fruit trees are pretty rare in this areas.

Site 23 Criț (type 1)

This site is situated to the west of Criț. It is mainly a wood-pasture area but with sparse wild pear trees. The site is not as specific as the Saschiz-Apold one but still important from the conservation point of view.

Sites 10,11,13,24,25,26,27,30 Bunești (type 3)

Fig. 18 Orchards near Roadeș

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These are typical near village sites. Sites 10,11 and 30 are to be found in the immediate vicinity of Meșendorf village while site 24 is situated near the village of Criț. Sites 25 is near Bunești and sites 26,27 are to be found near Viscri. Site 13 is near the village of Roadeș.

Besides this scaterred distribution all are typical apple, plum orchards traditionally managed by familial farmers. The age of trees is around 40 years and as other sites in the area tend to be abandoned.

This orchards do not occupy large areas, the larger one being site 10, situated just north of Meșendorf.

Site 12 Criț east (type 4)

This is a small industrial orchard from the communist era. It was managed by the local C.A.P (Cooperativa Agricolă de Producție – Agricultural Production Cooperative). It is not managed anymore and the trees are almost entirely gone. It was mainly composed of apple trees.

Sites 8,9,28,29 Meșendorf south (type 5)

Being type 5 these areas are composed of rare scattered fruit trees, some of them are to be found on the hummock area soith of Meșendorf (site 8) while the others are represented by scattered trees to be found on pastures. These are maily wild pear trees with some plum. The age of the trees is greater in the case of wild pear while the plum trees are around 40 years old.

3. Final selection stage

Based on the specific characteristics and type in this stage we selected the target areas for conservation. According to ther type this areas are:

Site no.1 Apold-Saschiz plateau (type 1)

This is considered to be the most important site. It is characteristic for type 1 sites, which have high nature value. The trees in this site are very old and need to be preserved because of their cultural and natural value.

The area is a typical wood-pasture and currently all these areas are under threat. Specifically this one is currently used as a sheep grazing area and the sheepherders are not recognizing the value of these trees. They use the trees for shelter and start fires besides them. As a result the trees are under threat to be burned or cut for fire wood.

Sites no. 5,10,21,24,25,27,30 (type 3)

These are all type 3 orchards located near villages. The conservation status is good but they all tend to be unmanaged as people do not use the fruits anymore.

The conservation of these sites is important because they represent traditional orchards and are a key part in the agro-biodiversity.

The orchards are mainly composed of aged apple trees and plum.

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Sites 2 and 18 (type 2)

These are landslide type small group of trees. They are a key features in the specific hummock landscape but are under threat as they are not seen as a valuable resource. They are usually cut for fire wood and to clear land for pastures.

Sites 8 and 9 (type 5)

These are sites specific to type 5 (scattered isolated fruit trees). Although they are not actually orchards these fruit trees are important landscape features and play a key role by increasing local biodiversity. As type 2 areas they are under threat as not being considered valuable.

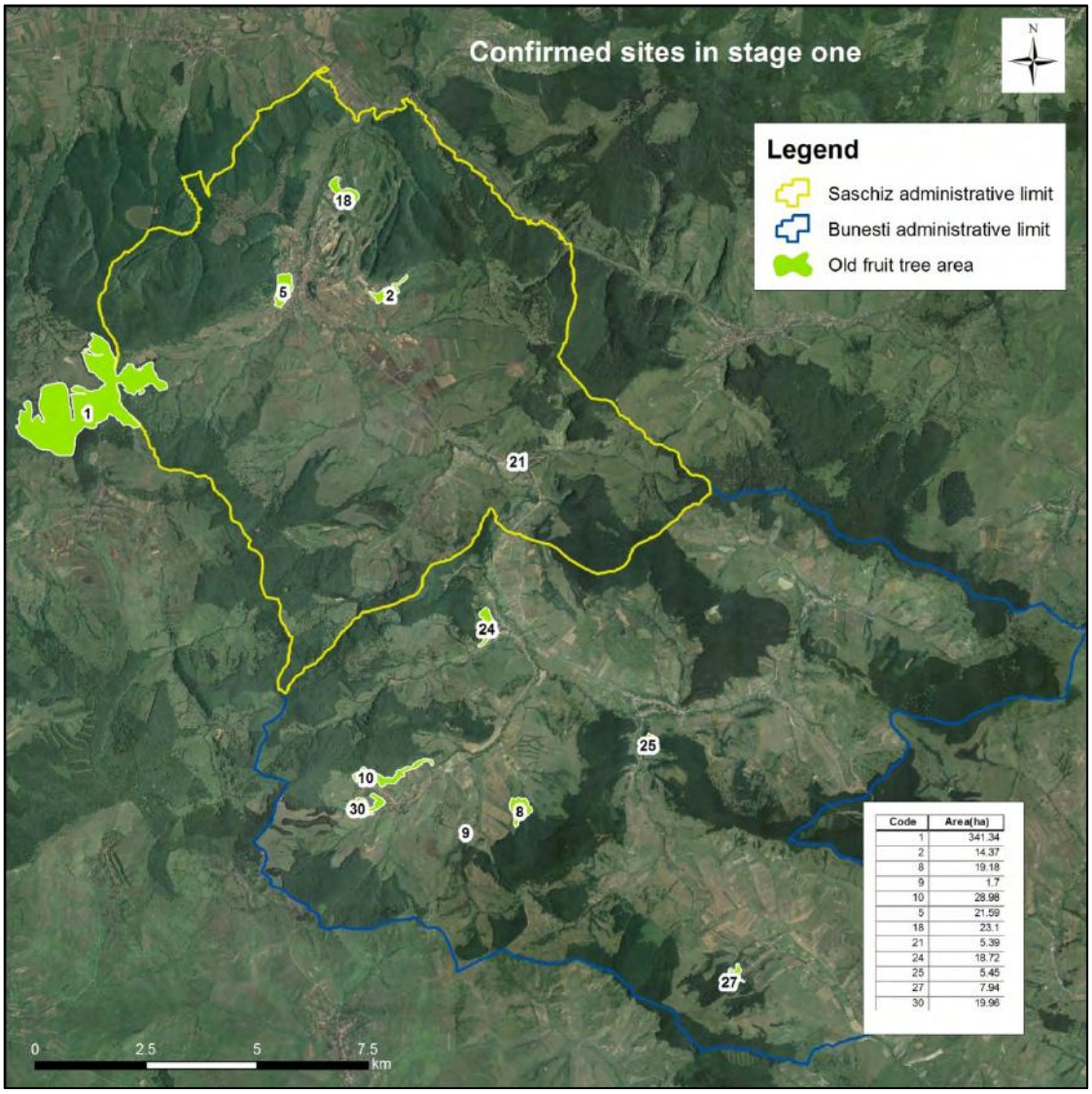

Fig. 19 Conservation target areas

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Type 4 orchard (industrial scale orchards) is not considered to be of a high conservation value. These areas are mono-specific (mainly apple trees) and do not play a key role in the conservation of biodiversity and landscape. However they must not be discarded as not important. As the pressure is increasing on the other types these undisturbed areas could became more important.

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PART B. Conservation issues and considerations

Romania (and particularly Transylvania) has one of the richest resources of land that can be classified as a High Nature Value (High Nature Value - HNV) , due to the wide variety of species associated with agricultural land, used as permanent grassland or traditional orchards, through traditional activities of mowing or grazing. As in the case of permanent natural and semi -natural grassland, lack of mechanization and avoiding heavy machinery alongside traditional farming techniques used in the management of extensive traditional orchards (basically a non- intensive grazing and mowing) contribute to the conservation of those habitats , along with the traditional cultural fund , biodiversity and edafic cover .

By using the criteria proposed by the European Forum for Nature Conservation and Pastoralism the following land use types may be placed in the HNV category:

• natural and semi-natural grasslands, particularly in the mountain and hilly regions,

• **traditional extensive orchards**, with well-preserved old meadows as background, making them one of the most valuable and best preserved traditional habitat in the Carpathian Mountains, Transylvania and peri-carpathic area. In addition, these traditional orchards preserve, in most cases, old local varieties of fruit trees, representing an ancestral, cultural gene pool currently under threat and that need to be preserved.

• permanent grassland used extensively are generally associated with high floristic diversity, which implicitly provides great diversity fauna (birds, insects, small animals).

Under these considerations some conservation measures are required in order to maintain these traditional extensive orchards. The list of proposed measures is as follows:

A. For the meadow/pasture

- the usage of chemical fertilizers and pesticides is prohibited
- the traditional use of manure is allowed up to the equivalent of up to 40 kg N / ha (1 AU / ha, AU – animal unit, cow equivalent)
- mowing can start only after June 15th
- grazing is carried out with maximum 1 AU per hectare
- vegetal mass mowed must be collected from the surface of the meadow under commitment no later than two weeks following mowing
- the meadow under the orchard cover most not be affected by reseeding or overseeding
- plowing of under tree area is forbidden

B. For the orchard itself

- the dead wood need to be maintained on the spot
- the farmer is encouraged to maintain small patches of natural vegetation (small ponds, hedges)
- there is the need to leave some of the fallen fruits on the ground
- the orchard needs to be rejuvenated by planting young trees (this excludes the cutting of all old trees in the orchard)

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- the usage of fertilizers and pesticides id forbidden
- it is forbidden to cut down old fruit trees
- the practice of vegetation burning is forbidden

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