BIOTOP SEE Part B

# Classification systems and database design

**Metadata for BIOTOP SE 4.0 (DBM220630)**



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# Change history

| Date/ | comment |
|---|---|
| 16-01-01 to 17-02-20 | Several versions at an early stage where the method was described in a single document. During this period, comments were made by i.a. SLU and the city of Stockholm |
| 17-03-01 to 18-10-01 | During this period, work on the manual was paused in principle completely because the development work in the *Remote Sensing in the service of the city* project was ongoing. During this work, the classification system has changed a lot.<br>The work has been tested in Södertälje as below. This work means that the classification system is reviewed one more time and modifications are introduced gradually |
| 19-04-15 | The report is prepared for referral. Thanks to sharp interpretation within Södertälje municipality, i.a. financed by the municipality itself and LONA funds ongoing during 2018 and 2019 further methodology development within Stage 2, aerial image interpretation.. |
| 19-09-09 | Review of all received referral responses, a total of 11 of different nature, some detailed on the content of the report, others of a supportive nature for the project as a whole. |
| 20-09-14 | In addition to incorporating feedback, the document has undergone major modifications and improvements over the past year to now respond to the final and significantly improved Stage 1 database approach and the implications for the Stage 2 database that this has brought. It has been very rewarding and very difficult to finish the method development to launch BIOTOP SE.<br><br>Work on producing biotope databases according to the method on a regional basis can begin. In case of major development steps, this document and all other documents belonging to the method will be updated. If you have questions or concerns about BIOTOP SE, please contact helle.skanes@natgeo.su.se. |
| 20-10-26 | Now some modifications in other text have been made and descriptions for 400, 700 and 800 have been overlooked. In order for you to find changes, I have made a comparative document that shows all changed and new places.<br>The document is also available in a clean version that you should be able to use. You can e.g. start by looking in the comparison document to see what has changed in other parts of the text and then focus on the clean version.<br><br>Remaining yellow markings are for your own part to remember to check. |
| 21-12-06 | Helle has only changed BIOTOP Stockholm to BIOTOP SE and highlighted what has been moved to part A<br><br>Otherwise, everything needs to be reviewed so that it is in line with the final classes, etc. Only Helle can do this work, but here |

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| | help is then needed to read and suggestions for shortening, simplifying the text, as well as the order of the content. |
| January-June 2022 | Total reorganization to be part of multiple manuals. General parts have been moved to Part A, while text and classification systems have been revised and simplified somewhat compared to previous versions. Nine main classes have become 7 and more class codes are common to Stage 1 and Stage 2. |

# Preface

Text coming

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*Credit to all the organizations and people who contributed!*

# Summary

The purpose of this report is to clarify and describe in detail BIOTOP SE's classification system according to the current version. The report is part of a series of central documents which together constitute metadata for the BIOTOP SE method. The classification system described in this report applies to the version of the database template that bears the report's version name, ie 3.1 (database template DBM200626). In case of future updates and modifications, new reports will be issued and these, together with the respective databases, will have later version numbers.

BIOTOP SE has three main target groups that span a wide field from research to practice; clients (mainly municipalities), executors (mainly consultants with expertise in GIS, remote analysis and digital aerial photography technology), and users (who in addition to clients and executors can be other consultants, researchers, associations and the general public).
This report is addressed to everyone involved in the biotope database and can be read at different levels. It is important that the project's other documentation is used together with this report. The report is dense with information and may be difficult to access for those who just want a quick overview of the method. As the method is complex and the need for detailed metadata is great, this report must be as detailed as possible.

The need for municipal and regional cooperation in sustainability issues is great. At the same time, access to regional knowledge base, financial resources and time for individual actors is severely limited. The county's municipalities and regional actors have for many years requested better maps of the county's nature. These are needed so that community building can take biological diversity into account, as well as people's health and well-being at the same time that urban areas can grow. This knowledge of nature's patterns and qualities is also needed to reach sustainability goals in Agenda 2030 and the Swedish environmental goals (refs). Correct and comprehensive metadata are crucial for optimal use potential of maps and databases and enable everyone involved to have a common understanding of the content (Ahlqvist, 2008; Björk & Skånes, 2015).

Animals and plants are not affected by municipal boundaries or other administrative divisions. In order to produce good models and analyzes that help us understand how they can move in the landscape, knowledge is needed that covers a larger area than the municipality itself. Since the 1990s, only the city of Stockholm and Solna have had access to their own maps of the nature of the municipalities (refs). However, these are produced with an outdated and time-consuming working method that does not have the capacity to be used to map an entire county.

The goal of BIOTOP SE is to be a regionally comprehensive, cost-effective knowledge base and collaborative platform for community planning and

nature conservation that can be used for analyzes of the county's nature, ecosystem services and green infrastructure. BIOTOP SE is developed for the county's needs but can be used throughout Sweden. The method is based on a smart combination of nationally available data via the Land Survey and other authorities, which makes it cost-effective. With a more efficient and more detailed regional biotope database as a basis, in-depth inventories and analyzes can be made possible and made more efficient.

In contrast to previous biotope mapping methods, BIOTOP SE is based on a hybrid method in several steps. Stage 1 includes initial automatic and semi-automatic classifications from aerial image-based remote sensing integrated with selected and further processed existing national data from e.g. the Land Survey's property map, the Swedish Agricultural Agency's block database and national land cover data, NMD. The purpose of Stage 1 is to create as detailed an initial biotope database as possible across the entire county to facilitate the work in Stage 2.

The subsequent Stage 2 comprises visual aerial image interpretation of infrared color aerial images in digital photogrammetric 3D environment with seamless connection to a geographic information system (GIS). The interpretation takes place as an improvement of the Steg database and the latter enables more efficient work that can be guided by the municipalities' most urgent needs, which can be geographically prioritized as well as thematically. For a detailed description of the aerial image interpretation in step 2 see BIOTOP SE Part E (ref).

BIOTOP SE is an extensive project which, with a high degree of detail, spans an unusually large geographical area. At the same time, it includes a varying administrative division where each municipality can have its own rules and prerequisites for data management and different systems for data processing in GIS.
It is therefore important that the regional perspective of the database can be respected through consensus so that it does not develop into a series of local databases that cannot be merged into a seamless regional database with common content. The practical, political and legal prerequisites for this are still ahead of the project. With the right conditions, BIOTOP SE intends to develop a long-term environment for co-creation, sharing and co-financing of regional data that bridges traditional management structures.

# Content

# 1. Introduction and background

## 1.1.Purpose and social benefit

The purpose of this report is to clarify and describe in detail BIOTOP SE's classification system according to the current version (DBM220630). Note that it is important to always use the current version. The report is part of a series of central documents that together constitute metadata for the method. Correct and detailed metadata is crucial for optimal use of maps and databases where everyone involved can gain a common understanding of the content (Ahlqvist, 2008; Björk & Skånes, 2015). The report is aimed at all users of the biotope database, ordering municipality, implementation consultant and end users, who want to use the database in planning and ecological analyzes at the landscape level.

**The method is documented in several parts**

This method for creating a biotope database is presented in several reports, tutorials, training packages and information materials. In order to make it easier for clients, executors and users of the biotope database, work is underway to find solutions for central management and communication of the methodology. The material will be distributed via the project's own domain biotop.se.

Below is a list of some of these products as well as their purpose and target group. When referred to in this document, "see Part" is used together with the relevant letter AE:

*BIOTOP SE Part A* ***Main document.*** For anyone interested (reference as specified in the reference list).

*BIOTOP SE Part B* ***Classification system and database design*** For clients, contractors and users who read at different levels. THIS DOCUMENT (reference given in the reference list).

*BIOTOP SE Part C* ***Guidance for procurement.*** For clients and contractors (reference given in the reference list).

*BIOTOP SE Part D* ***Construction of the Stage1 database.*** For executors and technical users (reference given in the reference list).

*BIOTOP SE Part E* ***Completion of Step 2 to complete database.*** For performers, aerial image interpreter (reference given in reference list).

# 2. Database design and generalization principles

BIOTOP SE is not *a* map but a methodology that creates a complex and regional database with the help of data from a number of actors. For an optimal and correct use of BIOTOP SE, it is required that all actors involved in its construction and use are well acquainted with its content and structural structure. Therefore, a well-thought -out *database design is required,* clear
description of *the structure of the classification system* including *generalization principles* and *minimum mapping unit.* All of this is needed so that clients, contractors and users can contribute to the common development of the database as well as for an optimal, safe and rewarding use of it.

## 2.1. The structure of the database and the need for a common format

BIOTOP SE is an extensive project which, with a high degree of detail, spans an unusually large geographical area. At the same time, it includes a varying administrative division where each municipality can have its own rules and prerequisites for data management and different systems for data processing in geographic information systems (GIS). It is therefore important that the regional perspective of the database can be respected through consensus so that it does not develop into a series of local databases that cannot be merged into a seamless regional database with common content.

Whatever format the end user can best handle in their current GIS
BIOTOP SE will be produced and managed as an ESRI file geodatabase.
The most important consideration that needs to be taken is therefore the database's production environment. The latter may also vary depending on the performers' environment for GIS and photogrammetry. The assessment is that the chosen format, file geodatabase with its domain structure and capacity to hold large and complex vector layers (ESRI, 2018), is the optimal format for BIOTOP SE. For distribution, it is conceivable that the Geopackage (GPKG) format may be used as this is an open and platform-independent standardized format for spatial data.
GPKG is increasingly the format used for distribution of spatial data between authorities.

A geodatabase consists of two components, a geometric spatial and a non-spatial information set in tabular form. The connection between these components is made up of a unique identity for each surface that is connected to the current set of information. The geometric consists of information about
each delimited surface so that it can be plotted in a GIS and compared with other spatial information, i.e. coordinate pairs for each point that makes up the grazing of a surface. The non-spatial part consists of one or more tables where the character of the surface is described, typically in the form of selectable values for various properties such as

are listed in columns, so-called attributes. The user can then ask questions to the database, through so-called SQLs (structured query language) to easily analyze the biotopes' properties and spatial distribution.

The domain structure allows the database to consist of coded classes, which is the best option for future analyses, while the names of the classes in clear text can be conveyed via domains. In addition to domains, the availability of topological tools and interactive updating of the area of each surface are the most important features of a geodatabase. Topological tools are crucial in the work of producing a correct database where all surfaces have a geometrically correct relationship to each other without overlap and gaps between surfaces, and where there are no errors and occurrence of surfaces that do not exceed the smallest mapping unit given possible exceptions. These characteristics of the file geodatabase may be a technical premium for many users, but are required to accommodate an accurate, flexible, easy-to-use, and common regional database design. The work of building a Step 1 database in GIS is technology-intensive and is described in detail in a separate document (Part D, Skånes 2021).

The format that users choose to later process the database's content in various analyzes is a completely different story. Most geographic information systems can handle the geodatabase format and if they cannot, it is always possible to export the various layers of the database as SHAPE files to simplify further analyses. However, it is very important that all municipality-sanctioned additions to the database that take place in another environment can be imported back into the original database.

In order to be maximally accessible to all users of BIOTOP SE, the project's database template, in addition to its described form in this manual, will also be available in the form of a database template in an Excel document, where each attribute has its own tab that is always divided into a code field, a Swedish description in plain text, an English translation in plain text, as well as possibly additional fields for explanation and additional metadata. The reason the database template is kept in this form is that it becomes more easily accessible and is easier to update the database's domains if necessary. While waiting for the project's platform biotop.se to be launched, material can be obtained by contacting helle.skanes@natgeo.su.se.

### 2.2. Hierarchical levels and descriptive attributes

One way to handle complex information in a database is to create a classification system with a hierarchical structure. In this way, you can clearly mark which classes belong to the same main group and thus have similar backgrounds and characteristics. The hierarchical division also controls how generalization principles are applied and which set of additional attributes to specify. In addition to these levels with own classes, it is advantageous to use descriptive attributes that do not involve creating new classes. An example could be that you divide the forest into a number of biotope classes based on tree species composition and moisture type, but choose to add land use and forest phase as additional properties for these forest types. If

if you don't do this, you risk getting an unmanageably large number of biotope classes that become difficult to manage and overview. The complexity of BIOTOP SE is already so high that the number of classes is large enough anyway.

Before the time of databases, when mapping of vegetation and biotopes was analog, all information about the biotope needed to be built into the code, which led to many classification systems becoming very complicated with many hierarchical levels and a large number of biotope classes (Bunce et al., 2008). With the availability of geodatabases, the classification systems have instead been able to be built up with fewer unique classes and instead with more descriptive additional attributes (Ståhl et al., 2011). The advantage of geodatabases is that instead of increasing the number of classes and hierarchical levels, descriptive attributes can be added that can be called when needed, which thus increases flexibility and usability.
At the same time, such a database places higher demands on the users to know how to combine the information from the various attribute fields.

Descriptive attributes can be surface delineation at different levels or additional information that summarizes, often continuous, data without affecting the surface delineation (Skånes & Andersson, 2011). The surface delimiter defines the biotope and the non-surface delimiter describes the character or internal variation of the surface. A surface delimiting attribute is used to divide surfaces into different biotopes or the same biotope into several surfaces where e.g. land use is different.
A dry-healthy grassland can consist of different surfaces depending on the land use (grazed or no land use) and whether it is completely open or has 30-50% shrub cover. These areas need to be demarcated from each other and form new areas within the same biotope type. This work is closely linked to the method's generalization principles as described in chapter 2.

Non-surface delimiting attributes are those where in the finished surface division you choose to add additional descriptive information, often automatically calculated properties from other sources that aim to further characterize the surfaces. Such attributes can be the degree of tree cover, average height in a forest biotope, or the proportion of semi-tall vegetation in an open area. It is very important to recognize the difference between these two attribute types in a situation where the biotope database continues to be processed geometrically after the attributes have been set. If a forest area is partially felled and divided into two new forest areas, a clearing and a forest, the tree height in the new clearing will obviously be 0 m or not relevant. However, in the remaining forest it is not at all certain that the original tree height is correct and the attribute thus needs to be recalculated.

The special thing about BIOTOP SE is that the database should be able to be used already in its automatically generated Stage 1 form and during the entire time that aerial image interpretation in Stage 2 is in progress. The idea is also that the interpretation should be able to be done in the client's own order of priority and that it is likely that many areas in a larger municipality will probably never be interpreted individually.
For a large municipality, the amount of automatically generated surfaces is simply far too large for all of them to be managed. Therefore, it is important to be able to make a smart selection so that the most important surfaces can be interpreted. Instead of using two

separate databases, these two code lists have been entered into the same database and summarized in the attribute Biotop, which has been created to be able to give users access to the entire database in different analyzes without the entire database having been aerial image interpreted (Appendix 1). The Biotop attribute is thus a merger of Step1_code and Step2_code and must always be updated so that Step2_code overwrites Step1_code.

Thanks to this solution with three attribute fields for the biotope code, all land where a Stage1 database has been produced will have a preliminary classification in the form of Stage1_codes. This step streamlines aerial image interpretation work considerably and it becomes easier to assess the nature and required work effort for each main class and Step1_code class before ordering aerial image interpretation by a municipality (Figure 3). Only with a well-developed Step 1 database can one estimate the costs of an aerial image interpretation of a new municipality.
Experience from previous projects shows that it is not possible to produce any specific cost per hectare or other area unit (Skånes et al. 2007). Many municipalities have a very different character, some have large water areas, others are dominated by forest, still others have a large proportion of urban green structure while still others have a large proportion of farmland. Some large municipalities also have a lot of everything.

Preliminary calculations in BIOTOP SE's pilot municipalities Södertälje and the City of Stockholm show that surfaces in different main classes take different time to interpret and that it generally takes between 0.5 and just over 1 minute per surface (regardless of size) if it is not complex and needs to be divided into many subsurfaces. See further in Part C.

In addition to a better cost estimate, the Step1 database provides the municipality with very good conditions for detailed control and prioritization of the interpretation work so that certain geographical regions (municipal parts or other administrative divisions) are completed first, or thematic priorities so that first all 200 urban green structure, or all broadleaf forest, or 400 Open - sparsely wooded land is interpreted first (BIOTOP SEE Part C and E). It is this flexibility that is BIOTOP SE's great strength and it is made possible by the fact that the classification system is designed as it is and that a Step 1 classification is already in place at the initial stage.

Other descriptive attributes that are specified to varying extents are e.g. land use, forest phase, tree layer and semi-high vegetation. These are usually surface branching and provide additional information to each surface in the database.

## 2.3. Reliability and generalization principles

In all mapping of spatial data that consists of vector data, i.e. surfaces and not rasters with pixels, you need to generalize. For this, a minimum mapping unit and rules for how generalizations are to be made in a consistent manner are needed.
Generalization principles include both the smallest mapping unit, but also rules for how too small areas should be generalized away, as well as how detailed the boundaries between the different areas should be drawn.

Any generalization affects how the reliability of a database can be assessed.
If a classification is based on a single source, an attempt is made to determine how well the result corresponds to reality. Often this is done by going out into the field afterwards and confirming whether the surface you have classified as e.g. deciduous forest really is. However, there are a number of problems with ensuring the reliability of all mapping methods, both regarding the accuracy of the delineation of the areas and the accuracy of the classification of biotope class and other descriptive attributes that the areas are assigned (Lechner et al., 2012). This applies not least to field-based methods where the reliability has at least as big problems between different carters as other methods have (Cherrill & McClean, 2016; Cherrill & McClean, 1999), and complicates the reliability further (Foody, 2010).

It is particularly difficult to manage the reliability when a hybrid approach is used that utilizes both existing classifications from other databases and creates its own classifications and then additionally combines these in the same database.
BIOTOP SE is just such a complex database. At the same time, it can be stated that the ambition with this database is not to produce actual figures on the accuracy of the classification or to correct deficiencies in the included data that have been used. It is simply not possible for the simple reason that the method is based on an interweaving and reclassification of data from a range of different sources and mapping methods. Instead, BIOTOP SE strives to make demands on responsible authorities and organizations to work to increase the security of replicative datasets in the long term.

Validation of a hybrid method raises many questions: In another application, can we assess the accuracy of the property map's water or the Swedish Agricultural Agency's block database? What is the accuracy of an automatic analysis of the property map's building type and property boundaries together with automatic classification of the IRF aerial imagery's spectral information and vegetation height? How well does our perception of urban correspond?
green structure when we assess it via remote sensing and when we look at it in the field?

Again, we are talking about man's attempt to put limits on the continuous features of the landscape in order to simplify its complexity. These attempts have always been, and will remain, constructions and thus always a question of interpretation. We must not be deceived into thinking that the accuracy of a mapping increases by generalizing and simplifying the complex reality further. This can sometimes further complicate the interpretation of the results.

In order to bridge the various sources of the method, the strategy is instead to choose to a greater extent than ever before to accept boundaries and classifications that come from existing maps (mainly the property map and the block database), and the automatic/semi-automatic data capture methods in step 1 and national land cover data. In this way, the new biotope database method becomes less certain, but at the same time more detailed and more cost-effective. If the aerial image interpreter in Step 2 is to correct everything in the database from the smallest limit-

attraction to nuances in the classification, the method instead becomes very inefficient and expensive. The question the interpreter has always asked himself during the interpretation of aerial photographs is whether he/she could have drawn the line in a similar way.

BIOTOP SE strives to be as accurate as possible but accepts various uncertainties and uses a relative terminology regarding classification certainty similar to Metria's preliminary accuracy for

national land cover data described as *low, insufficient, acceptable, good,* or *good* (Metria, 2018). It is expressed in the Reliability attribute where it provides
the user an idea of how well the surface is expected to correspond to reality at Stage1 and Stage2 level. The method thus tries to balance what is "good enough" against the risk and cost of being wrong as expressed by a prominent landscape ecologist (Wiens, 2016).

**Minimum mapping unit**

Minimum mapping unit means that objects below a certain size are not drawn.
Instead, these surfaces must be generalized into their surroundings and in the database become as if they didn't exist. The minimum mapping unit and degree of generalization depends entirely on the scale at which the database is intended to be used, which in turn depends on whether the database is intended to cover entire regions.

The general minimum mapping unit for all surfaces in BIOTOP SE is 0.1 ha.
Exceptions to this rule have certain surfaces which, due to its original source,
mapped to smaller areas. These are islands and bodies of water according to Lantmäteriet's property map as well as arable islets according to the Swedish Agency for Agriculture's block database, areas that can be in the order of 30 m². These small areas have been retained regardless of size because they are often associated with values in the landscape. Fine mesh green structure embedded in urban land with removed vegetation has also been saved down to 200 m². These can be considered an attempt to maintain the small biotopes in the stone city. They can be green roofs, small grass areas or small areas with a mixture of trees, grass and non-vegetation.

All surfaces that are allowed to deviate from the general minimum mapping unit are marked with a class in the Size attribute described in chapter 3. It is important that this is taken into account when searching for information in the new biotope database. The purpose of this size marking is to e.g. distinguish a small body of water where the size itself can imply part of the object's character from a small area of a bay that juts in from the other side of the municipal border

or a small vegetated area in a large lake.

Each specification of the minimum mapping unit must be followed by a recommendation of minimum width of an object. Often this is resolved automatically because an area of 0.1 ha with, for example, 1 m width means that the object must have a length of 1 km to form a large enough area to be mapped. Thanks to its exceptions from 0.1 ha as the smallest mapping unit in BIOTOP SE, no fixed minimum width is specified, but a general recommendation is that widths below 5 m are only applied to classes where the objects are of special importance, or by definition

are narrow. This mainly applies to roads and road verges towards arable land in the open landscape, but not narrow waterways. Only water found in the surface layer of the property map is plotted.

**Generalization principles and the vertical structure of the database**

In addition to the smallest mapping unit, as already mentioned, there are always generalizations in a surface-based database. This applies regardless of how small the details can be and regardless of whether delineation and classification has taken place manually or via automatic methods. Generalization principles must be clearly described and easy to follow in visual assessment, as well as robust and repeatable in automatic classification. The term generalization is used in all mapping when geographical simplifications are made when delimiting areas.
Examples of general generalization principles are how to choose to combine different parts that are individually too small but which together form a meaningful unit.

In the stage1 database, the generalization principles are tightly regulated and form the basis for how the various GIS models are run, in which order each part of the mapping takes place. These are described in detail in Part D (Skånes and Wennbom 2022).
It is important to remember that weighting must take place when different existing data are to be used in the same database. In BIOTOP SE, certain inputs take precedence over others.
This means that certain compromises must be made and that this has physical consequences for how boundaries are drawn between different objects. This can be described as the vertical structure of the database. IN BIOTOP SE
the mapping takes place at ground level where there are controlling masks. These are water from the property map, arable land from the block database and the infrastructure from the traffic authority. The consequences manifest themselves primarily through the blurring of overhanging higher vegetation above these layers (Figure 2).

Basically you can say that generalizations between main classes and its
biotopes work so that e.g. no change should take place between water and land unless the waterline is clearly incorrectly drawn or permanent changes in the water's boundary have occurred. Otherwise, the generalization principles described in chapter 3 apply.

Simplifications can also be simplification of borders, which is then often done through the GIS operation, so-called. "Smoothing" to give a cartographically better curvature where you want to avoid too roughly straight borders but also too detailed borders. This is particularly important when the boundary is drawn between open land and forest or between different forest types within the tree mask. In a product like BIOTOP SE that is based on several different inputs, the generalization therefore varies in boundary drawing depending on whether the boundaries are taken from existing maps, are automatically segmented, or whether they have been drawn by an aerial image interpreter. We simply have to accept that these differences exist in the same database. We also have to accept that there will never be a clearly drawn boundary between wooded land and other land, because there can be so many definitions.


*Figure 1 The picture shows the difference between BIOTOP SE's demarcation between controlling masks, in this case the infrastructure, and other information. In cases where the border is against high vegetation (>5 m), this means that the overhanging tree crowns are cut away. This, in turn, means that many tree-covered areas in the city can feel underrepresented and that narrow avenues often disappear under the smallest mapping unit.*

# 3.BIOTOP SE's classification system

BIOTOP SE's classification system has been based on the city of Stockholm's existing biotope database (Stockholms miljöförvaltning, 2012). To suit a modern and cost-effective mapping method and the increased focus on the urban environment, the system has been modified and further developed in several rounds since the development work began in 2014. The increased focus on the urban environment is not only regional but also applies to Sweden as a whole (BIOTOP SE Part A, Skånes & Tullback Rosenström). In order to seriously understand and utilize the capacity of the database, it is important that all involved, clients and producers as well as users familiarize themselves with the classification system and make use of the project's documentation (BIOTOP SE Part A, C, D, and E).

### 3.1.History

BIOTOP SE builds on accumulated experience from previous national projects which, over decades, have developed methodology for local, regional or national mapping or monitoring of vegetation, nature and its properties. Some of these are the Land Survey's vegetation map, which is based on the development of vegetation mapping in the mountain range and in the rest of Sweden (Ihse, 1978; Ihse & Wastenson, 1975), valuable objects in the landscape such as the meadow and pasture inventory (Ihse & Lindahl, 2000), the wetland inventory VMI ( Gunnarsson & Löfroth, 2009), The environmental effects of food policy LIM (Ihse & Blom, 2000) National inventory of landscapes in Sweden NILS (Ståhl et al., 2011), Natura 2000 base inventory (Skånes et al., 2007).

Traditionally, the most reliable source of detailed landscape information, vegetation and biotopes has been based on manual visual aerial image interpretation in 3D (Allard & Skånes, 2011; Ihse, 2007; Skånes et al., 2007; Ståhl et al., 2011). However, they are not fast or cost-effective enough to cover such large areas as Stockholm County in an efficient manner. Automatic methods, on the other hand, are rarely thematically detailed enough to meet the needs of nature conservation and urban planning despite the rapidity, especially in terms of features for open vegetation and detailed land use (Rydell et al. 2013). The new biotope mapping method therefore effectively seeks to bridge the capacity of modern remote sensing with visions and ambitions from applied nature conservation. This requires a balance between how detailed mapping we can do and the cost that the actors are willing to pay and that is in reasonable proportion to the computing power and complexity of analysis required. This also places demands on how the classification system of the biotope database can be designed to function in the best way in the modern digital environment, i.e. in geographic information systems (GIS).

Each new classification system is designed to fulfill specific functions and BIOTOP SE is no exception. Experienced users of other systems may find the restructuring in this system problematic when e.g. marshland disappears from the top tier and others change places from one main class to another. The important thing to understand here is that this classification system serves several purposes that are important to the method and an effective mapping procedure.
At the same time, BIOTOP SE's classification system means flexibility for reclassifications which may be necessary to summarize and visualize an individual municipality's green structure at different levels and in different contexts.
This will be described in detail in the chapters below.

A new effective biotope mapping cannot contain the sum of all previously detailed inventory systems that exist for parts of the landscape, e.g. meadows and pastures, wetlands, key biotopes, etc., but needs to be more comprehensive in order to be developed at a regional level. There are always opportunities to carry out in-depth inventories and mapping based on a biotope database, but these can then be called additional modules. The most important thing in this context is that BIOTOP SE intends that Examples of such additional modules will be reported separately (BIOTOP SE Part G).

The project also takes height so that the database can be updated over time where the first generation database will be able to be updated where changes occur. It is difficult to advise how often a biotope database needs to be updated other than that the method can work well in different time scales. What an urban municipality will need to update often is the urban expansion that can be measured in the proportion of vegetated land that turns into urban structure. The easiest thing here is of course to make new classifications of vegetated land versus non-vegetated land via Step 1. For a municipality that is dominated by forest landscapes, the most important updates will concern forestry and mainly fellings. New fellings will also be able to be followed via Stage 1, but also via national channels and datasets, e.g. satellite data.

### 3.2. General structure and hierarchy

The classification system is designed to be applied to a hybrid method that utilizes a wide variety of data on a regional scale. The method was developed to cover the entire Stockholm county. Thanks to its general structure and use of national data, the method is ideally suited for, in principle, all of Sweden
where the current input data for Step 1 is available (BIOTOP SE Part D, Skånes and Wennbom 2022).

BIOTOP SE is structured in this way and has a flat hierarchical structure with two primary hierarchical levels that constitute themselves. The number of biotope classes is thus kept down and instead there are a number of descriptive attributes (see chapter 3.2).
Note that different attributes are specified in different ways depending on the main class.

BIOTOP SE contains two hierarchical levels, a simplified division for illustration, as well as a series of descriptive additional attributes that in different ways

clarifies the content and characteristics of the database. The top level, main class (Table 1) shows the basic grouping. How the seven main classes 100 Urban gray structure, 200 Urban green structure, 300 Cultivated land, 400 Open land, 500 Shrub land, 600 Forest/Tree-covered land, and 700 Water hang together is shown in figure 5. For detailed information on the Step1 method, refer to BIOTOP SE Part D (Skånes & Wennbom 2022).

It is generally known that the moisture in the soil affects the species composition of the plants, and it is often the case that detailed division at the biotope level is precisely about different degrees of moisture. In vegetation mapping, biotope names that refer to this are often used; dryland, open meadow and wet meadow (Påhlsson, 1998). Information about the moisture regime, which in turn affects the properties of the biotopes, is used through a generalization of SGU's soil type map is used in combination with the alluvial soil layer of the property map (Table 9). Initially, it was investigated whether the so-called topographic wetness index could be used to characterize moisture types, but it turned out to be far too uncertain, even the soil topographic wetness index produced for National Marktäckedata (Metria, 2017) turned out to be too uncertain and complex to be used . It was therefore decided that SGU's soil type information was the one that could best characterize the conditions of the biotopes in four broad moisture regimes.

*Table 1. Moisture regime is built into several main classes except the urban structure and arable land. Otherwise, the four humidity regimes control the biotope class with one of the numbers in the code, which usually makes up the second number. The only exception to this principle is the cultivated grassland, where the coding did not allow the humidity to be entered as the second digit of the code. Even in the main class 400, the moisture coding deviates from the others. X in the table corresponds to a number that indicates a specific characteristic of the biotope.*

| ***Main class*** | ***Mountains of the day according to SGU*** | ***Coarse sediment according to SGU*** | ***Other moisture regime (fine sediment and moraine)*** | ***Wetland according to SGU and the property map sankmark*** |
|---|---|---|---|---|
| 100 Urban gray structure | Is not applicable | Is not applicable | Is not applicable | Is not applicable |
| 200 Urban green structure | Is not applicable | Is not applicable | Is not applicable | Is not applicable |
| 300 Cultivation land | Cult only. grassland 310 | Cult only. grassland 320 | Cultivated only grassland 330 | Cultivated only grassland 340 |
| 400 Open ground | 41X | 42X | 43X | 440, 450, 460 and 447/470 |
| 500 Shrubland 51X | | 52X | 53X | 54X |
| 600 Forest/ wooded land | 61X | 62X | 63X | 64X |
| 700 Water | Water according to FK | Water according to FK | Water according to FK | Water according to FK |

Note differences between SGU's definitions and botanical definitions of e.g. mountains in the day. This is mainly because SGU uses a mapping depth of 0.5 m. Rock in the day can therefore contain land with <0.5 m soil cover, which botanically would not count as rock in the day. This means e.g. 611 Pine-dominated tree-covered land on SGU mountain today does not have to be outcrop stable forest in the classic definition, but that the land is on SGU mountain today and thus with a high probability is characterized by outcrop. In the same way, a 621 Pine-dominated tree-covered land on SGU coarse sediment needs to be made up of pine-dominated aspen forest, but well located on well-drained land according to SGU. The corresponding principle applies to the wetland. The principle is also valid for other biotopes in all main classes where the principle is used in accordance with Table 9.

*Table 2. Main class is BIOTOP SE's top hierarchical level. The structure is driven both by the new technology and by new needs to further divide the urban environment into gray and green components, as well as clarify the composition of the landscape on a regional level.*

| Main class | Definition |
|---|---|
| 100 Urban gray structure | All land with removed vegetation, both hardened land and non-hardened land, including buildings. The breaking point between urban gray structure and urban green structure is at the threshold >10% involvement of vegetation. The main part of this class is produced in Step 1 through automatic classifications of orthophotos. |
| 200 Urban green structure | Green structure in urban affected areas. All urban environments >10% vegetation, i.e. plots of land, grassy areas, parks, etc. Delineated with the support of the property map's built-up areas, property boundaries, houses and characterized by the components non-vegetation, low, medium-high and high vegetation that are developed in Step 1. |
| 300 Cultivation land | All farmland incl. fields, orchards, energy forest and cultivated grasslands. Information for this is taken from the Swedish Agricultural Agency's block database and the economic map from the 1950s. |
| 400 Open land | All open land that is not included in the other main classes, broad and uncertain class. In the end, semi-natural land, both vegetated and substrate-dominated, but initially anything is possible. There is also tree-covered grassland here, which is judged to be mainly of an open nature. The biota classes here require visual assessment in Step 2. |
| 500 Bushland | Own main class to capture the spread of scrublands (>50% scrub cover). These are included in the Steg1 database divided into four soil types, if the orthophoto is later than the beginning of June. Earlier dates give insufficient information. The biotope classes here require visual assessment in Step 2. |
| 600 Forest/wooded land | Main class for all tree-covered land that is deemed to be forest due to land use, but also other tree-covered land. Wooded land, in principle >10% tree cover and >5 m tall trees with forest type classification from NMD. Non-tree-covered land under the property map's forest mask becomes, depending on the context and input data, disturbed tree-covered land, conduit streets and sparse/low outcrop forest. Tree-covered land that is deemed to be embedded in the urban environment is included in main class 200 (231-237 urban green structure of tree character). Sparsely tree-bearing traditional grassland is included in main class 400. |
| 700 Water | All aquatic surface taken from the national shoreline (NSL) of the property map. In Step1_kod, an initial classification of open and vegetated water into four classes is specified. In the aerial image interpretation, aquatic vegetation, larger urban facilities and possible land use are assessed. |

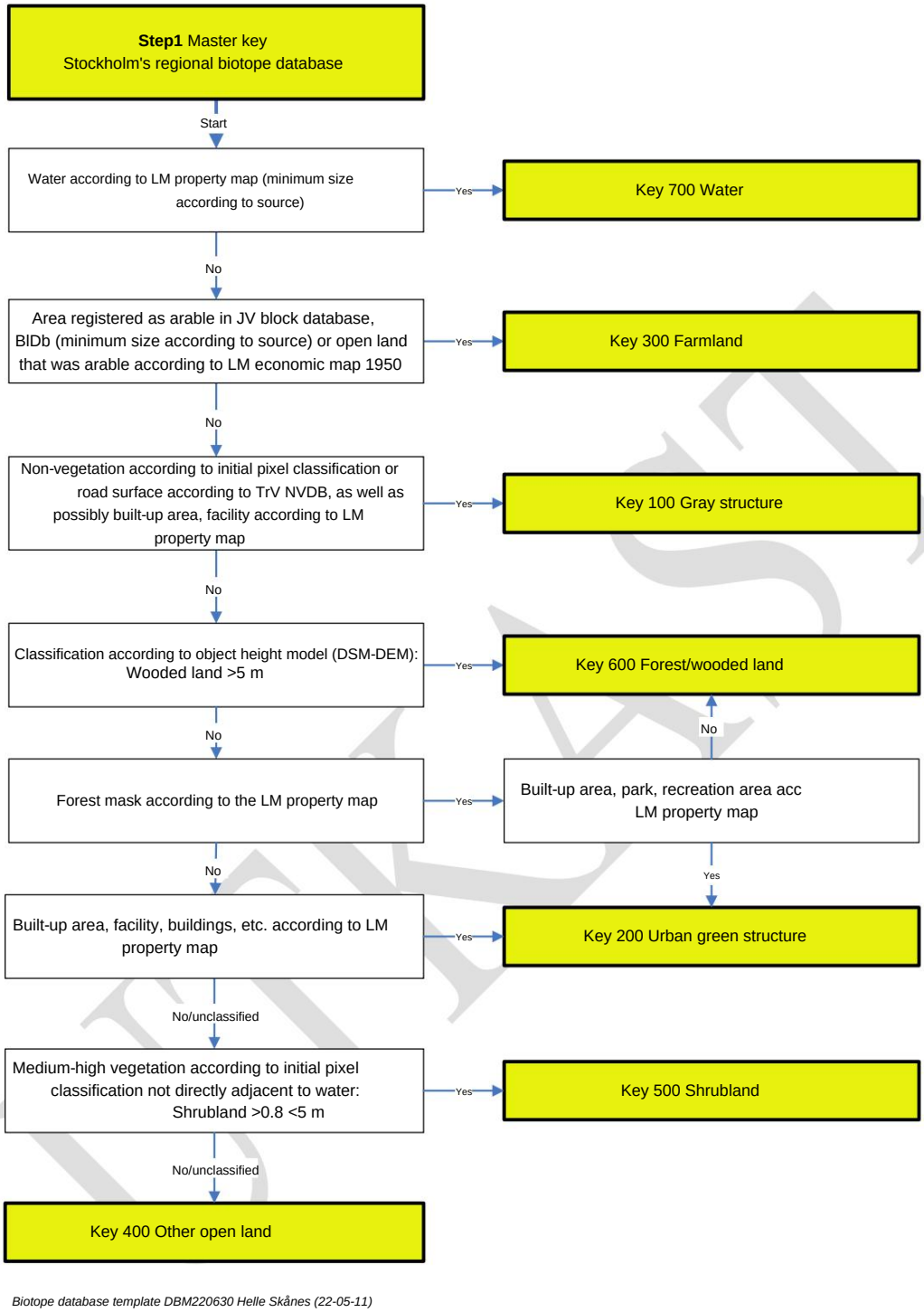



*Figure 2. Main key to BIOTOP SE. The key shows which basis governs the classification of biotopes within Stage 1 for each main class. The flow shows that main class 400 can be something of a slush funnel if the surface is bad for urban structure. In future chapters, each key is shown separately under the respective main class. A more detailed master key for Stage 1 is given in Appendix 2.*

## 3.3.Main class (level 1)

Main class constitutes the top hierarchical level in the classification system with seven broad main classes (Table 2). Main class is mainly used to indicate the hierarchical group affiliation of the biotope classes. Often the same rules apply to attributes within the respective main class and biotopes within the same main class have common generalization rules which say that you should primarily generalize within the same main class.

All biotope classes belonging to a main class have the first number of the main class as a code, i.e. all biotopes urban gray structure have a code starting with 1, all biotopes belonging to water have a code starting with 7, etc. Each main class contains a number of biotope classes which in turn are described with a number of attributes. The biotope classes are described briefly under the respective main class (chapter 3.3) and in more detail in the total biotope list (chapter 4).
The main classes differ in various ways from the existing database of the city of Stockholm, which had eight main classes with a partly different focus (Stockholms miljöförvaltning, 2012).

Below is a brief description of each main class with reference to all included biotope classes in the form of interpretation keys that are used in Stage 2 aerial image interpretation and thus account for both Stage1 codes and Stage2 codes.

**Main class 100 Urban gray structure**

Urban gray structure includes all land with removed vegetation, both hard and unhardened land, and includes buildings, traffic and built-up areas. Some natural non-vegetation such as day rock and exposed sediments are also included initially as it sometimes requires visual judgment to determine what they are. The term urban gray structure is chosen to meet and balance the concept of urban green structure (see Main class 200 Urban green structure). The breaking point between urban gray and green structure is at the threshold value of 10% vegetation (Table 3).

The primary source of urban gray structure is BIOTOP SE's initial pixel classification, which distinguishes with high precision all non-vegetation from land covered by vegetation through the analysis of infrared orthophotos, surface models and soil model. The boundaries within the main class are an intricate combination of the Land Survey's built-up areas, construction areas and smaller properties, as well as open land containing buildings.

Most of the non-vegetation will already be delineated in the input data and land use can be picked up from the property map where such is indicated, but to get a detailed breakdown into biotopes excluding buildings extensive aerial image interpretation is required. In the final database, it is divided into three biotopes governed by the nature of the non-vegetation, high non-vegetation, hardwood and non-hardwood respectively (Figure 6).

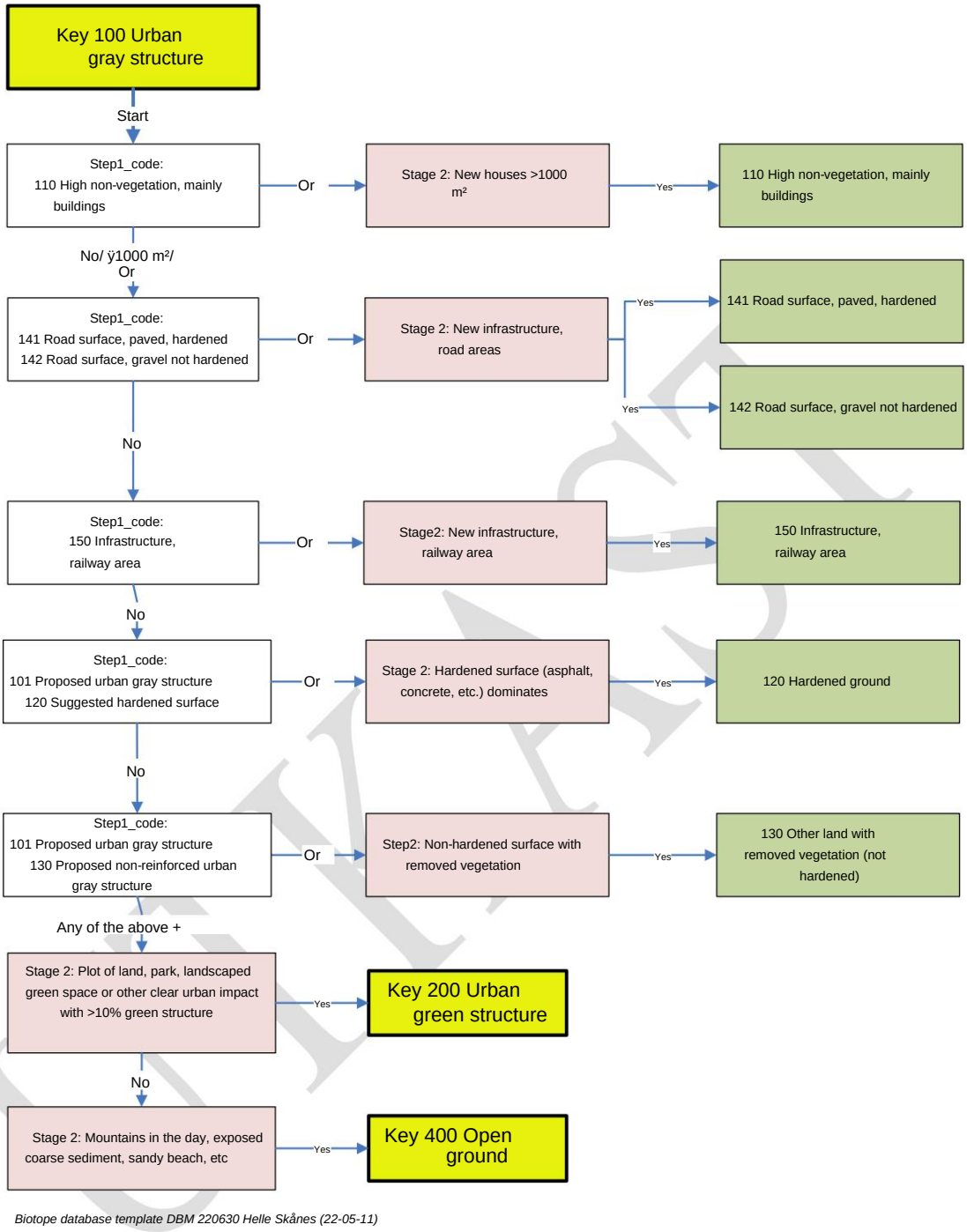



*Figure 3 Detailed key to biotopes within the main class 100 Urban gray structure. Note that additional attributes are available for all biotopes. For urban gray structure, this mainly applies to land use. Most of this is already set in the Step1 database.*

**Main class 200 Urban green structure**

This main class has been added as a result of an increased focus on the green structure in the urban environment, and that the new method primarily distinguishes vegetated land from non-vegetated land in the initial semi-automatic parts of the method's step 1. In BIOTOP SE, the word structure and not infrastructure which is a common term today, e.g. green infrastructure (Environmental & Agency, 2017). The main reason for this is that the biotope database does not show the landscape from the perspective of the distribution of a certain species or species group, but the physical distribution and intricate patterns of a number of biotopes without taking a position on their mutual relationships or value. Only when the biotope database has been used to analyze the distribution pattern or living conditions of a certain species can the result be said to show green infrastructure.

The urban green structure in Stockholm County's biotope database consists of all surfaces with >10% vegetated land within the urban environment that should not be counted as other land (Figure 7). The main criterion for the urban green structure is that it is marked in a significant way by human urban activity. The intention is to separate the green structure of forestry, farmland and grasslands from the green structure that is judged to be established or clearly affected by human urban activity, ie; built-up structure, open grassy areas, sports fields, residential gardens, golf courses and parks as well as all other land deemed to be part of built-up structure and urban impact.

In the future city, all green structure is important, even the urban one, and then it is important to try to show as much detail in the fine mesh structure as possible. To meet this need, the urban green structure is already divided at an early stage according to the main characteristics, open (grass) character, leafy character, tree character and gray character. These are calculated with the support of the project's elementary land cover classes in combination with the property map's built-up areas, construction areas, building layers, and property boundaries already in the Step1 stage. To see details of this preliminary work, refer to separate documentation (BIOTOP SE Part D).

The characterization is purely mechanical and is based on a few simple components together with as detailed a division as possible of the urban green structure according to the thresholds presented in Table 3. Initial tests have shown that the agreement between the automatic classification and what an aerial image interpreter can accept is good to very good. Best agreement, according to preliminary study in Södertälje stage 1, 210 has open (grass) character (95%) and 220 leafy character (88%), while 230 tree character and 240 gray character were lower (71 and 67% respectively). The reason for the lower agreement with the latter two can be explained by the fact that it can be more difficult to assess the whole in an area dominated by trees or non-vegetation. The accumulated experience of this test means that there is no reason for an aerial image interpreter to approve every single surface of urban green structure that can be counted in the thousands within an urbanized municipality, but it is enough

that the interpreter has made a random check that the correspondence is sufficiently good. Since there is no precise conclusion as to what is experienced as a leafy, open or tree-filled environment and that the automatic classification, despite its accuracy, can become blunt if one looks for details, the characteristics of the urban green structure should be used for precisely an indication of the potential values which may be there.

In order to prevent built-up areas on outcrop land from ending up in classes 210 or 202, a reclassification of 210 and 202 has also taken place after the characterization in built-up areas with the support of SGU's soil type map. Only areas with the land uses Scattered settlement/residential settlement/farm settlement outside LM's settlement areas often in rural areas (605) and Clear urban impact, undetermined or other than 501-598 (599) have been used in the reclassification because residential settlement can often be of grass character even if it is on mountains in the day. If the classification is not clear, but in some municipalities that have a lot of this type, often in an archipelago environment, gives a relatively good picture of this plot type.

*Table 3. In order to improve the mapping of the fine-mesh urban green structure, rules for property-level classification within the urban environment have been set up regarding basic characteristics for each property. When the initial polygon drawing is done in the Step1 database, the urban environment is characterized at property level into four of the classes below. All urban green structure must contain |10% vegetation cover.*

| **Rules for automatic classification of Step1_code for urban land** | **Non-vegetation** | **Low vegetation <0.8 m** | **Semi-high vegetation 0.8-4.5 m** | **Tall vegetation >4.5 m** |
|---|---|---|---|---|
| 101 Urban gray structure, non-vegetation | **>=90%** | | <10% | |
| 210 Urban green structure open of (grass) character | <50% | **>50%** | <30% | <50% |
| | **<50%** | **<50% <30%** | | **<50%** |
| 220 Urban green structure of a leafy character | <50% | <50% | **>30** % | <50% |
| 230 Urban green structure of tree character | <50% | <50% | | **>50%** |
| | | | or in combination >50% of which semi-high <30 | |
| 240 Urban green structure of gray character | >50% and <90% | | | |

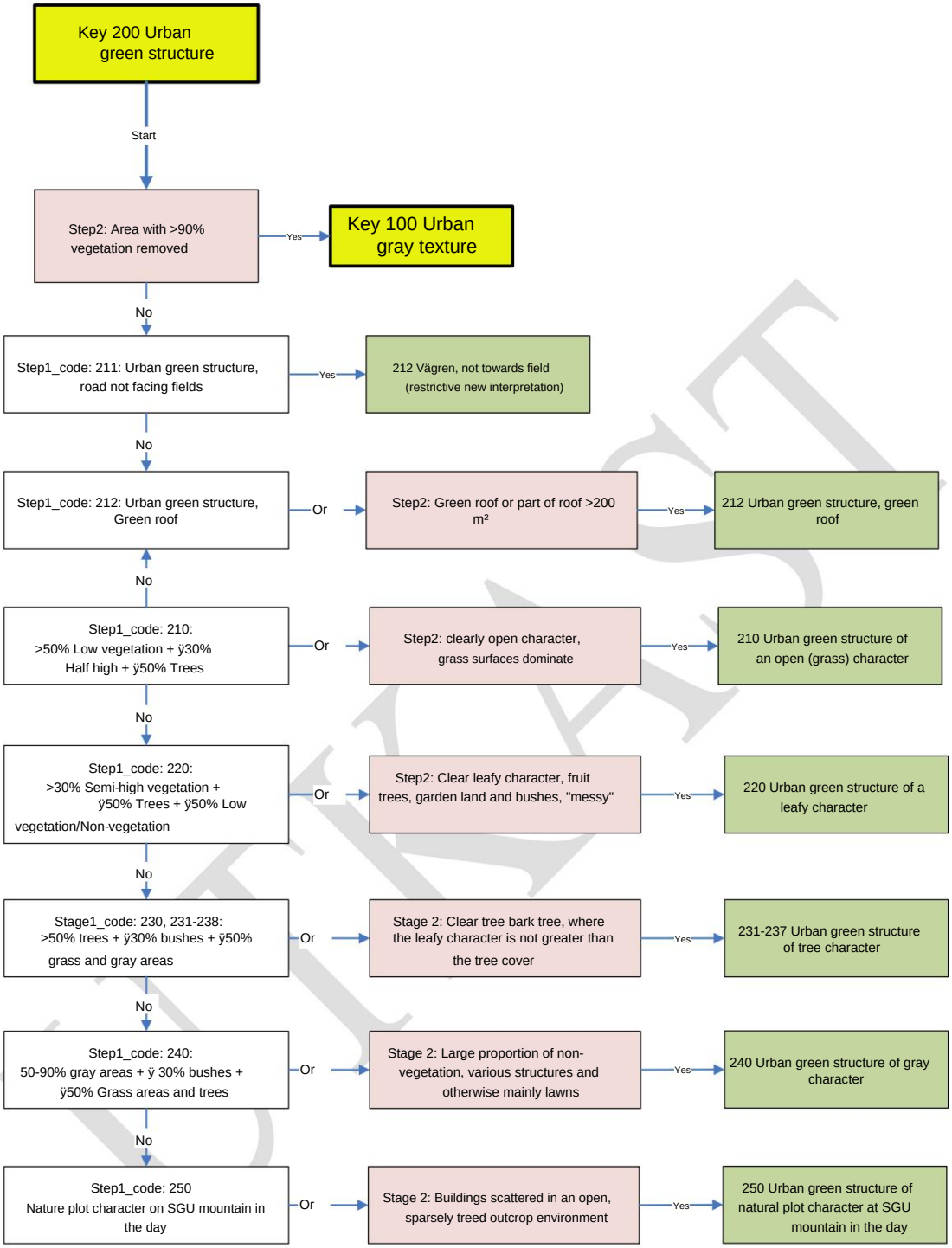



*Figure 4. Detailed key to biotopes within the main class 200 Urban green structure. Note that additional attributes are available for all biotopes. For urban gray structure, this mainly applies to land use and possibly Size.*

**Main class 300 Arable land**

The farmland has its own main class. This is to be able to highlight the spread of agricultural land at the highest level, as it has a significantly more significant presence in a regional perspective. Arable land here refers to arable land, grazed arable land and other cultivated agricultural-related crops.

Semi-natural grasslands are included in 400 Open land or 600 Forest/Tree-covered traditional land depending on tree cover, these must essentially be interpreted from aerial photographs as the Swedish Agricultural Agency's grassland database TUVA is not comprehensive. The class includes all arable land regardless of how it is cultivated according to the definitions of the Swedish Agricultural Agency (Figure 8).

The arable land has been taken from two sources: The main one is the Swedish Agricultural Agency's block database where all demarcated arable land, long-standing hedgerows and permanent crops have been selected. Pasture and other land have not been taken into account because these are often roughly demarcated areas with mixed content and are therefore classified as something else in the biotope database. Thanks to the level of detail in the Swedish Agricultural Agency's block database regarding land use (SBI-1070), further refinement of Step1_code and proposed land use can be estimated at an initial stage and then only need to be checked by aerial image interpreters when possible. You can rely on the land use from the biotope database's Steg1_kod
if you trust the Swedish Agricultural Agency's block database.

In a regional biotope database, it is important to know the land use on the agricultural land, and when the pressure for expansion rises, it is common for arable land to be converted into urban gray and green structure faster than the block database is updated. However, it is very time-saving to use the block database's demarcation of arable land with crop rotation, long-standing hedgerows and permanent crops. As these limits are used for legal regulation of support systems at EU level, it is quite natural to let these limits prevail over all other limits in the Stage1 version of the database.

The other source of the cultivated land and then mainly 310-340 Proposed cultivated grassland is an automatic classification of all arable land from the Land Survey's economic map from the 1950s or thereabouts. This document shows the majority of all arable land that was mapped in 1950. The mask is burned
not straight in, but split into two parts. The first phase is that it is burned into what remains as 400 open land when various main classes are entered, 100, 200, 300 (the block database), 600 wooded land, and 700 Water. In this way, we get a good estimate of the grassland that is not expected to be semi-natural but cultivated and the area within the main class 400 Other open-sparse tree-covered
land that is expected to be mainly natural-semi-natural is thus reduced significantly. The second phase is the forest where it automatically sets all the forest on the former field as land use forestry and the forest phase young middle-aged forest (see Main class 600 below).

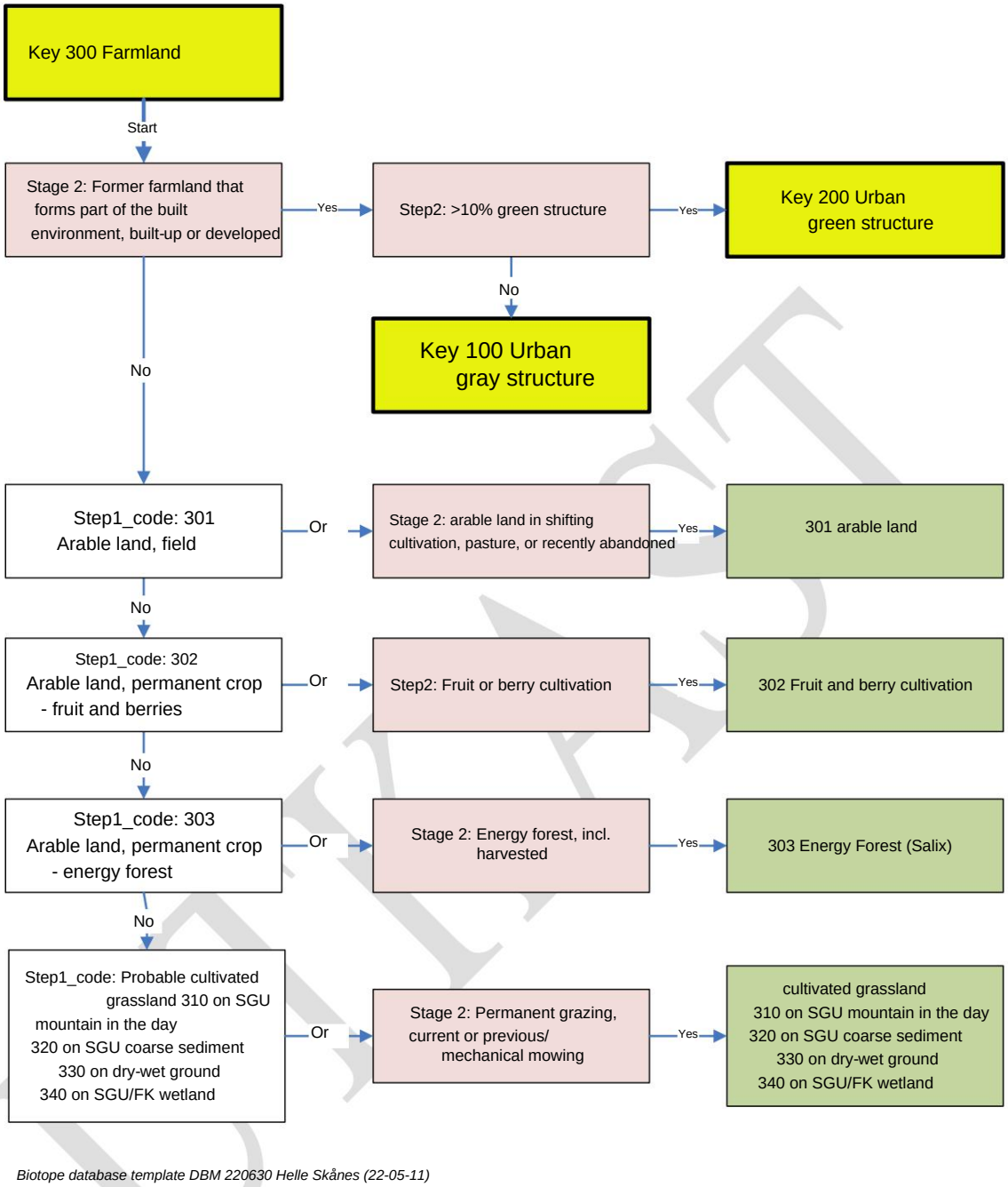



*Figure 5 Detailed key to biotopes within the main class 300 Arable land. Both the automatic main delimitation of the biotope in the Stage1 database and the proposed land use are taken from the Swedish Agricultural Agency's block database. In Step 2, the land use is checked visually and unblocked areas are added as far as they are found. Note that additional attributes are available for all biotopes. For urban gray structure, this mainly applies to land use and possibly Size.*

**Main class 400 Open ground**

This main class is the most important and yet the worst classified in the entire automatically generated database. Here is everything that has not been able to be transferred to other main classes through support in the input data in the work with Steg1-the database. The main class therefore includes everything from vacant land and other urban-style land to the finest grasslands. The entire main class 400 must therefore be interpreted in aerial photographs to find out what is what. This is the very essence of BIOTOP SE; to try to delineate everything that can be said about and then focus the manual interpretation work on the most difficult and at the same time most important areas.

The division in the Step1 database follows the rough moisture regimes of rock in the day according to SGU, coarse sediment according to SGU, wetland according to SGU and the property map and then everything in between which can be summarized as dry-wet (everything from fine sediment to coarse moraine). The minimum mapping unit for this class is generally 0.1 ha, but islands, arable ridges and arable islets can be considerably smaller, the latter down to close to 30 m². This applies to the Stage1 database. In the case of continued aerial image interpretation, these should in practice not be reinterpreted. For biotopes, see Figure 9.

The main class open ground is significantly affected if the Step1 database has been prepared with orthophotos from the spring (approximately earlier than the turn of the month June-July). Mainly it is the automatic classification of dense reeds and elements of other semi-tall vegetation that suffers because deciduous shrubs are not visible well then either.

In BIOTOP SE, this main class constitutes all open land that essentially has <10% tree cover (with the exception of tree-covered grassland which may contain a higher crown cover) and that is not included in any of the other vegetated main classes 200, 300, 500 and 600, and mainly includes substrate-dominated lands and grasslands and wetlands. Other open land that is not included in the open land is temporary open land such as clearings and conduits that are included in 600 Forest land biotopes, fields and cultivated grasslands that are included in 300 Arable land biotopes, as well as plots and urban-shaped grass areas that are included in 200 Urban green structure.

Precisely when it comes to the transition between 400 Open land, 600 Forest/tree-covered heritage land and 600 Forest land, it is important to remember that these divisions are a construction of how society currently views the openness of the landscape (Björk & Skånes, 2015). The transitions are gradual and boundaries can be drawn in different places depending on how you define class boundaries and what scale you work in. It will therefore always be difficult to draw

the boundary between open and wooded land, and in some situations there may be exceptions. See more detailed reasoning common to both
the main classes under Main class 600 Wooded land below.

Depending on the direction from which the observer starts, areas can be assessed as open land even though there is >10% tree cover. As we can do

detailed automatic analyzes of wooded vs. open land, it becomes increasingly difficult to manage these two concepts. In the preliminary work in Step 1, we can in practice bring out each tree and separate it from the open ground. But, this doesn't help much as we have to be able to handle the smallest mapping unit >0.1 ha. All scattered trees will then end up in the open ground and it is not until later by visual assessment and further demarcations that we can finally separate the open ground from the wooded ground.

The traditional tree-covered environment is ecologically important but difficult to delineate with automatic methods (Figure 13). Even when it comes to the demarcation between traditional land and forest, the line is diffuse because a large proportion of our leaf-dominated forests have a history as both open and wooded pasture/mowing land. Just as described under Main class 400 Open land and 600 Tree-covered land above, the transition between open land and tree-covered land is gradual and 700 Tree-covered ancient marked land is placed somewhere in between with potential overlap with open land but with total overlap with the tree-covered land (Figure 14). In addition to the gradient in tree cover, the gradient from well-established to long-abandoned must be added here. Write something about why it is still put in Forest with land use

It is easy to visually find the sparsely treed pastures that are claimed continuously, but considerably more difficult to see pasture under denser canopy cover. You can often see the impact of grazing over a long period of time in spontaneously regrowing forests that can be anything from conifer-dominated to broadleaf-dominated, but there is a sliding boundary where someone needs to decide when a tree-covered grassland should turn into a forest. In general, one can describe traces of uprooting as the beaten or well-grazed field layer, animal paths, trampling damage, broad-crowned trees, trees of different ages, clearings and/or straight edges towards the surroundings. Other clearing, forestry, arable farming or other anthropogenic activity is not included in the concept of clearing (Skånes et al., 2007).

The problem is that this class is completely bound by land turnover and there is no comprehensive data on all land claimed by grazing or mowing. The meadow and pasture inventory and the subsequent Meadow and pasture inventory with the TUVA database as an available source contain only the finest meadows and pastures. All those judged to be fertilized or not sufficiently species-rich have been omitted. This means that TUVA can only help us find the finest wooded pastures. It may also be the case that recently restored wooded pastures are not registered in either TUVA or the Block database. In other respects, the image of 700 Tree-clad heritage-marked land will gradually emerge as a municipality's Step1-

database aerial images are interpreted. Possibly, the block database's information on pastures with special values can be used to improve the search for the tree-bearing priority areas. In the current version of BIOTOP SE, this has not been solved in the automatic part, but all surfaces within the main class must be interpreted in Step 2, or captured with the support of the municipality's knowledge.

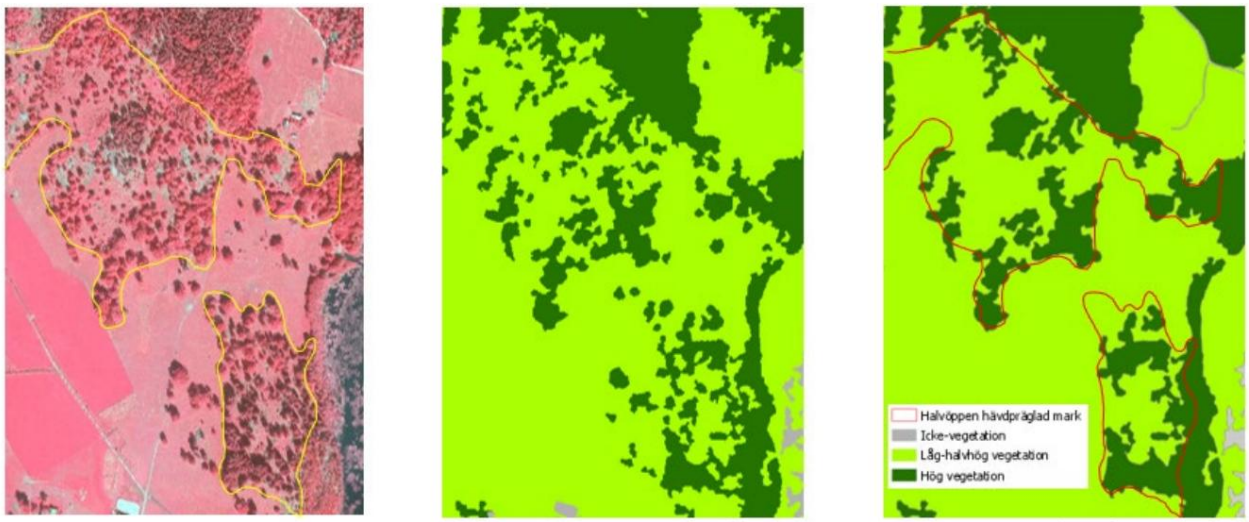



*Figure 6. The semi-open ground is difficult to handle with automatic methods. Above two IRF aerial images where it is easy to visually delineate tree-covered ground. Above center is the original tree mask from the aerial image's classified object height. Above on the right, the biotope database's generalized tree mask >0.1 ha is visible, where the semi-open ground is difficult to see in tree-covered and open details.*

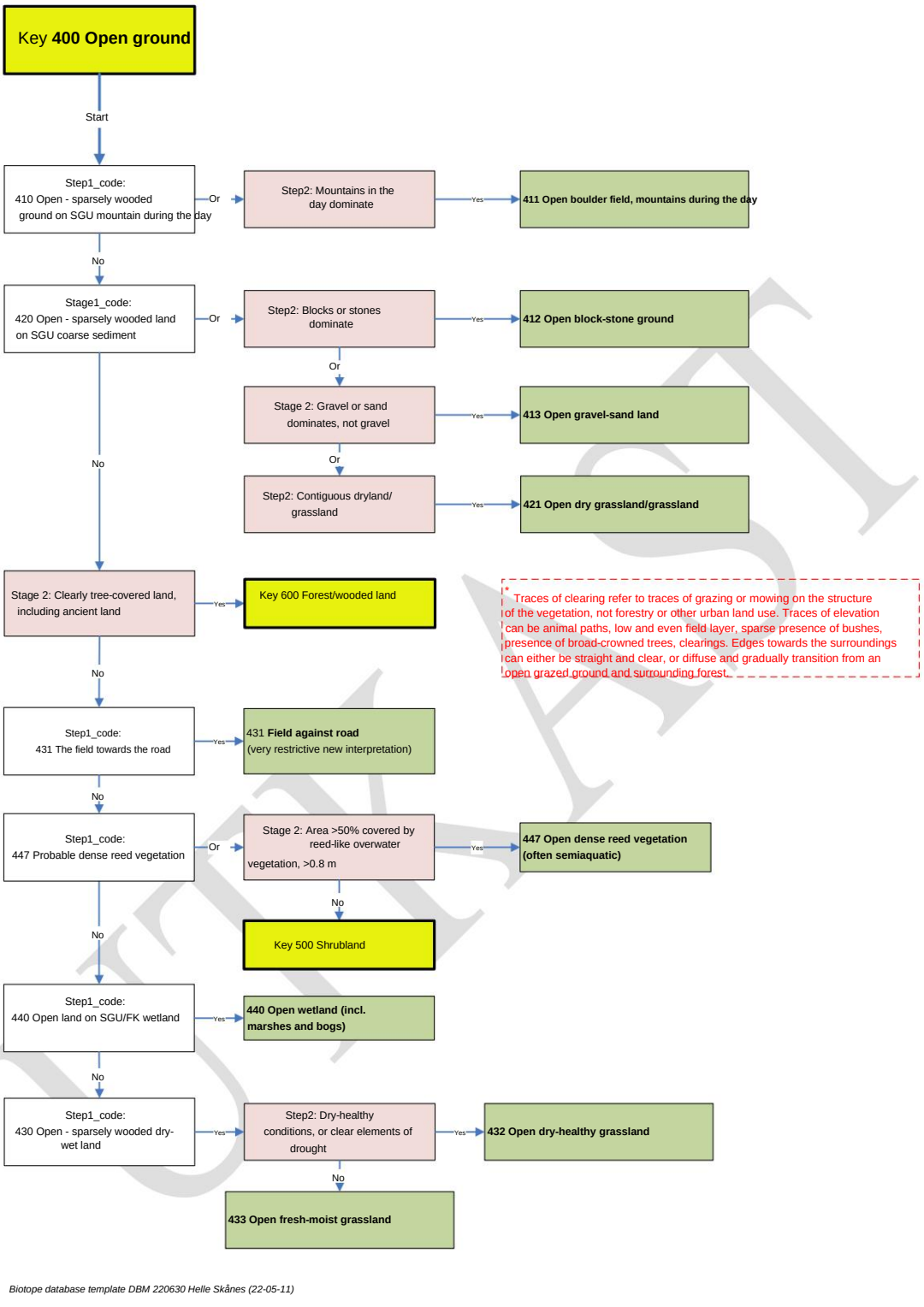



*Figure 7 Main class 400 Open land (figure 12). The division is mainly based on humidity. Land use is important, but lies as an attribute where it is mainly grazing and mowing that form the hallmark. The only difference between 400 and 700 is that the latter is clearly tree-lined.*

**Main class 500 Shrubland**

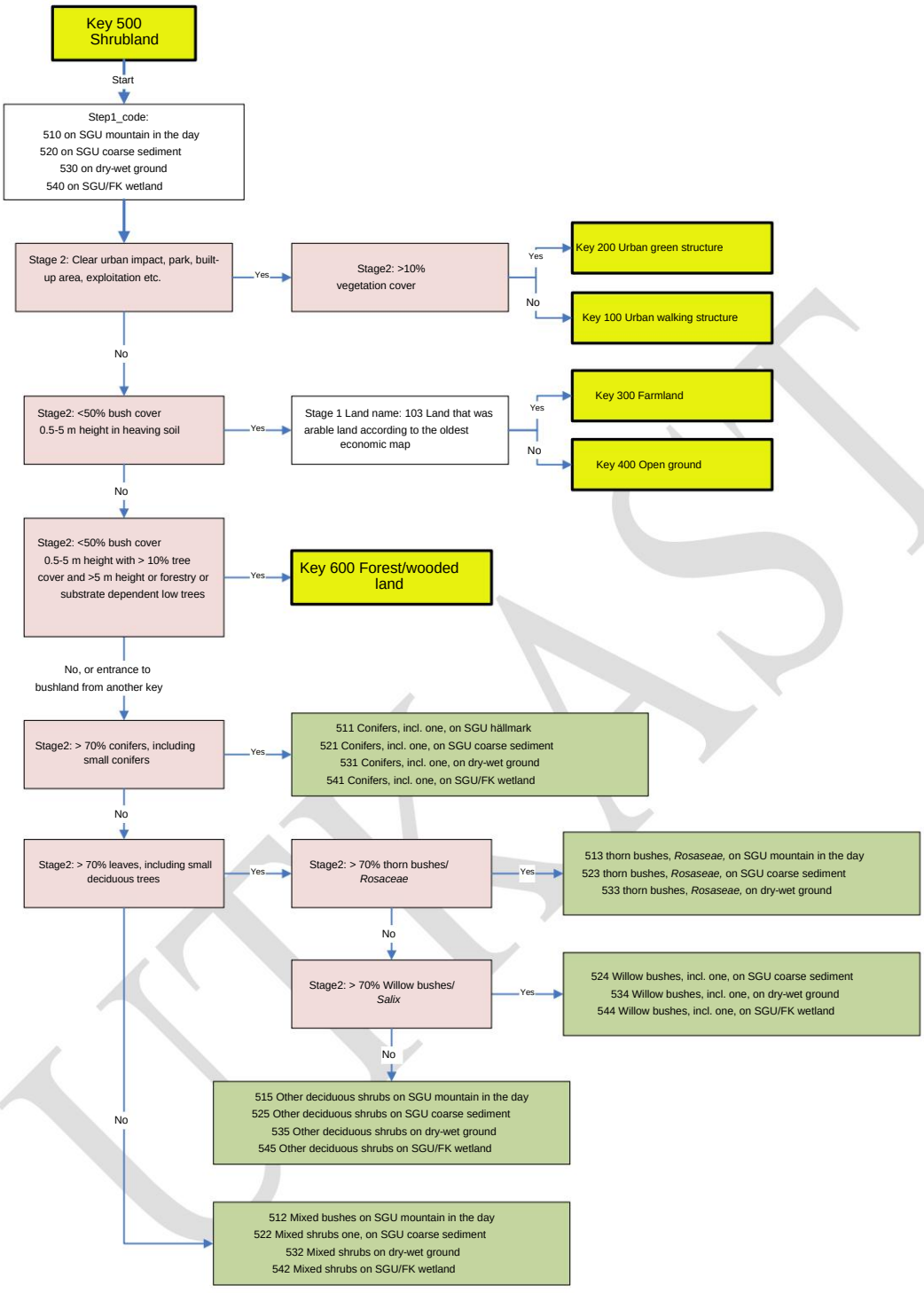
The main class includes all shrubland that exceeds the minimum mapping unit of 0.1 ha where the degree of shrub cover is >50% (Figure 10). If the bush coverage in an open environment is 30-50%, then the bush coverage is specified in the Shrubs attribute. The biotope classification is based entirely on the type of shrubs that dominates. The division is similar to that of forest where the main line runs between conifer-dominated, leaf-dominated and mixed shrubland respectively. The leaf-dominated is divided according to the grouping of thorny bushes, willow bushes and other deciduous shrubs. Dividing the bushland in this way is a tradition in vegetation and biotope mapping. It is basically impossible to go into specific species when it comes to shrubs, but the thorny bushes which are often dominated by sedges, rosebushes, hawthorns and other bushes with thorny branches are often recognisable, as are the willow bushes. Both of these types are interesting thanks to the fact that both flower and that the thorn bushes are also load-bearing.

The classification is based on the initial pixel classification and is thus dependent on the presence of the bushes and the fact that the leaves have turned out at the time of registration. The breakdown in the Step1 database follows the rough moisture regimes of rock in the day according to SGU, coarse sediment according to SGU, wetland according to SGU and the property map and then everything in between which can be summarized as dry-wet.

The minimum mapping unit for this class is generally 0.1 ha, but islands, fields and islets can be considerably smaller, the latter down to close to 30 m2.

The main class bush land is significantly affected if the Step 1 database has been prepared with orthophotos from the spring (approximately earlier than the turn of the month June-July). All shrubland except possibly the conifer-dominated one will then be underrepresented in the database.

In order not to become too complex and uncertain, all deciduous shrubs that are not clearly dominated by either thorn bushes or willow thickets have been placed in a class 550 Other deciduous shrubland.




*Biotope database template DBM 220630 Helle Skånes (22-05-11)*

*Figure 8. Overview of the main class 500 Shrubland. The division is mainly based on conifer-leaf type, but is also indirectly an indication of humidity, as thorny bushes mainly grow dry-healthy and willows on wetter soils.*

**Main class 600 Tree-covered land and non-tree-covered land under forest cover**

The tree cover in the landscape is not naturally divided according to clear and given breaking points. In fact, the transition between forest and open land constitutes a gradient that can vary in width and character in space but also change over time (Käyhkö & Skånes, 2006). Forest is thus a concept that is as obvious as it is complex. How we perceive and define forest depends on many factors and varies from organization to organization and between contexts (Björk & Skånes, 2015). No classification system thus escapes the dilemma of demarcation between open land and forest, and all must deal with the problem in a systematic and reasoned way. As a rule, a tree-covered area is not called a forest until its land use or lack of land use has been determined (FAO, 2012). According to FAO's forest definition, which we have adopted in Sweden, trees that do not reach 5 m in height are defined because climatic or substrate-related limitations, as well as trees that have not yet reached the correct height, including clearings as forest (FAO, 2012). In BIOTOP SE, tree-covered land can belong to both 200 urban green structure and 600 Forest/Tree-covered land. All depending on land use (Figure 11).

However, land use cannot be determined in detail by automatic methods, but only later with the support of visual assessment by aerial image interpreters. But, before the land use has been established, it can be established with good certainty whether an area is covered with trees or not. This is also initially important information because the tree cover itself is important for the properties of a biotope and can be used as far as possible in various analyses. Therefore, there is the preliminary main class 600 Tree-covered land in BIOTOP SE, which consists of Stage1_codes that are expected to transition to Stage2_codes after visual assessment of land use. In the final biotope database, it is therefore expected that no areas of main class 600 Tree-covered land will remain.

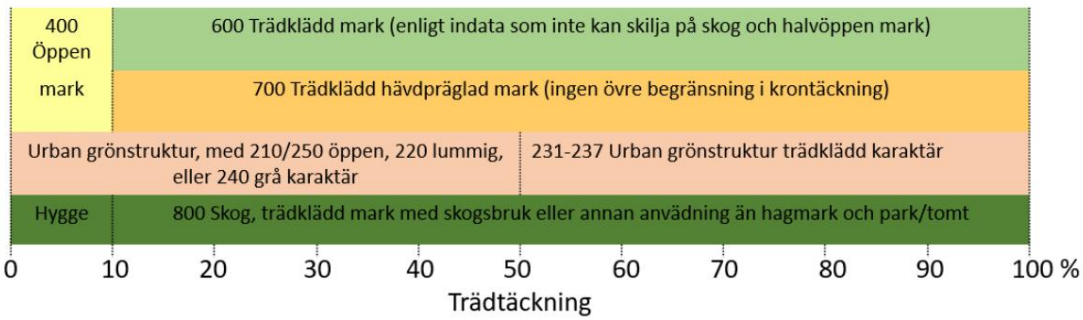


*Figure 9. Illustration of tree cover management in relation to land use and main class/ biotope class. Tree-covered land/ forest is indicated from approx. 10% tree cover in forest and tree-covered ancient land, but from 50% in an urban environment. The reason why the tree coverage in urban green structure deviates from other tree-covered environments is primarily because it would take too long to determine what type of trees are in the urban environment.*

The primary source for tree-covered land is BIOTOP SE's initial pixel classification, which with high precision distinguishes all vegetation from land that is not covered by vegetation and divides the vegetation into different height ranges. The division in the Step1 database follows the rough moisture regimes of rock in the day according to SGU, coarse sediment according to SGU, wetland according to SGU and the property map and then everything in between which can be summarized as dry-wet.

However, not all tree-covered land has trees in all locations, and therefore the property map's forest mask is also used as input. Thanks to this and National land cover data, temporarily non-tree-covered land can be captured and brought to the tree-covered land in any case. A hygge is certainly open land, but is expected to return to wooded land in the foreseeable future and should therefore not be confused with e.g. an open grassland. Thanks to the aerial image's elevation model being combined with the property map's forest mask and national land cover data's forest classification, the problems are also compensated when the pixel classification has been made from orthophotos taken in early spring.

The minimum mapping unit for this class is generally 0.1 ha, but islands, fields and islets can be considerably smaller, the latter down to close to 30 m2. For biotopes, see joint key with Main class 600 forest/wooded land
(Figure 15).

Tree-covered land and tree species distribution are also perceived very differently from the ground and via remote sensing, incl. visual assessment in 3D aerial images, which depict the landscape from above. The fundamental difference is therefore that it must be based entirely on tree cover as seen from above in remote sensing and not the base area, which is measured in the field as the basis of assessment accepted in forestry (Skånes et al., 2007). Then the worm for the tree-covered land in BIOTOP SE
is calculated automatically from object height taken from the surface models of the aerial images and not laser point clouds, the calculation also cannot say anything about estimated crown coverage, i.e. the density of the tree-covered ground.

By combining tree-covered pixels (1x1 m) that are adjacent to each other or where open areas <0.1 ha surrounded by tree-covered land have been generalized into the tree-covered land in combination with information from the forest mask of the property map, the contiguous tree-covered land is captured, which in the foundation is what is sought after. When it comes to tree species distribution, it can also become a comparison problem because in field methods you count the number of trunks of each species and in remote sensing data you can only determine the relative coverage of the crowns. In the latter case, an overestimation of the leaf element often occurs in practice (Figure 12).

In the gradient towards the open ground, this means that small groves of trees, often <0.1 ha, are generalized into the open ground in the post-treatment. This is the main reason why areas that can actually be both forest and tree-covered reclaimed land instead land in the Step1 database end up in main class 400. Visual assessment of these areas is often required to meaningfully decide whether the area should be 400 open, or 600 forest/wooded land (see Main Class 400 above).

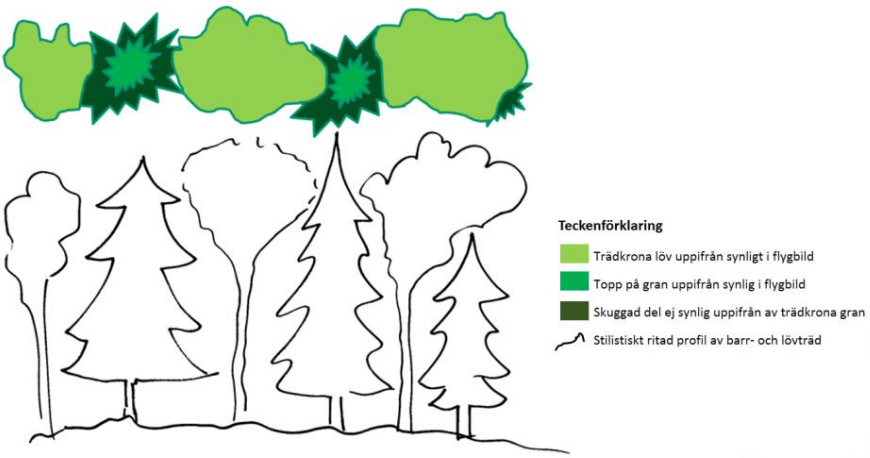



*Figure 10. In all remote sensing, we grapple with the problems of how to be able to define forest types with appropriate certainty and above all with consistency with how we define forest types from the ground. The vertical perspective means that estimates in wood species composition cannot be considered 1:1 with a field-based estimate. We also tend to overestimate the leaf component relative to conifers and also underestimate the spruce component relative to pine.*

As part of the streamlining of BIOTOP SE, the forest type is taken from Metria's national land cover data NMD, which has eight forest classes in two moisture classes, pine, spruce, mixed coniferous, deciduous mixed conifer, deciduous (trivial), deciduous, mixed deciduous, and disturbed forest. Dividing all forest types manually from scratch is an impossibility. In this situation, the NMD constitutes the most detailed and country-wide forest classification available. NMD's classification method is a supervised classification method (Maximum Likelihood) based on two points in time, one before leaf cracking and one from high summer (Metria, 2018). Although NMD is in an early stage of development and is expected to significantly improve its accuracy in the coming years, there is no reason to wait to use this data.

Thus, this land is under main class 600 tree-covered land with a preliminary proposal for a forest phase until the aerial image interpreter has made an assessment of land use and other factors that determine the tree-covered land should be moved to one of the main classes 600 forest/tree-covered land 200 or Urban green structure (Figure 15). We will always have problems deciding what is forest and what is not forest. The important thing in BIOTOP SE is not primarily to solve this Gordian knot, but to offer the tools to be able to be flexible in the different stages of the method. Because it is actually the case that we can mean different things with the concept of forest depending on the situation in which the question is asked, even within the same database, and then we should not once and for all try to determine where the boundary should be before the data can be used.

Even in the tree-covered land, systematic mapping of four broad moisture regimes with soil conditions deemed important for the ecological status of the surfaces has been used (see table 9).

**Main class 600 Forest land/wooded land (incl. disturbed forest)**

Forest land is essentially land that is characterized by trees, with the exception of clearings, and that has a land use that makes it a forest. In an initial stage, most of the forest is included in main class 600 Tree-covered land. When the database has been interpreted from aerial images, the forests will end up below 600. Note that in large municipalities with a large proportion of forest land, far from all the forest will be able to be interpreted from aerial images. What mainly determines whether the biotope is classified in the main class 600 Forest land/wooded land is the land use. All biotope classes belonging to the main class belong to the attribute Steg2_kod. All forest with traces of all land use, except for a clear urban character (such as a park) brought here, as well as all forest without traces of any clear land use. Surfaces that are dominated by clear land use such as sports activities, playgrounds or parks are brought to main class 200 Urban green structure and interpreted further. Areas that are in direct connection/embedded in buildings and urban environment but only partially exhibit urban influence may be allowed to belong to main class 600 but then with an urban land use.

The forest land is divided according to three main characteristics (Figure 18) The first is the species composition taken from national land cover data (Metria, 2018). This is represented by the last digit of the code (1-7). The second is humidity regime/substrate type in rough terms represented by the second digit of the biotope code where 1 stands for mountain in the day. 2 stands for coarse sediment, 3 for dry-wet and 4 for wetland. In addition to these characteristics, which are built into the biotope code, the support criterion Forest Phase is crucial, which is used both to distinguish substrate-dependent low-growth forest and production forest. Of course, the land use is decisive for the description of the forest. The most important thing to know is whether the forest is characterized by forestry or not. In addition to land use, the forest is characterized by the attribute forest phase (Table 5). In order not to spend an unnecessary amount of time on subdividing the forest phase into clearing, plantation forest, clearing forest, thinning forest, full-grown forest and old forest, the forest phases for the production forest have been combined so that clearing and plantation forest get one class, young-middle-aged forest (including clearing and thinning phase) as one and full growth to old forest as one class. The latter differentiates between essentially homogeneous age structure and essentially heterogeneous age structure, but cannot indicate specific conservation values or actual age.

It is of the utmost importance that users understand that the forest type found in the database is essentially the one that has been classified in the national land cover data NMD, but with additional refining characteristics via SGU's soil type map and BIOTOP SE's forest phase. It would be impossible for the aerial image interpreters in the Stage 2 work to correct misclassifications in the NMD by checking tree species composition and merging production forest into larger, simpler units that would be more appropriate. The biotope database will therefore also live with the corresponding classification problems that NMD has. At the regional level, this is the safest and most accessible classification that

is available. As NMD refines its method and gains access to more satellite images, security is expected to increase as far as possible.

With several satellite images during the season, several problems with the classification of e.g. deciduous forest and trivial deciduous forest are minimized because deciduous trees often mature later than trivial deciduous trees. However, there are some classic problems that cannot be solved with phenological information alone. The biggest thing is that aspen and oak are often mixed together and that even the aspen matures late in relation to the other deciduous trees. Moist deciduous forests also mature later than deciduous forests on dry, healthy land, and this means that even birch and alder can continue to mix together. In the latter case, Metria works by using the wetness index to find the moist deciduous forest, which is usually dominated by trivial leaves (Metria, 2018). It will be exciting to follow Metria's method development and as NMD improves, future biotope databases will also improve. The forest that is most likely to be adjusted by an aerial image interpreter when interpreting is precisely broadleaf forest and larger stands of aspen, which can be very clear in aerial images (BIOTOP SEE Part E). With the above in mind, it is up to the user to always look at land use and forest phase and thus get guidance on how well one dares to trust the forest classification from NMD with the support of these attributes.

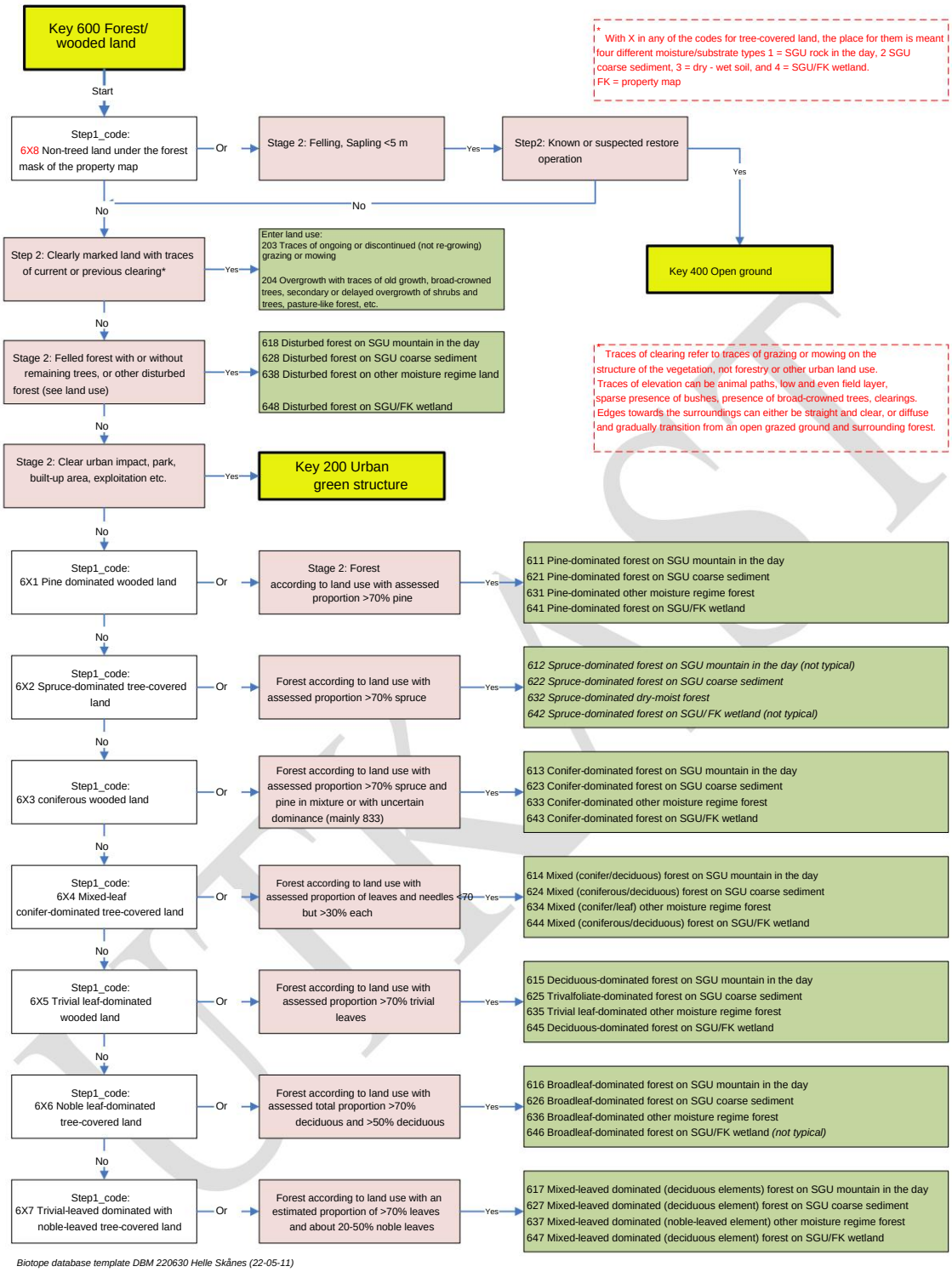



*Figure 11 The forest classes, Main class 600, in Step2_code which fully follows the National ground squirrel data's tree species types (Metria, 2018) and humidity classes, but where forest not on wetlands in BIOTOP SE is divided into dry-wet and open ground character, which is an important biotope. For mixed forest and deciduous forest, the automatic support is weak for the outcrop character.*

**Main class 700 Water**

All water within BIOTOP SE's biotope database is taken in Step 1 directly from the property map's surface layer for water. The main reason for this is to speed up the mapping process so that the interpreter does not have to redraw all the lines by hand. The advantage of taking the border from the property map's national shoreline, NSL, is that this border is nationally agreed between the Land Survey and the Maritime Administration and will be kept up to date by these authorities (Sjöhed & Nordström, 2016). In order not to lose any of the wealth of detail in small bodies of water that are ecologically important from a landscape perspective, all small bodies of water found in the property map are kept down to the smallest puddle. During the work with the Step 1 database, all islands are also counted and the information about these <0.1 ha is kept in the database so that even areas < 0.1 ha can be kept and traced to an island in the same way as small arable islets and small bodies of water are interesting to know that they are just small areas surrounded by something completely different.

Note that watercourses are only included if they are drawn as surfaces in the real estate map. Narrower waterways and ditches indicated as lines can be called up directly from the property map or other mapping. However, no distinction is made between stagnant and flowing water. If such an analysis is needed, it is better for users to combine the property map's hydrographic line layer with local knowledge of what counts as running water or not.

Water areas are further divided according to the presence of aquatic vegetation and obvious facilities that indicate a land use that may cause disturbance to the ecosystem (Figure 19). These are facilities in the form of larger pier complexes, marinas, marked swimming areas, etc.

In the stage 2 work, no fine adjustments are made to the waterline, but it is accepted as much as possible as indicated. If the aerial image interpreter has found new water or water that is perceived as permanent which for some unknown reason was not included in the input data, it will be plotted. It is also important to consider that the waterline can vary greatly depending on the time of year. Flooding in the spring can make it difficult for mapping. If this happens and the interpreter has not been able to interpret what is under the water, water surface will be added but not merged with the water area highlighted according to the property map.

The biotope classes of the water are reported in figure 17.

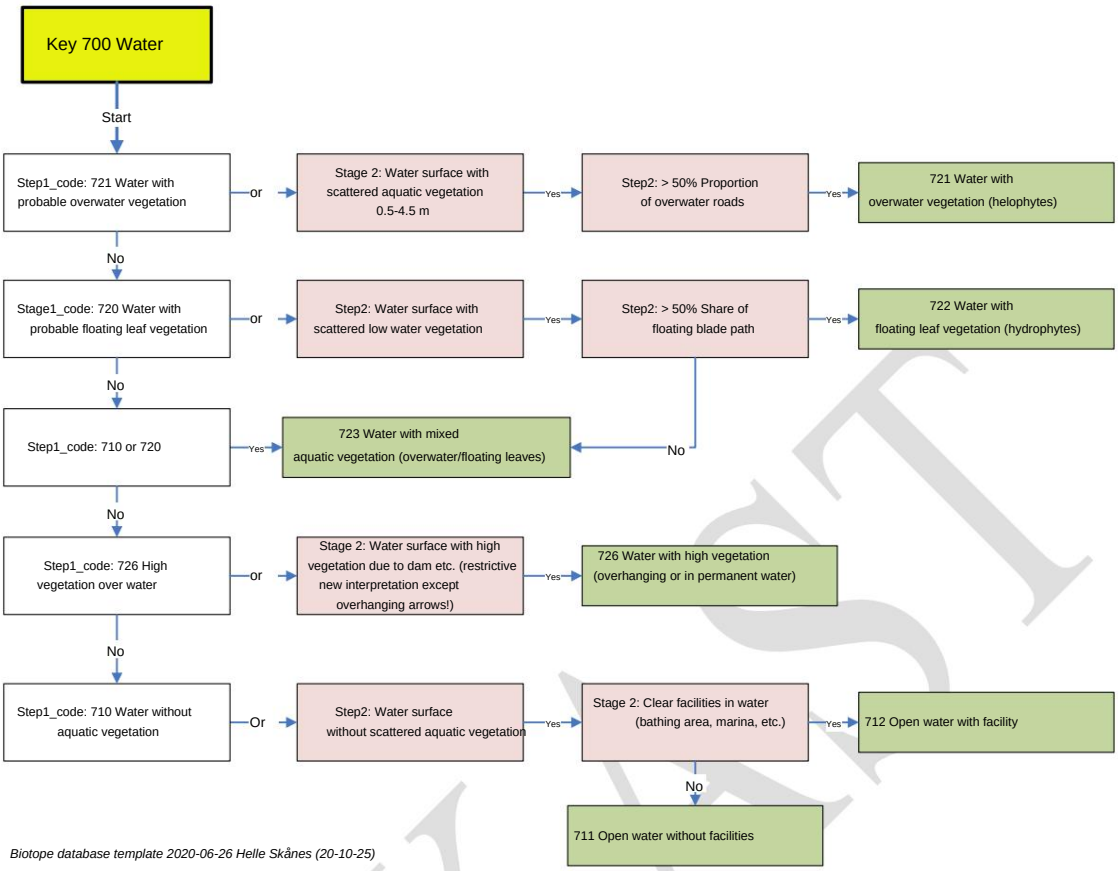



*Figure 12. Overview of the biotopes in main class 700 Water. All delineation comes from the water layer of the property map (NSL national shoreline). The division into water without or with aquatic vegetation is done by analyzing the IRF orthophoto in lakes and <50 m from shore in seas.*

## 3.1.Biotopes (Level 2)

One of the main purposes of BIOTOP SE is to be able to use its total content already at an initial stage. The method consists of several different steps (Figure 1) and already after the first step there is a lot of information that can be used. Even if some biotopes are not visually assessed, they still have great value to be able to consider as they are. To make this possible in one and the same biotope database, two parallel code systems have been developed which are linked together in the attribute Biotope according to the explanation given below. See complete list of all biotope codes in Appendix 1.

**Biotope**

Biotope belongs to hierarchical level 2 which is the most detailed level with a total of 114 classes of which 66 are common to Stage 1 and Stage 2, 23 are unique to Stage1_codes (including some temporary work codes), and 25 are unique to Stage2_codes. Biotope is thus a combination of preliminary Step1_code that is overwritten with Step2_code when such is available after aerial image interpretation has begun.
The purpose of this attribute is to be able to display a complete biotope database already

before the aerial image interpretation is completed. The field is the one to use when the database is used in illustrations and for analyses.

When the biotope database is to be used in ecological and other analyses, it is important that the Biotope attribute is used after being updated as above.

Status in Step1

In the delivered Steg1 database, Biotop contains a copy of the codes in Steg1_kod. Note that updating rows in a particular attribute in is not automated. Before using the main class attribute, you must check that it is correctly specified. Biotop is calculated retrospectively after the completion of the interpretation session by searching the database, where all surfaces that contain a Step2_code are overwritten in the attribute Biotop.

**Biotope_LIGHT**

Biotop_LIGHT is a generalization of Biotop to be able to color the database and also work with a merger of Stage1 and Stage2 codes. The attribute contains 84 broader classes where mainly Stage2 classes are generalized into their respective Stage1_classes. This mainly applies to classes within main class 400 Open-sparse wooded land and 500 shrubland, but also partly in main class 700 Water. The generalization is arbitrarily made to meet general needs of a simplified database and is not intended for anything other than to inform the viewer. Stylization files for this attribute have been produced within BIOTOP SE as the official appearance of the database (See Part A for further details on stylization).

Status in Step1

In the delivered Stage1 database, all Biotop codes for all surfaces have been automatically recoded to the respective Biotop_LIGHT. Note that updating rows in a particular attribute in is not automated. Before using attribute main class, you must check that it is correctly specified.

**Step1_code**

Step1_code is the initial level from the hybrid method's first step, Step 1, where the classification is done completely without visual interpretation support (see part B chapter 2.2). It contains 89 classes, of which 66 are common with Steg2_kod and is based entirely on a smart merging in different stages of carefully selected and processed existing data from different national databases and automatic classification and segmentation of aerial photogrammetry and image processing (Part D). Step1_code should in principle never be used in any analysis of the database as soon as aerial image interpretation has started and there are Step2_codes. Then the Biotope attribute is used instead.

Status in Step1

Before aerial image interpretation, there must always be a complete set of preliminary biotope codes that are the result of the preparatory work with the Stage1 database. As soon as a Step2_code exists, the Step1_code becomes obsolete and should not be used. It will

therefore set to 999. Often mergers and divisions of surfaces occur when the final code is set and it is therefore not with certainty a 1:1 relationship between these codes. If you want to compare with the original Steg1 database's coding, you have to do an overlay analysis between Steg1-
database_ORIGINAL before it is processed by aerial image interpreter in Step2.

The Step1_code attribute should in principle never be used in any analysis of the database as soon as aerial image interpretation has started and there are Step2_codes. It is therefore important that the Biotope attribute is updated and always used in analysis.

**Step2_code**

Step2_code belongs to hierarchical level 2 which is the most detailed level with its own class code where only the 91 codes representing surfaces visually assessed by an aerial image interpreter can be entered. Of these, 66 are common with Step1, i.e. the correspondence with the Step1 class is 1:1 and then the code is common in both fields. For certain main classes where the division in Stage 1 is limited or where land use cannot be picked up automatically, it may be the case that the Stage 1 code is a basic code that needs to be divided into several specific biotope codes based on e.g. interpreted land use and moisture. In general, it can be said that the Step1 code reflects the basis that has been used, which, as previously described, is not always sufficient.

Status in Step1

The initial Stage1 database contains no areas with Stage2_code except for the common codes where no aerial image interpretation is needed or planned (eg infrastructure and buildings). Before aerial image interpretation begins, all surfaces have the code Null. As aerial image interpretation continues, Null is replaced with a current Step2_code.

The work with the Step2_code and how the Step1 database should be interpreted is described in a separate manual Part D (Skånes 2020). Steg2_kod will probably never be completely filled, and it therefore does not make sense to use Steg2_kod in isolation in some analyses, because the biotope database at the regional level but also at the municipal level will take time to complete. If Steg2_kod is used, larger or smaller parts of the database may therefore be without information. Instead, the final field to be used by all users is Biotop as shown below.

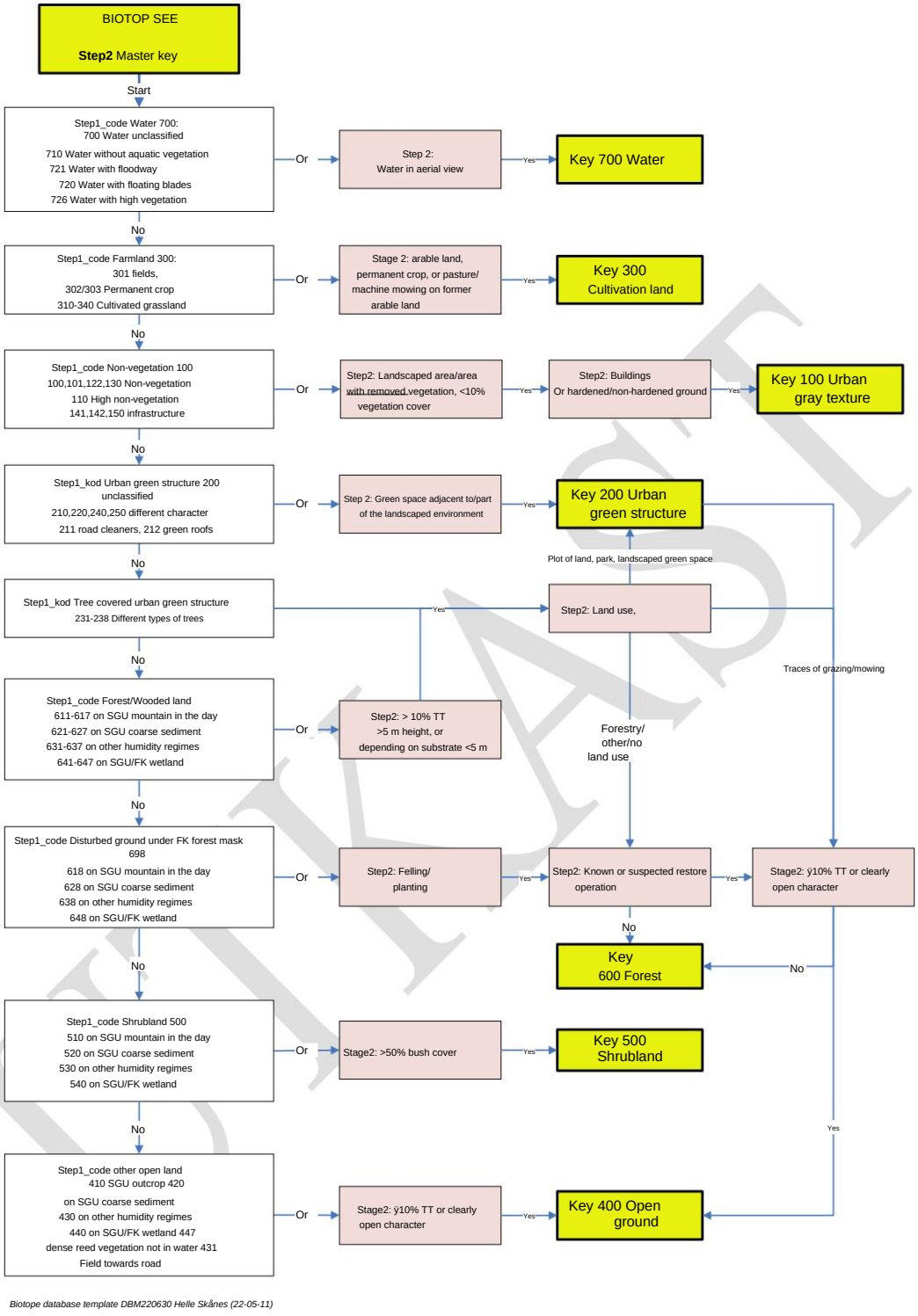



*Figure 13. The main key of the biotope database's classification system for Stage2_codes (main class). Step2_code is primarily entered through aerial image interpretation. Note that each Step2_code is primarily based on a Step1_code. This constitutes a basic prerequisite for a time- and cost-effective regional biotope database. See detailed biotope-level keys under each main class below.*

## 3.2. Other descriptive biotope attributes (Level 3)

In addition to Main class and biotope classes (divided into Biotope, Stage1_code and Stage2_code), there are a number of descriptive attributes. Note that different attributes are specified in different ways depending on the main class (Table 5). Descriptive attributes can be surface delineation at different levels or additional information that summarizes often continuous data without affecting the surface delineation further (Skånes & Andersson, 2011). A surface delimiting attribute is used to divide surfaces into different biotopes or the same biotope into several surfaces, e.g. where there are different land uses. In the first case, the variation is thus greater than what the biotope code allows and in the latter case it is smaller. A dry-healthy grassland (422) can consist of different areas depending on the land use (grazed or no land use) and whether it is completely open or has 30-50% shrub cover (Figure 11). These surfaces need to be separated from each other and form new surfaces. Here you immediately realize that this has to do with generalization principles as described in chapter 2.

A non-surface delimiting attribute is one where in the finished surface division you choose to add additional descriptive information, often automatically calculated average values, standard deviations or proportions that aim to further characterize the surfaces. Such attributes could be the average height of the trees in a forest biotope, or the proportion of semi-tall vegetation in an open area.

It is very important to realize the difference between these two attribute types in one situation where the biotope database continues to be processed after the attributes have been set. The surface delimiter defines the biotope and the non-surface delimiter describes the surface's character or internal variation. If a forest area is partially felled and divided into two new forest areas, a clearing and a forest, the tree height in the new clearing will obviously be 0 m or not relevant. However, in the remaining forest it is not at all certain that the original tree height is correct.

As shown in table 4, some descriptive attributes are automatically calculated in Step 1 and need to be recalculated when the Step 2 classification is carried out. Fewer attributes are specified for some main classes (100 and 200, as well as 700), while more attributes are specified for others (biotope 310-340, main class 400 and 500). It all has to do with what is already in the biotope code. For example, tree species are already included in main class 600, which is why the Trad layer attribute should not be specified. In the wooded land, it is difficult to estimate the degree of cover of bushes, which is why Halvhog should not be entered there either. Salinity is indicated for water only. Humidity is specified for all main classes except the urban-oriented 100 and 200. All surfaces need to be added to a land application in the end. In many cases such is already indicated in Step1, but for many surfaces there is no support in existing sources that is safe or detailed enough to be used. Sometimes there is a preliminary proposal, but often this aerial image interpretation is required to set a final and safe land use.

*Table 4. Descriptive attributes specified for biotopes in each main class The rules for how the work should proceed are given in detail under each attribute below. Example of interpretation: FT/ S1 A = attributes are supplemented and checked during aerial image interpretation, FT = interpreted with limited support in Step 1. A= is calculated automatically. Gray-marked areas should not be interpreted manually in aerial images, but should be calculated automatically when the interpretation is finished.*

| Attribute | | | | | | | |
|---|---|---|---|---|---|---|---|
| Main class | S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A | | | | | | |
| Biotope_LIGHT | S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A | | | | | | |
| Biotope | S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A S1/2 A | | | | | | |
| Step1_code | S1 A S1 A S1 A S1 A S1 A S1 A S1 A | | | | | | |
| Step2_code | FT/ S1 A | FT/ S1 A | FT/ S1 A | FT | FT/ S1 A | FT/ S1/2A | FT/ S1 A |
| Land use | S1 A/ (FT) | S1 A/ (FT) | FT/ S1 A | FT FT | | FT/ S1 A | S2 FT |
| *Forest phase* | - | S1 A/ A2 FT | - | FT FT | | FT/ S1 A | - |
| *Tree layer* | - | S1 A/ A2 FT | - | FT FT | | - | - |
| *Medium height vegetation* | - | - | - | FT | - | - | - |
| Salinity | - | - | - | - | - | - | S1 A |
| Humidity | - | - | S2 A (310-340) | S2 A S2 A S2 A S2 A | | | |
| Size | - | S1 A S1 A S1 A S1 A S1 A | | | | | S1 A/FT |

**Land use**

Land use is a very important and complex attribute that often defines the biotope itself and can largely determine the ecological potential and ecological conditions of the object (Appendix 3). If a forest is not characterized by forestry, there is often potential for higher biodiversity and more ecosystem services than if it is cultivated. The same applies if a grassland is claimed by grazing or long unclaimed and overgrown, or if the pasture is presumably cultivated or semi-natural depending on land use history. There is rarely or never sufficiently detailed data that shows land use at object level in a biotope mapping, which is why the attribute is very important for the aerial image interpreter to assess. In BIOTOP SE, the land surveying department's oldest economic map is used to mark open land or forest that was arable land in the 1950s. This information is baked into the Step1_code for open land (as 310-340 cultivated grassland), or as land use 103 in wooded land.

All surfaces in BIOTOP SE must have an assigned land use in the final product, and often it is the land use that defines the biotope itself. Often, therefore, the land use type can already be read out in the biotope class, but most of the time there is an additional wealth of detail in the land use attribute, which has been grouped according to the type of land use to make it easier for the user (Table 5 and Appendix 3). Which land use a surface has can also control how other attributes are to be filled in, e.g. forestry to be followed up with forest phase. In the City of Stockholm's existing biotope database, a more limited number of land uses are specified, often embedded in the biotope class at level 3.

It is important to realize that there is rarely or even never a single land change in a surface and that the landscape rather offers a range of different often parallel ecosystem services and is thus characterized by a clear multi-functionality. Specifying different land uses in all biotopes would be very time-consuming and sometimes certain land uses also leave no traces in aerial images or even in reality. Examples of this are low-intensity recreation such as berry and mushroom picking and forest walks. Therefore, the land use listed in the biotope database is considered to be the most decisive land use and characterizes its appearance. A managed forest can be used in parallel for e.g. recreation etc. If a forest is characterized by forestry, then the land use becomes forestry. The user of the biotope data base can later assume that the surface is also suitable for recreation depending on its location in relation to distance and accessibility to the public. A user should therefore bear in mind that only the clearest of several possible land uses should be specified.

Thanks to the use of e.g. the block database and the property map, many areas can get a final land use already in the Stage 1 database. These mainly apply to the main classes 100 Urban gray structure, 200 Urban green structure and 300 Arable land. Note that if an arable land has been incorporated into a

urban environment where a field has become a grass field that is kept open by mechanical mowing or mowing, the surface turns into urban green structure.

*Table 5. Functional grouping of the attribute land use. See Appendix 3 for all land use classes. All surfaces must have a land use and this is often set via aerial image interpretation.*

| ***Grouping of land use*** | ***Current main class*** | ***Description and extraction method*** |
|---|---|---|
| Forestry related - Clear traces or no clear traces (codes 100-103) | (500), 600 | In the Steg1 database there is a preliminary automatic proposal for areas with traces of forestry. This is based on the tree height and disturbed forest in the NMD and needs to be checked visually as there will be a lot of error in it, especially in outcrop and wetland forest. Only the land use in main class 800 Forest land is countable. |
| The cultivated landscape and semi-natural grassland (codes 201-208, 501) | 300, 400, 500 and 600 | Here there is a good preliminary classification from the block database for main class 300, but all surfaces need to be checked and a large interpretation effort lies in the interpretation of ancient vegetation in the main classes 400 and 600 Forest/Wooded land. |
| Natural disturbance (codes 301-303) | All, mainly 300 and 600 | This includes surfaces with clear disturbance in the form of fire, wind, water and animals (insects, birds, beavers). Here are known premises that the municipality may have informed about, otherwise these are interpreted as aerial photographs. |
| Urban exploitation (401-404) | All, mainly 100, 200 and 600 | Here, ongoing exploitation is marked without specifying the reason, but also landfills, roofs and conduits through forest. The ongoing exploitation is primarily that which has been started after the property map's latest information and is therefore mainly interpreted as aerial photographs. Other information can often be taken from the property map. |
| Other urban land use (501-611, 700) | Mainly 100 and 200, in some cases 600 | Here there are different land uses that can often be taken from the property map. They relate to everything from golf courses and residential areas to built-up structure, infrastructure and building type. The most common class that will always be interpreted aerially is mechanical mowing, grass cutting or other open maintenance. |
| Infrastructure (701-704) | 100 | Roads and railways |
| Other land use All | | Can be used if land use exists, but is not selectable in the list. |

It is significantly more difficult to get accurate land use in the other main classes. It is most difficult for the open ground. As already mentioned, there is no comprehensive detailed data on all land claimed by grazing or mowing. The meadow and pasture inventory and the subsequent Meadow and pasture inventory with the TUVA database as an available source contain only the finest meadows and pastures (class 1-3). In addition, in the same way that agricultural land can become urban green structure, so too will a lot of open land in aerial image interpretation.

As for the forest land, the situation is somewhat better. But, despite the fact that there are many forestry plans where land use and forest phase could be picked up, this data is not always generally available and is usually scattered depending on the type of ownership (private, municipality, company, church), which makes it difficult to try to use it on a regional level . An approach is made to try to find as much of the cultivated forest as possible already in Stage 1 by calculating the average height of the trees in the forest areas of the Stage 1 database. One can expect that forest that is lower than 10-15 m is young-middle-aged and probably cultivated forest, except for that which is located on stony ground or bog where the forest is often substrate-controlled low growth. These forests will already be assigned to Step1_kod to the land use Forestry and in addition Forest Phase young to medium-aged trees are specified. In this way, already in the uninterpreted database, you can search out forest land that is probably full to old growth and start working with it. Otherwise, much of the land use needs to be assessed visually by aerial image interpreters.

**Forest phase**

Forest phase is a descriptive attribute that provides important information about the expected properties of the tree-clad surface, which relate to a relative age distribution and indirectly different stages within forestry (Table 5). The criterion must be used together with land use to provide the full level of detail. A full-grown to old forest that has not been characterized by forestry can be expected to have a better ecological potential than one that has been characterized by forestry. The classification of forest phase must not be too complex, because then it also becomes more time-consuming and difficult to perform. The general ambition is to separate clearcuts and young forests and other young-middle-aged production forest so that users have the opportunity to locate full-grown-old forest or wooded land that is expected to harbor potentially higher ecological values than the first two classes.

The forest phase is an age-related component but should not be seen as an approach to indicate actual age. It more easily follows common production patterns in barrdo mined forest, but has more difficulty capturing the character of mixed forest and deciduous forest where the cultivation cycle can look different and where you e.g. do not clear and weed in the same regular way. The term old forest is also highly relative and the meaning can vary widely in the actual number of years between tree species, where in the country's climate zones they grow, and whether the question is asked from a production technology angle or in a nature conservation context. It is important to be able to specify

whether the full-grown old-growth forest or the semi-open old-growth land has an essentially same-age or different-age structure. Production forest is essentially the same age, even if it may have passed the recommended felling age.
Spontaneously grown forest usually exhibits a heterogeneous age structure.

Initially, forest phase will be assessed based on the individual criterion of tree height in combination with the soil moisture regime as a rough measure of possible age structure. Note that forest phase and tree height are not the same thing as substrate-conditioned low-growing trees at the outer edge of the moisture gradient where forest of heath character and wooded bog on peat land can be very old without exceeding 5-15 m. The following division into preliminary Step1 codes has been made as in Step 2 is changed to the correct Step2_code (see number 5).

The areas that receive forest phase *10 Proposed hygge-plantation forest/ other non-tree-covered land under forest cover <5 m* are the areas which, according to the database's initial tree cover, are not covered with trees but which lie below the forest cover of the property map and on everything except mountains during the day. It can also be disturbed forest which in national land cover data has been classified as 118/128 Temporary not forest. Areas which in NMD have been classified as forest but which in BIOTOP SE have a height of <5 m are brought to the class *50 Proposed low growth forest on mountains in the day, sparse and mainly <5 m* so as not to be confused with presumed fellings. It is likely that this class contains the most interesting outcrop-characterized forests, but also areas that actually belong to the open outcrop.

The areas that are brought to *20 Proposed young-middle-aged forest/ wooded land (5-15 m)* is tree-covered land on dry-wet land, while trees in the same height range on mountains during the day are brought to *60 Proposed full-grown forest on SGU mountains during the day 5-15 m height*. The reason for this is that they are probably not young-middle-aged, but rather substrate-dependent low growth forest of considerable age despite their low height.

For all tree-covered land with trees > 15 m in height, an assumption is made that the probability of similarity is greatest that these are fully grown to older on all land types and are taken to class *34 Proposed full-grown forest / tree-covered land (>15 m) unspecified age structure*. The choice of code 34 is to mark that the final class *3 Mature-old forest/ wooded land (>15 m), essentially* the same age and *4 Mature-old forest/ wooded land, distinctly different ages* require visual judgment to distinguish. Wooded land on mountains in the day with Forest Phase 34 is probably land that is not of the outcrop type in the true sense, but on land with a shallow ground cover with consequently taller trees.

*Table 6. Attribute classes for forest phase should be seen as a structure description rather than an age.*
*Forest phase intends to highlight forest that is mature to old. Forest phase should in principle only be specified for forest land, but also in tree-bearing land that is traditionally favored, and if justified in certain open land.*

| ***Code Step 1 (proposal)*** | ***Code Step 2*** | ***Attribute class's name*** | ***Description*** |
|---|---|---|---|
| 10 | 1 | Hygge plantation forest (<5 m), including forest | Forestry area or other land use that creates a similar situation, e.g. in power line streets with regular clearing. Tree height < 5 m. Stated in Step 1 for land without tree cover under the forest mask of the property map, which is also disturbed forest according to NMD. 10 is an attempt to distinguish between clearings and plantations at an early stage. The code must be replaced in Step 2. |
| 20 | 2 | Young-middle-aged forest/ wooded land (5-15 m) | If marked by forestry (see land use), the class corresponds to cleared forest-thinning forest. If not characterized by forestry, this may correspond to younger successional forest or other younger forest. 20 is an attempt to distinguish at an early stage the not fully grown forest which is probably young-middle-aged production forest. |
| 34 | 3 | Full-grown-old forest/ wooded land >15 m, essentially the same age | The area as a whole is dominated by mature to old trees. This criterion in combination with land use forestry or no visible traces of forestry is a way of distinguishing between older production forest and spontaneous forest. Can only be specified by visual assessment. |
| 34 | 4 | Full-grown - old forest/ wooded land, clearly different in age | Specified for forests that are not single-layered or of the same age. ATTENTION! theoretically, this class could be used for both forestry and natural forestry. This is determined in combination with land use Forestry or No clear traces of forestry, respectively traces of grazing. Can only be specified by visual assessment. |
| 50 | 5 | substrate-dependent sparse and/or low growth forest on SGU mountain during the day or wetland, mainly <5 m | Indicated for sparse open ground forests or wetland forests that are lower than forest with BIOTOP SE's height and density criteria, but which can still be considered as forest. It is probably in these areas that the most interesting alluvial forests can be found. |
| 60 | 6 | 60 Proposed mature forest on SGU mountain during the day 5-15 m height | Indicated for tree-covered land on mountains in the day and considered as potentially full-grown but substrate-dependent low forest. Therefore, 20 young-middle-aged is not specified as a class on wooded land on mountains in the day. |
| 999 | | Attributes should not specified | The attribute should not be specified for the biotope class of the current surface. The forest phase attribute is not specified for land other than main class 600 wooded land, with a few exceptions (e.g. some power line streets). |
| Zero | | Attribute not yet rated | . |

**Tree layer**

The Tree Layer attribute is used on 500 Shrubland, as well as the 400 series if the surface is evidently characterized by scattered trees (Table 7). Also in 231-237 Urban green structure of tree nature should be specified, but for practical reasons only in environments with >50% tree cover.

The attribute only shows what kind of tree species summary there is in the sparsely wooded land that is not counted as forest in the biotope data base. If Tree Layer is specified, Forest Phase must therefore also be specified. In this way, we can find out in which pastures, parks or other urban green structures with tree character harbor potentially valuable trees. However, this attribute must be used with consideration, otherwise there is a risk that it will reduce the production rate considerably, as the tree classification in the national land cover data (NMD) may be missing or have low classification certainty in the sparsely tree-covered land. NMD has documented problems correctly classifying single trees or small stands of trees in open environments. This is a general problem for all classification of small surfaces due to a spectral impact from the field layer.

**Medium height vegetation**

Mid-height vegetation with 30-50% cover can be either shrubs or overwater vegetation. The criterion is only specified in 400 Open land and is intended to provide an early warning of overgrowth in open-semi-open mature vegetation. of bushes or reeds, the semi-tall vegetation criterion can be used instead (Table 7). All semi-tall vegetation with <30% degree of coverage is ignored and all semi-tall vegetation covering >50% of the assessment area, i.e. the area that has been delineated, is taken to 500 Shrubland if perennial shrubs or low trees, or to 470 Dense reed vegetation if dominated by tall grass, mainly reeds.

*Table 7. Attribute classes for Tree layer, specified in biotopes within 500 Shrubland and land that is initially classified as 400 Open land, but which contains groves of trees and scattered trees that will be recoded to Tree-covered heritage-marked land in later calculations. The classes show information on tree species composition and are the same as for autoclassified input data for tree-covered land.*

| ***Code Attribute*** | | ***Description*** |
|---|---|---|
| 601 | Pine | Indicated upon rapid assessment that pines dominate >70% of the tree cover |
| 602 | Fir | Indicated by rapid assessment that spruce dominates >70% of the tree cover |
| 603 | Mixed conifers | Indicated for an obvious mixture of pine and spruce, or if it is difficult to state whether it is one or the other tree species. |
| 604 | Conifers and leaves | Indicated if the mixture of leaves or needles is 30-70%. Currently, there is no code for conifers and leaves with elements of noble leaves, which is problematic. The reason for this is that the National Martäckedata does not offer this classification and it is because it is admittedly difficult. |
| 605 | Leaf | Indicated by rapid assessment that trivial deciduous trees dominate >70% of the tree cover |
| 606 | Noble leaf | Indicated if NMD indicates broad-leaved forest or in case of rapid assessment that broad-leaved trees dominate >50% of the tree cover. The remaining 30% of the tree cover up to 70% must be dominated by leaves. |
| 607 | Mixed leaves with noble | Indicated if the proportion of noble leaves in other deciduous forest (>70% leaves) is difficult to assess or if the mixture is obvious. NMD states that it applies to 20-50%, Note that this mixture does not exist against coniferous or mixed forest, which can be a problem for some municipalities. |
| 997 | >10% estimated cover of tall vegetation | Entered by automatic calculation in Step1 database with orthophoto that is later than the beginning of June, to be replaced by 601-607 when interpreting. |
| 998 | <10% trees in the surface | The area within the current main class 400, 500 is below 30% and is therefore ignored. However, it is important to indicate on surfaces that are genuinely open. |
| 999 | The attribute shall not specified | The attribute should not be specified for the biotope class of the current surface. The purpose is for all surfaces to be classified in some form so that the value does not just become 0. The value can be calculated automatically by simple search of the current main class. |
| Zero | Attribute not yet rated | This class should not be included in the final product. As far as possible, it should also not be included in the stage1 database. |

*Table 8. Attribute classes for Semi-tall vegetation are indicated in open and tree-covered heathland and sparse forest with approx. 30-50% degree of cover by shrubs. When the degree of bush coverage is > 50%, the surface is counted as main class 5XX, bush land. The classes are the same as for the shrubland biotopes.*

| ***Code*** | ***Attribute*** | ***Description*** |
|---|---|---|
| 501 | Conifers incl. a Merger of | all types of conifers, i.e. except junipers also low pines and firs. It is not possible to distinguish these at a regional level when the assessment must be rapid. |
| 502 | Mixed shrubs, conifers/leaves | Mixture of deciduous shrubs and conifers of any type. |
| 503 | Thorn bushes | Prickly bushes belonging to the *Rosaceae family* dominate, e.g. sedge, rosehip and other rose bushes, hawthorn or the like. |
| 504 | Willow bushes (salix) | Bushy willow species dominate. Can of course include species that become trees. Energy forest is not included but has its own biotope code under farmland. Often, willow shrub land is wet semiaquatic, but willow bushes can of course be found on healthy land. |
| 505 | Other deciduous shrubs | Deciduous shrubs dominate. These can either be deciduous (the hedge is not included) or mixed deciduous shrubs without a clear dominance of thorny bushes or willow bushes. Can contain all deciduous trees, hazel <4.5 m |
| 506 | Overwater vegetation (reeds) on terrestrial land | It is not uncommon for reed vegetation to spread even on semi-aquatic and moist-wet land |
| 997 | >30% estimated coverage of semi-high vegetation without type classification | Entered with automatic calculation in Step1 database with orthophoto that is later than the beginning of June, to be replaced by 501-505 when interpreting. |
| 998 | Shrub cover <30% | Entered with automatic calculation in Step1 database with orthophoto that is later than the beginning of June, must be checked when interpreting. |
| 999 | The attribute shall not specified | The attribute must not be specified for the biotope class of the current surface. Specified for all surfaces where the attribute must not be specified (main classes 100, 200, 300, 500-700). |
| Zero | Attribute not yet rated | This class should not be included in the final product. As far as possible, it should also not be included in step 1-the database. |

**Salinity**

The attribute is specified for all water in the database and should be included in the input data (Step1-the database). In the biotope database, no distinction is made between salt and brackish water (Table 8). It is not entirely obvious how the transition from fresh water to salt water goes when the water is continuous. If this were to be desired, clear definitions, agreed upon by all involved, must exist for where the interpreter should draw the line in a meaningful way. A manual demarcation has been made along the entire Baltic Sea where all inflowing waterways have been cut off at the mouth and where bays and lagoons are allowed to retain salt water as long as they are connected to the sea outside or through wide channels.

How this criterion should be used on beach meadows and other areas that are directly adjacent to the sea has not been determined. Although it is highly possible to do this both manually and automatically, the question is how far up the beach does the salt effect go. As a compromise, the aerial image interpreters in Step 2 will code all wet-semiaquatic surfaces facing the sea as salty and all other surfaces that are <1 ha in the same position. This is to avoid that large areas of forest or other land receive the attribute salt stamp, even though it is unreasonable for this to go far into the forest. Other division or division of areas adjacent to the sea needs to be done at a later stage after careful definition of what is meant by salt impact.

*Table 9. Classes for salinity. Indicated for water, beach meadows and, where applicable, bush areas on the beach. Should be coded for all existing water in the stage-1 database. In all remapping of water, salinity must be specified. Note that the attributes are inherited to all surfaces when shared.*

| ***Code Attribute*** | | ***Description*** |
|---|---|---|
| 1 | Freshwater | All water that is not ocean. |
| 2 | Salt or brackish water | Includes all seas and lagoons/estuaries that can be classified as brackish water. It is not possible to distinguish different salinities or other chemical properties in aerial images. |
| 999 | the attribute shall not specified | Before the interpreter delivers a finished database, this is classified for all surfaces that do not belong to main class 700 Water or coastal meadows. Still uncertain if this also covers other coastal environments such as e.g. rocks/boulders and forest. |
| Zero | Attribute not yet rated | This class should not be included in the final product. As far as possible, it should also not be included in the stage1 database. |

**Humidity**

The purpose of this attribute is to be able to directly and collectively show the humidity of the landscape and is based on a direct translation of the humidity information that is included in the names of biotopes. Just as in the city of Stockholm's existing biotope database, it can be said that there are two parallel gradients, a more detailed one for open and tree-covered land and a simpler one for forest (see table 10). This is due to the fact that it is more difficult to assess detailed moisture in wooded land.

The humidity is included as part of the majority of biotopes and will not be assessed separately in the aerial image interpretation. Sometimes it can be interesting to quickly retrieve information about the humidity in the landscape without having to analyze. This attribute is for collecting the information about humidity in the different biotope classes that are embedded in the biotope name and are thus not easily searchable (Table 2).

*Table 10. Attribute classes for moisture regime are given on all land except urban gray structure, urban green structure and cropland (cultivated grassland excluded). The code is based entirely on an extraction from the names of the biotope codes, often taken from the underlying classification from the SGU's soil type map and the bottomland layer of the property map. Note that the humidity classes are specified differently in different main classes, which is why 1-8 do not constitute values along a gradient*

| ***Code*** | ***Attribute*** | ***Extraction method and current main classes*** |
|---|---|---|
| 1 | Hällmark/mountain during the day | Mountains of the day according to SGU. |
| 2 | Dry | Automatically extracted from coarse sediment according to SGU or visually indicated for thin soil cover |
| 3 | Dry wet | Automatically extracted from all surfaces that are not part of SGU rock in the day, coarse sediment or wetland, i.e. other moisture regime. This can be anything from fine sediment to moraine. |
| 4 | Wetland/semi aquatic | Automatically extracted from all surfaces included in the SGU/property map's wetlands. |
| 7 | Water | Automatically extracted from the biotope name in the main class 700 Water. |
| 999 | Attribute shall not specified | The attribute should not be specified for the biotope class of the current surface. These are the main classes 100, 200, 300 (except 310-340 cultivated grassland). |
| Zero | Attribute still not assessed | This class should not be included in the final product. As far as possible, it should also not be included in the stage1 database. |

### Size

Size is a very important attribute because the biotope database allows for a range of objects smaller than the general minimum mapping unit of 0.1 ha (Figure 22). Note that some of them (islands, islands and small waters) are marked up to 1 ha because it is accepted to talk about small waters and small islets and islands. Larger areas, or smaller areas that together make up a larger island, arable island or water should not have any marking in Size. It may also be the case that narrow road verges and other smaller areas are retained and then these must always be coded in this attribute, otherwise they will disappear in GIS processing during the course of the work and also in future processing of the finished database. It is important for users to know and respect this descriptive attribute because otherwise it is easy to accidentally eliminate smaller areas during the construction of the database. Size is indicated in five classes (Table 10).

Table 11. List of the different types of surfaces that must be kept even though they are too small. This criterion must be specified in all areas in question, regardless of biotope class. Note that this criterion does not necessarily coincide with other definitions of e.g. small waters which are often considered to be <1 ha.

| *Code Attribute* | *Definition/ Description* |
|---|---|
| 1 Small water <0.1 ha | In the stage1 database, all water bodies <0.1 ha have been given this code. Small waters must be surrounded by semiaquatic or terrestrial land. Small vegetated water surfaces in a large lake are not included. Small patches of water at the outer boundary that are actually part of a larger water surface are coded as Size = 5. |
| 2 Ö < 0.1 ha | In the stage1 database, all islands <0.1 ha in water have been given this code by automatic classification. |
| 3 Åkerholme <0.1 ha | In the stage 1 database, all åkerholme <0.1 ha in arable land have been given this code through automatic classification. |
| 4 Fine mesh green structure in urban gray structure, incl. green roofs | Areas with green structure that are locked in infrastructure (roads, railways) and other non-vegetation that are smaller than the smallest mapping unit but larger than 200 m2 (hipped minimum limit). These are small green roundabouts, green roofs, and other green surfaces that are embedded in gray infrastructure, as well as various green patches enclosed in non-vegetation. There may be many in urban municipalities, but they are probably the ones who want to keep track of these areas. |
| 5 Other surface that is <0.1 ha to be saved | Primarily automatic coding in the Stage1 database of narrow, elongated surfaces bordering fields and roads that have been clipped from other polygons. Mainly automatic calculation, was restrictive when reinterpreting. |
| 999 attribute should not specified | Prior to delivery, the interpreter checks through surveys that all areas that should have received a minimum size have received it and that the rest, i.e. all areas >0.1 ha, have received the code 999 in this attribute. |

*Figure 14. The minimum mapping unit of 0.1 ha does not apply to shallow waters, islands, arable islets and arable plains. These are exempt but must be labeled in the Size attribute (see Table 10).*

## 3.3.Administrative attributes (level 4)

In addition to the descriptive attributes listed above, it will in BIOTOP SE are a series of administrative attributes that guide users in how far the work with the database has progressed, who has signed the classification, and which version of the classification system and geodatabase template the classification is based on.

**Reliability**

Reliability is linked to status, but the approach here is to indicate the degree of reliability in the different classes of the biotope database depending on different sources of origin and the degree of automatic and visual processing (Table 13). The reliability is indicated on a scale from 1-9, where 1 is to be regarded as basically no reliability at all and 9 is the highest possible reliability. It is a difficult balancing act to determine which reliability to set because it can be both general and depend on individual assessment. The attribute is still preliminary and is currently being tested in Södertälje municipality.

Note that the reliability is not based on each individual interpreter in the first place, but is an assessed reliability within the project as indicated in table 11. Of course, an executing organization would change the reliability to a higher or lower level depending on its own special skills or lack thereof. In this case, the customer must be notified in writing in order not to disturb the reliability of the attribute.

**Signature**

Signature is a temporary attribute used during the aerial image interpretation in Step 2. As soon as the interpretation work is finished, the attribute should be removed (See Part E).

*Table 12. A preliminary attempt to grade the reliability of the database's individual surfaces.*
*Of course, this is not a simple assessment, but should still give the user support in their assessment. In general, Stage2_codes have higher reliability than Stage1_codes and are both dependent on the input data used in Stage 1 and the degree of correction that has taken place during the aerial image interpretation, see detailed list in separate database template (Annex1_Biotopdatabasen_databasmall_DBM200626.xlsx)*

| ***Code*** | ***Name*** | ***Exemplification*** |
|---|---|---|
| 1 | 1 Low reliability | An unreliable automatic classification has been carried out. Proposals for a biotope code exist, but it is not sufficient without a visual assessment. This class includes e.g. tree-covered land with NMD's forest types mixed leaves with elements of noble leaves 617-647. |
| 2 | 2 Acceptable reliability | 720-721 water with aquatic vegetation (may contain shadows and problems in early orthophotos) and wooded land with NMD forest types deciduous forest, 616-646. |
| 3 | 3 Relatively good reliability | 310-340 Proposed cultivated grassland based on the block database or arable land from the 50s |
| 4 | 4 Good reliability | 101 Non-vegetation without subdivision, 203 and 204, 406, and Tree-covered land with NMD's forest types trivial deciduous forest 615-645 and mixed forest 614-644 |
| 5 | 5 Very good reliability | for example the property map's water areas and the block database's arable land in Stage 1. Wooded land with NMD's forest types coniferous forest. |
| 6 | 6 High reliability | Automatic classification from various sources of high reliability, e.g. 110, 210-202 and input from maps, e.g. 301-303, as well as visual interpretation of 411-470, 711-750 and certain forest types that have been visually checked, mainly coniferous forests and |
| 7 | 7 Highest Reliability | Underlying automatic classification of high reliability that has assessed via aerial image interpretation in 3D, e.g. 120-130, 210-250, 310-340, 511-545, disturbed forest, coniferous forest, 711-726 |
| Null | The attribute not yet assessed | This class should not be included in the final product. As far as possible, it should also not be included in the stage1 database. |

### Version of classification system and database template

It is crucial that all surfaces in a database are marked with the version of the classification system and database template from which they were established (Table 12). Otherwise, there may be problems managing metadata and lyre files and other things that depend on the database's domain structure. It is also important to be able to compare databases over time and also update older versions to new ones because the method is expected to be alive and updated over time. It is likely that an entire municipality has been produced using the same classification system, but in some situations it is possible that updates have taken place according to a modified

system. As new versions are produced, the list will update the domain structure.

*Table 13 The System attribute indicates which version of the biotope database's classification system has been used in a certain municipality.*

| ***Code Name*** | | ***Definition/ Description*** |
|---|---|---|
| 1 | 1 Classification system 1.0 trial version | Terrorist background that was never put to practical use |
| 2 | 2 Classification system 2.1 2016 | First prototype that was developed and tested in Sollentuna as a pilot municipality. The manual was never published and may not be used. |
| 3 | 3 Classification system 2.2 from 2017-02-13 | Third prototype developed with Ekerö and Sollentuna as pilot municipalities. The manual was never published and may not be used |
| 4 | 4 Classification system 3.0 from 2019-01-07 | Third prototype developed with Södertälje stage 1 as pilot municipality |
| 5 | 5 Classification system 3.1 from 2019-10-07 | The first sharp manual that was developed after further technical development and with Södertälje stage 2 as pilot municipality |
| 6 | 6 Classification system 3.2 from 2020-05-05 | Continued development work under the Innovation project. Has not been applied in any municipality |
| 7 | 7 Classification system 3.3 from 2020-06-26 | The first official version used in regional Stage 1 for the entire Stockholm county |
| 8 | 8 Classification system 3.4 from 2021-06-18 | BIOTOP Stockholms Regional Stage 1 implemented in prototype across the entire Stockholm county for 2015 |
| 9 | 9 Classification system 4.0 from 2022-06-30 | BIOTOP SE final simplified classification system |

# 4. Complete biotope list with definitions

In this chapter, each biotope class in BIOTOP SE is defined and explained. In cases where biotopes have most of the characters in common, such as e.g. the forest classes, several biotopes can be described at the same time. Each biotope code begins with the starting number of the main class, which facilitates the understanding of the mutual relationship.

To keep the text mass as limited as possible, the descriptions in this chapter are structured so that each biotope or biotope group described contains the following headings:

- Definition. Brief description of the biotope's character traits and properties. For demarcation with other biotopes, reference is made to the various keys reported under the respective main class in chapter 3.3. Detailed instructions for the delimitation of Steg2_kod biotopes are given in a separate aerial image interpretation manual (BIOTOP SE Part E).
- Applied area limitations and generalization principles. See also description in chapter 3.
- Status in the attribute field Step1_code (see chapter 3.1). The code in Steg1_kod reports the initial automatically and semi-automatically calculated biotope code that is produced in the method's first more technical step (see chapter 3.1).
- Status in the attribute field Step2_code (see chapter 3.1). If there is one Step2_code specified, it means that the surface has either been assessed visually by an aerial image interpreter, or that it has been automatically classified and does not need to be followed up in detail (buildings, mainly buildings and infrastructure). In the latter case, this must be coded in the attribute Auto_Steg2.
- Status in the Biotope attribute field (see chapter 3.1). Prior to delivery of aerial image interpreted database, the aerial image interpreting organization must always ensure that Biotop is updated as follows: if only Stage1_code exists, it applies in Biotop, if Stage2_code also exists, it must replace the Stage1_code in Biotop. In other words, Biotope is the attribute field that shows the current status of the entire biotope database and is the field to be used in all analyses.
- Other descriptive attributes specified for the class. Brief description of the descriptive attributes to be specified. Note that administrative attributes are not described here as they must be specified for all surfaces. Sometimes presented in tables, sometimes referred to chapter 3.

**100 Unclassified non-vegetation**
**101 Non-vegetation, mainly urban gray structure**

Definition

Non-vegetation is all land surface that to >90% (automatically calculated), consists of land that is not covered with vegetation. This can be urban gray structure, but in its most uncertain form here it can also consist of exposed rock in the day, sand or other natural material, as well as temporarily removed vegetation in arable land that is not block-laid (and therefore not in the Swedish Agricultural Agency's block database). This class is a pure Step1_code with no assessment if the surface is really urban and if so if it is hard made or not. It is not likely that the municipalities will order a detailed interpretation of 101 non-vegetation until other biotopes with a higher priority have been mapped, e.g. forest, grasslands, and urban green structure. The interesting thing is, of course, that this code is usable right from the start to analyzes where it does not matter if the vegetation is not hardened or permeable. An overview of how the biotope relates to other biotopes in main class 100 is given in Figure 8 and to other Stage1 biotopes is given in Figure 20. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (Part E).

Applied area limitations and generalization principles

In the input data, the minimum mapping unit of 0.1 ha is strictly followed, with the exception of areas that are arable islands according to the Swedish Agricultural Agency's block database, or islands according to the Land Survey's property map. In cases where smaller areas of vegetation are present, they have been initially generalized into Main Class 400 Open semi-open land or secondarily into surrounding 6XX wooded land.
Vegetated areas <0.02 ha completely surrounded by non-vegetation have automatically been generalized into the surrounding non-vegetation and thus affect the percentage of vegetation cover in a way that sometimes causes initially classified 101 to turn into 204 Urban green structure of a gray character.

Status in the attribute field Step1_code

101 Non-vegetation is a pure Stage 1 biotope that can be considered the pre-stage to urban gray structure. It has been classified through automatic image processing of IRF orthophotos, surface models and DEM according to methodology described separately (BIOTOP SE Part D Skånes and Wennbom 2022).

In general, it can be said that the reliability of 101 Non-vegetation is good, but that it can be confusing due to that it contains the finest meshed green structure.

Status in the attribute field Step2_code

Does not exist. Here, the appropriate Step2 code must be selected.

Status in the Biotope attribute field

In the biotope field, the code 101 Non-vegetation only remains if no visual assessment of Step2_code has yet been made. The code is expected to disappear from the biotope database when the aerial image interpretation is complete.

Other descriptive attributes specified for the class

Only in exceptional cases are there proposals for land use, mainly 599 Other urban land use (see appendix 3), as well as possible coding for Size if the surface is a small arable island or an island.

**110 High non-vegetation, mainly buildings**

Definition

The surfaces are not produced by using the national property map layer with existing buildings, but only correspond to the classification of high non-vegetation (>2.2 m above the national elevation model NH ) according to the initial pixel classification that has not undergone any other generalization than the smallest mapping unit and smoothing. The latter means that the shape of the buildings is not geometrically straight, but rather undulating and bubbly.
The problems with the shapes have several causes, not least that the orthophotos used are not so-called true orthos but contain sloping houses which, if they are high, can create a significantly larger impression than if they were imaged directly from above. Even shadows and temporary taller objects can be embedded in the buildings. This is perfectly fine and should not be addressed in Step 2.

Applied area limitations and generalization principles

In the input data, the minimum mapping unit of 0.1 ha is strictly adhered to, even though the building layer of the property map contains topological errors that mean that large buildings are sometimes divided into several smaller building bodies.

Status in Step1_kod

110 is one of the few biotope codes found in both Stage1_kod and Steg2_kod. In some cases, the property map contains topological errors, e.g. overlap or gap, where building parts that belong together in the map have sometimes been split into smaller segments. This makes it difficult to automatically search for buildings above a certain size. The layer has been slightly processed to correct the topological defects.
All errors have not been corrected in Step 1 because it feels unreasonable to correct a database for which the Land Survey is responsible. The hope is instead that the building layer will be improved in the future.

Status in Step2_kod

If the code is present, it probably just means that an aerial image interpreter has calculated over the code from Step 1. There is essentially no new mapping of buildings unless they are very large.

Biotope

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The only attributes set for 110 Buildings are the land use 611 Building/s.

**120 Hardened ground**

Definition

Land with removed vegetation, i.e. urban gray structure where the surface is hardened by asphalting, casting or otherwise not permeable to water. The hardened ground must have <10% embedded green structure. The surface must be dominated by hardened ground, i.e. there can be elements of non-hardened ground or any biotope type under the smallest mapping unit in the surface scattered in the hardened surface. An overview of how the biotope relates to other biotopes in main class 100 is given in Figure 6 and to other Stage 2 biotopes is given in Figure 5 and Appendix 2. Detailed instructions regarding delimitation to other biotopes are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

In general, 0.1 ha applies as the minimum mapping unit, but as it is very time-consuming for aerial image interpreters to distinguish hardened from non-hardened land in detail down to this accuracy and this is not the main purpose of BIOTOP SE, it is likely that there will be considerable quantities 130 within the surface 120 Hardened ground and vice versa. This mainly applies to large areas.

Also note that the area may contain a larger number of buildings <0.1 ha, as well as open land covered with vegetation or tree-covered land < 0.1 ha.

Status in the attribute field Step1_code

102 exists but 120 does not.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code after visual assessment.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. In general, it can be said that the reliability of 120 Hardened ground is high to the highest.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). In general, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the Step 1 database was produced or was missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified.

**130 Other land with removed vegetation (not hardened)**

Definition

Land with removed vegetation, i.e. urban gray structure where the surface is permeable to water and not hardened by asphalting, casting, etc. These surfaces can be of many different types, gravel surfaces, sand surfaces, dug or deposited. The unhardened ground must have <10% embedded green structure. . An overview of how the biotope relates to other biotopes in main class 100 is given in Figure 6 and to other Stage 2 biotopes is given in Figure 5 and Appendix 3. Detailed instructions regarding delimitation to other biotopes are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

In general, 0.1 ha applies as the minimum mapping unit, but as it is very time-consuming for aerial image interpreters to distinguish hardened from non-hardened land in detail down to this accuracy and this is not the main purpose of BIOTOP SE, it is likely that there will be considerable quantities 120 Hardened ground within the surface 130 and vice versa. Also note that the area may contain a larger number of buildings, as well as open vegetation-covered land or tree-covered land < 0.1 ha.

Status in the attribute field Step1_code

103 exists but 130 does not.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. In general, it can be said that the reliability of the 130 is high to high.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). In general, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the Step 1 database was produced or was missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified.

*Figure 15. The urban environment is a jumble of green and gray components. All lawns are clearly visible in the IRF aerial image and when the land use changes and the green structure is exploited, it is called ongoing exploitation in the biotope database. The left picture is from 2015 and the right one from 2017.*

**141 Infrastructure, paved road area and bridge over water,**
**142 Infrastructure, road area gravel road**
**150 Infrastructure, railway area (step1-2_code)**

Definition

All road surfaces and railway areas according to the Swedish Transport Agency's national road database NVDB where surface coverage and a simplified land use have been picked up via automatic classification with the support of the Swedish Transport Agency's and Statistics Sweden's templated surface layers.

Applied area limitations and generalization principles

There are no area restrictions here, other than that the smallest v

Status in the attribute field Step1_code

The status is very good and the biotope codes are the same for Stage1 and Stage2 to show that this class should not be interpreted further.

The following data have been selected as input to BIOTOP SE. These classes are used to cut up road surfaces into more manageable units at the same time that the road network is divided into paved roads and dirt roads respectively and gets a systematic land use.

DKSlitlager (NVDB_DKSlitlager.shp). At the biotope class level, the classes paved road (141 paved road) and gravel road (142 gravel road) are used

DKVagslag (AGGREGATVagslag.shp). In this layer there are 16 road classes which (TYPE) have been generalized to the following land use in BIOTOP SE. Also information about bridges and tunnels was used (BROCHTNNEL) to erase tunnels:

Status in the attribute field Step2_code

In principle, no further processing has taken place unless new road areas have been discovered.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

There are no attributes here because land use according to the national road database's road type (simpler merging of rough road classes) and wear layer (basis for the biotope class).

**200 Urban green structure unclassified**

Definition

Urban green structure is land covered with vegetation (>10% degree of coverage). vegetation) which is clearly and predominantly urban in character. Even former agricultural land can be within this code if the surface has ended up embedded in an urban environment where the original claim has ceased and replaced by other land use. An overview of how the unclassified biotope 200 relates to other biotopes in main class 200 is given in Figure 9 and to other Stage1 biotopes is given in Figure 20. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

0.1 ha if the surface does not form a small island or an arable islet.

Status in the attribute field Step1_code

This is a preliminary Step1_code before the biotope type has been classified. Essentially, this code should not appear in the final database, nor in the Stage1 database. If it does, then either automatic classification of 210-204 must occur or aerial image interpretation must determine the final code. In general, it can be said that the reliability of the 200 is low.

Status in the attribute field Step2_code

Does not exist

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

There are probably no attributes here because land use according to the property map's built-up areas or construction areas are not set until the biotope type is set.

**210 Urban green structure of an open nature**

Definition

The class is typically dominated by open grassy areas, usually lawns or old fields in an urban environment. In the automatic classification of 210, these areas contain >50% low vegetation and <30% semi-high vegetation, which are the main characteristics (Table 5). Other elements (non-vegetation, semi-tall vegetation and tall vegetation) must therefore together be below 50% and semi-tall vegetation. In visual assessment of 210, the aerial image interpreter determines what is most characteristic without trying to estimate actual percentages. An overview of how the biotope relates to other biotopes in main class 200 Urban green structure is given in Figure 9 and to other Stage1 biotopes is given in Figure 20 and Stage2 biotopes is given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SEE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme. Note that the characterization of urban green structure is not absolute but rather an attempt to give the fine-mesh urban green structure additional character that may be of importance when assessing the biological diversity or ecosystem services in the urban environment.

Status in the attribute field Step1_code

210 is a class that comes from automatic classification in the stage 1 database.
As the characterization of the urban green structure is based on a processed version of the property map's property layer, the calculation becomes blunt if the plot divisions are too large or are missing entirely. In these, mainly out in the countryside or in newly built areas where property boundaries have not been updated, aerial image interpretation will be required to improve the biotope. In general, it can be said that the reliability of the 210 is judged to be very good.

Status in the attribute field Step2_code

If the code 210 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code 210 is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. Code 210 has the highest reliability.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). Generally, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the

The Stage1 database was produced or missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified. In addition to åkerholme or island, a common area, which may be smaller here, is a road slope between field and road or other urban element.

*Figure 16. The urban green structure is often dominated by open grass areas of lawn type and these are then classified as 210 Urban green structure of an open (grass) character.*

**211 Urban green structure refuse/slope (Step1-2_code)**

Definition

Road slopes are a class that has essentially been automatically calculated in areas where there is a clear wide open clearing between roads and other non-vegetation. Road verges between road and wooded land have largely been generalized away because the border between open and wooded land is often unclear and it does not work as well to keep all narrow road verges here as those between road and arable land.

Applied area limitations and generalization principles

General minimum mapping unit of >0.1 ha.

Status in the attribute field Step1_code

There is, but not to a particularly large extent.

Status in the attribute field Step2_code

This class should not be systematically reinterpreted because it has been subjected to harsh generalization measures in the construction of the Stage1 database. It is therefore not desirable to manually draw out all the narrow road lines between the road and the forest afterwards. Of course, you can choose to draw out clear and wide road lines, but this is a potential time waster and should be avoided.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Step2_kod has been entered

over to Biotope. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

Either land use must be indicated, often mechanical mowing, or no obvious land use.

**212 Green roof (step1-2 code)**

Definition

Green roofs come in many guises with different ecological conditions and importance. They can be grouped in different ways, e.g. intensive, semi-intensive or extensive and are called everything from sedum roofs and brown roofs to biotope roofs, etc.
The different types are not always sharply separated from each other in terms of definition, which makes it difficult to classify them (Sjögren 2020). BIOTOP SE makes the assessment that this method is not the right one for distinguishing different green roofs, on the other hand, the approach is to include them in the biotope database as far as possible.
So the definition the method states is as follows: A green roof is a roof or part of a roof that has a clear plant bed on its surface. It must be >200 m² to be drawn and must be above a building, i.e. >2.2 m height from ground level.

Applied area limitations and generalization principles

The code is used for all green roofs >200 sq m and, if they are less than 0.1 ha, may Size class 4 fine mesh urban green structure and land use 611
Building/s.

Status in the attribute field Step1_code

These are roughly mapped with the support of a very current building layer from the municipality (the building layer of the property map is not sufficiently updated).
If the Stage1 database is not based on aerial images later than 2017, the probability of finding many green roofs is small as they appear to have been added mainly after this time.

Status in the attribute field Step2_code

No green roofs appear in Step2 code before aerial image interpreters have made a visual assessment. Typically, the situation is that where there are green roofs in Step1_kod, there will probably be several roofs in the immediate area that have not been caught in the automatic process.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

There are no attributes here because land use which should always be 611 building/s.
Information about specific land use for the building which

users can download such from other sources, e.g. the building layer of the property map.

*Figure 17. Most green roofs can be found well via the initial pixel classification used in Step 1.*

**220 Urban green structure of a leafy character**

Definition

These areas should be characterized by low fruit trees and flowering/bearing bushes. Initial unpublished studies show a good correlation between lush gardens and presence of number of bird species (Stoessel unpublished). In the automatic classification of 202, these areas contain >30% semi-high vegetation, leafy structure (Table 5). Other elements (non-vegetation, low vegetation and high vegetation) must therefore together be below 70% and none of them must exceed 50%. When visually assessing 220, the aerial image interpreter determines what is most characteristic. Overview of how the biotope relates to other biotopes in main class 200 Urban

green structure is given in Figure 9 and against other Stage1 biotopes is given in Figure 20 and Stage2 biotopes are given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme. Note that the characterization of urban green structure is not absolute but rather an attempt to give the fine-mesh urban green structure additional character that may be of importance when assessing the biological diversity or ecosystem services in the urban environment.

Status in the attribute field Step1_code

202 is a class that comes from automatic classification in the stage 1 database.
As the characterization of the urban green structure is based on a processed version of the property map's property layer, the calculation becomes blunt if the plots are too large or are missing entirely. In these, mainly out in the countryside or in newly built areas where property boundaries have not been updated, aerial image interpretation will be required to improve the biotope. In general, it can be said that

the reliability of 202 is judged to be high except in areas with low coniferous vegetation on outcrops where the class may be overrepresented. This is hoped to be resolved by looking at the spectral characteristics of the surfaces where the outcrop environment is very different from grass-dominated plots. At the moment this is not resolved.

Status in the attribute field Step2_code

If the code 220 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code 220 is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. The code 220 has the highest reliability.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). In general, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the Step 1 database was produced or was missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified.

*Figure 18. Example of urban green structure with leafy structure with plenty of flowering and fruit-bearing bushes and low trees. The top picture shows a garden that differs significantly from surrounding gardens. Below you can see a lush colonial cottage environment*

**230, 231-238 Urban green structure of tree character**

ATTENTION! This I must now finally redefine and narrow down so that there is a crystal clear difference between what ends up in 230 and what should go to 600.

In the basic product, it must not be the case that different municipalities make different assessments about this! However, in different analyses, you may want to choose to make a different assessment.

Can I assume that tree-covered land in an urban context must be >1 ha instead of 0.1 ha. This is due to several reasons. An area of 0.1 ha can be judged to be too affected to be called forest. In addition, this surface is probably too poorly classified in the NMD and therefore becomes wavy.

One could imagine not classifying forest within what is counted as built-up areas in the property map. Check if it can work. are, after all, commons and other things not _ included.

Definition

These surfaces are characterized by trees and can otherwise be very heterogeneous. This includes both tree-lined residential plots as well as larger parks and groves embedded in the urban environment where the assessment is that they are exposed to extensive urban impact. It is the main land use that determines where an urban is tree-like green structure transitions into a forest. Since this is also a gradient, it can feel difficult to make a clear decision. However, it is less important for the use of the biotope database because the tree composition information is recorded in the Tree Cover attribute. In the automatic classification of 202, these areas contain >50% tall vegetation, which is the main characteristic (Table 5). Other elements (non-vegetation, low vegetation and semi-tall vegetation) must therefore be below 50% and semi-tall vegetation leafy structure must be below 30%. When visually assessing 230, the aerial image interpreter determines what is most characteristic. An overview of how the biotope relates to other biotopes in the main class 200 Urban green structure is given in Figure 9 and against other Step1-

biotopes are given in Figure 20 and Stage2 biotopes are given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme. Note that the characterization of urban green structure is not absolute but rather an attempt to give the fine-mesh urban green structure additional character that may be of importance when assessing the biological diversity or ecosystem services in the urban environment.

Status in the attribute field Step1_code

203 is a class that comes from automatic classification in the stage 1 database.
As the characterization of the urban green structure is based on a processed version of the property map's property layer, the calculation becomes blunt if

plots are too large or missing entirely. In these, mainly out in the countryside or in newly built areas where property boundaries have not been updated, aerial image interpretation will be required to improve the biotope. In general, it can be said that the reliability in 203 is judged to be good, but needs to be checked according to directives from the ordering municipality what should be included in the class and what should be included as 600 Forest land.

Status in the attribute field Step2_code

If the code 230 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code 230 is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. Code 230 has a higher reliability than 203.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). In general, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the Step 1 database was produced or was missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified.

**240 Urban green structure of gray character**

Definition

The class is dominated by non-vegetation of all imaginable forms, buildings, paving, garage driveways, trampolines, etc. In the automatic classification of 204, these areas contain >50 but <90% non-vegetation, which is the main characteristic (Table 5). Other elements (low, semi-high and tall vegetation) must therefore be below 50% and semi-high vegetation with a leafy structure must be below 30%. When visually assessing 240, the aerial image interpreter determines what is most characteristic. An overview of how the biotope relates to other biotopes in main class 200 Urban green structure is given in Figure 9 and to other Stage1 biotopes is given in Figure 20 and Stage2 biotopes is given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SEE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme. Note that the characterization of urban green structure is not absolute but more of an attempt to provide the fine mesh urban green structure

additional character that may be of importance when assessing the biological diversity or ecosystem services in the urban environment.

Status in the attribute field Step1_code

204 is a class that comes from automatic classification in the stage 1 database.
As the characterization of the urban green structure is based on a processed version of the property map's property layer, the calculation becomes blunt if the plots are too large or are missing entirely. In these, mainly out in the countryside or in newly built areas where property boundaries have not been updated, aerial image interpretation will be required to improve the biotope. As for the gray character, the classification is affected by the fact that buildings in certain locations are connected to garage driveways and or that buildings are >1000 m² and thus fall out as their own code. In these situations, you can say that 204 is underestimated.

In general, it can be said that the reliability of the 204 is judged to be acceptable.

Status in the attribute field Step2_code

If the code 240 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code 240 is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. Code 240 has the highest reliability.

Other descriptive attributes specified for the class

The only descriptive attribute for the biotope is land use which is common to main class 100 and 200, mainly of the type Urban exploitation or Other urban land use (see Appendix 3). In general, there is a proposed land use that has been taken from the property map information already in Step 1. If the surface is newly interpreted, i.e. the urban structure has arisen after the Step 1 database was produced or was missed in the automatic classification, land use is indicated by aerial image interpreters. If the area is <0.1 ha and is to be retained, Size must be specified.

*Figure 19. Example of urban green structure with tree character. These are often park environments or plots of land. The top picture shows a centrally located park. The lower one is a nature area embedded between exhibition halls. Here the tree species composition will be recorded*

**205 / 250 Urban green structure of natural plot character at SGU mountain in the day**

Definition

This is an attempt to distinguish the large areas with frequent leisure settlements on mountains during the day, an environment that is barren and strongly characterized by the outcrop environment and low pines. If we don't separate this out this environment lands in 210 or 220 which is unfortunate. A first attempt to separate these has been made in Step 1 for the entire Stockholm county. It works best in an archipelago environment, worse in urban areas where mountains have often turned into lawns during the day and thus should land in 210.

Applied area limitations and generalization principles

Status in the attribute field Step1_code

Status in the attribute field Step2_code

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

There are no attributes here because land use according to the national road database's road type (simpler merging of rough road classes) and wear layer (basis for the biotope class).

*Figure 20. Example of urban green structure of natural plot character on SGU mountain in the day*

**301 Arable land – Arable in rotational use (crop, fallow cultivation, pasture, fallow)**

Definition

The Swedish official definition of arable land is not entirely clear (Glimskär & Skånes, 2015). It states that the land must be suitable for plowing and growing crops or grazing, but it does not explicitly state what applies to the current use at a specific time (SCB, 1981). The class consists of arable land with the land use being crop rotation or fallow. The arable land can be ploughed, sown, planted with crops or harvested. It can also be grazed. The difference between grazed field and other grazing land is sometimes unclear, but the main rule for grazed arable land is that the pasture does not look permanent or that the surface has been plowed in the next few years. An overview of how the biotope relates to other biotopes in main class 300 is given in Figure 11 and to other Stage1 biotopes is given in Figure 20 and Stage2 biotopes is given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SEE Part E).

Applied area limitations and generalization principles

For newly added areas, the general minimum mapping unit of 0.1 ha applies, but if smaller areas are included in the block database, they will also be included in the biotope database. In the Stage1 data base, adjacent areas with the same land use have been merged. Surface demarcation within the arable land only takes place >0.1 ha and if the land use differs in relation to the database's land use classes (Appendix 3).

Status in the attribute field Step1_code

301 is a class taken directly from the Swedish Agricultural Agency's block database.
The reliability of the biotope class is judged to be high, but land use needs to be controlled.
Due to urban expansion, it is not unusual for arable land to have turned into an urban structure.

Status in the attribute field Step2_code

If the code 310 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The only descriptive attribute of the biotope is land use that is common to main class 300 and 400 is the group Cultivated landscape and semi-natural grassland (see Appendix 3). Generally, a proposed land use that has been taken from the block database information is already in Step

1. If the surface is newly interpreted, i.e. the arable land is not blocked, land use is indicated by the aerial image interpreter.

**302 Cultivation land - permanent fruit and berry crop**

Definition

The class consists of fruit and berry farms and is included as part of the definition of arable land. The definition does not include any requirement that cultivation be active or commercial. In other words, surfaces are brought there, e.g. fruit trees remain but the land use has changed to grazing still in this biotope. Either it is a question of fruit trees, usually apple trees but other fruits may occur, or berry cultivation or similar. An overview of how the biotope relates to other biotopes in main class 300 is given in Figure 11 compared to other Stage 1 biotopes given in Figure 20 and Stage 2 biotopes given in Figure 21.

Detailed instructions on how the biotope is converted to Steg2_kod are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

For newly added areas, the general minimum mapping unit of 0.1 h1 applies, but if smaller areas are included in the block database, they will also be included in the biotope database. In the Stage1 data base, adjacent areas with the same land use have been merged.

Status in the attribute field Step1_code

302 is a class taken directly from the Swedish Agricultural Agency's block database.
The reliability of the biotope class is judged to be high, but land use needs to be controlled.

Status in the attribute field Step2_code

If the code 320 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The only descriptive attribute of the biotope is land use that is common to main class 300 and 400 is the group Cultivated landscape and semi-natural grassland (see Appendix 3). In general, there is a proposed land use that has been taken from the information in the block database already in Step 1. If the surface is newly interpreted, i.e. the arable land is not blocked, the land use is indicated by the aerial image interpreter.

**303 Farmland - permanent crop, energy forest, Christmas tree cultivation**

Definition

The class includes all cultivated energy forest, usually salix on former arable land.
It covers all phases of cultivation, i.e. harvested or growing. Other energy crops,
mainly grass, are not included as this is too difficult to distinguish from other arable land Overview of how the biotope relates to other biotopes in main class 300 is given in Figure 11 and to other Stage 1 biotopes is given in Figure 20
and Stage2 biotopes are given in figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

For newly added areas, the general minimum mapping unit of 0.1 ha applies, but if smaller areas are included in the block database, they will also be included in the biotope database. In the Stage1 database, adjacent areas with the same land use have been merged.

Status in the attribute field Step1_code

303 is a class taken directly from the Swedish Agricultural Agency's block database.
The reliability of the biotope class is judged to be high, but land use needs to be controlled.

Status in the attribute field Step2_code

If the code 330 is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The only descriptive attribute of the biotope is land use that is common to main class 300 and 400 is the group Cultivated landscape and semi-natural grassland (see Appendix 3). In general, there is a proposed land use that has been taken from the information in the block database already in Step 1. If the surface is newly interpreted, i.e. the arable land is not blocked, the land use is indicated by the aerial image interpreter.

**310-340 Cultivated grassland at different soil moisture**

Definition

The class consists of all areas that are grazed or have been grazed and are clearly cultivated. II this term mainly includes former arable land, but also other land that looks prepared or fertilized. The surfaces are taken from two sources. The first is the field of the block database with long dikes where the land use can be pasture or no land use. The second source is open land outside the urban structure which, according to land surveying, is the oldest economic

map from the 1950s was arable land. An overview of how the biotope relates to other biotopes in main class 300 is given in Figure 11 and against other Stage1-biotopes are given in Figure 20 and Stage2 biotopes are given in Figure 21. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

The Stage 1 surfaces, the proposed cultivated grassland, can, above all in an urban environment, be something completely different, usually urban green structure that has not had support from the automatic sources, mainly the land surveying's built-up areas and the building layer of the property map. Both of these lag dangerously behind in time.

Applied area limitations and generalization principles

For newly added areas, the general minimum mapping unit of 0.1 ha applies, but if smaller areas are included in the block database, they will also be included in the biotope database. In the Stage1 data base, adjacent areas with the same land use have been merged.

Status in the attribute field Step1_code

There are four classes of proposed cultivated grassland that follow the same moisture regime as in the other main classes. Here, however, it was difficult to follow previously applied rules that the second number in the code should correspond to the humidity. Therefore, the humidity corresponds to the last digit in the Step1_code, these are:

310 Cultivated land - Proposed cultivated grassland on SGU mountain in the day
320 Cultivated land - Proposed cultivated grassland on SGU coarse sediment
330 Cultivated land - Proposed cultivated grassland on other moisture regime
340 Cultivated land - Proposed cultivated grassland on SGU/FK wetland

Status in the attribute field Step2_code

Only in Stage 2, when aerial image interpreters have assessed the surface and assigned a Stage2_code, can the cultivated grassland be trusted.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The only descriptive attribute of the biotope is land use that is common to main class 300 and 400 is the group Cultivated landscape and semi-natural grassland (see Appendix 3). In general, there is a proposed land use that has been taken from the information in the block database already in Step 1. If the surface is newly interpreted, i.e. the arable land is not blocked, the land use is indicated by the aerial image interpreter.

*Figure 21. The difference between grazed field and cultivated grassland (340) is not always crystal clear. But, when the pasture seems to be long-term, the class changes from 310 arable in rotation (including pasture) to 340 Cultivated grassland..*

**410 Open - sparsely wooded ground on SGU mountain during the day**
**420 Open - sparsely wooded land on SGU coarse sediment 430**
**Open - sparsely treed dry-wet land**
**440 Open - sparsely wooded land on SGU/FK wetland**

Definition

These codes consist of an automatic classification which does not really say much about its character other than the rough moisture regimes/substrate types on which BIOTOP SE rests (see table 1). It is the class that remains when everything else within the Step1 database has been assigned a different code. What characterizes this class is that it is dominated by low-semi-high vegetation or consists of dry environments that can often be characterized by bare substrate. The class contains many interesting biotopes that need to be classified manually through visual aerial image interpretation in 3D (see Part E). An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 9 and to other Stage1 biotopes is given in Figure 17. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Preliminary Step1_code before biotope type has been classified is 4X0 where x stands for the database's main four humidity regimes. These four codes should essentially not appear in the final database. In general, it can be said that the reliability of main class 400 Step1_code is low because it can contain completely different biotopes.

Status in the attribute field Step2_code

Does not exist.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

There is no attempt at land use here, unless the client has provided specific documentation, but large areas containing buildings have, for example, received the land use 599 Clear urban impact, undetermined or other than 501-
598 to indicate that the surface should rather land in main class 200 urban green structure. Otherwise, there is an indication of whether there is >10% tree cover (Tree layer 997) or 30-50% bush cover (halvhog 997). In the final database these should be classified into a tree species composition or a shrub type.

**411 Open boulder field, mountains during the day**

Definition

The class is clearly dependent on the substrate and is dominated by outcrop/rock during the day. Often the entire gradient between outcrops via dry land to open meadows is included, but in a mosaic that cannot be distinguished. The open land must have <10% tree cover, while the tree-covered land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing in order to be 711. So note that all tree-bearing open ground that is not clearly marked is taken to forest of open ground character (see 811-817). The only 711 that exists is the one that is part of the grazing paddocks and bears clear marks on the ground. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 9 and to other Stage 2 biotopes is given in Figure 15. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Not found but typically retrieved from 410 or 611 with forest phase 50, or possibly urban gray texture where it may have accidentally ended up.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. Reliability is judged to be good.

Other descriptive attributes specified for the class

The descriptive attribute to be entered for the biotope is land use, ur the group Cultivated landscape and semi-natural grassland (Appendix 3), as well as listing in Semi-high vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation. If >10% trees, regardless of whether the surface is taken to 711 or 811, even low trees must be counted as forest phase 5 or 6 unless obvious logging marks the surface, this is because the substrate can often affect the conceivable height of trees.

**412 Open block-stone ground**

Definition

The class is clearly dependent on the substrate and is dominated by block-stone soil. The open land must have <10% tree cover, while the semi-open land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing. The only 712 that exists is the one that is included in pastures and bears clear marks on it, which is not so likely because difficulties for animals to be able to move in this environment. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 9 and to other Stage 2 biotopes is given in Figure 15. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Not available, but probably retrieved from 420, i.e. surfaces from SGU's coarse sediment, or possibly urban gray structure where it may have accidentally ended up.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute to be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as in

where applicable Half-height vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

**413 Open gravel-sand land**

Definition

The class is clearly substrate dependent and is dominated by exposed gravel-sand.
The open land must have <10% tree cover, while the semi-open land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing. The most common examples here are probably sandy beaches and old abandoned gravel or sand roofs. The only 712 that exists is the one that is included in pastures and bears clear marks on it, which is not so likely because difficulties for animals to find food in this environment. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 9 and to other Stage 2 biotopes is given in Figure 15. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Not available, but probably retrieved from 420, i.e. surfaces from SGU's coarse sediment, or possibly urban gray structure where it may have accidentally ended up.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute that must be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (Appendix 3), as well as, where applicable, Semi-tall vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

**421 Open dry grassland/grassland**

Definition

Open (421) or Wooded (721) dry grassland or heath that dominates the surface. This type of land is often vested, but not always. The open land must have <10% tree cover, while the semi-open land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing.

Note that grassland includes both meadow-dominated (herbs and grass) and heath-dominated land (rice and narrow-leaved grass) according to the series concept (Påhlsson, 1998). In dry environments, vegetation cover is limited and underlying substrate often shines through. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 12 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of if the surface is a small island or an arable island.

Status in the attribute field Step1_code

Not available, but probably retrieved from 420, i.e. surfaces from SGU's coarse sediment.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute that must be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as, where applicable, Semi-tall vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

**432 Open dry-healthy grassland**

Definition

Open (432) or Wooded (732) healthy grassland with distinct distribution of areas of torrent character that are too small to plot. Wet elements can also be present, but it is the dry parts that predominate. This type of land is, as a rule, marked by heritage. The open land must have <10% tree cover, while the semi-open land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing. Note that grassland includes both meadow-dominated (herbs and grass) and heath-dominated land (rice and narrow-leaved grass) according to the series concept (Påhlsson, 1998). In dry environments, vegetation cover is limited and underlying substrate often shines through. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 12 and to other Stage2 biotopes is given in Figure 21.

Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Does not exist, but is probably retrieved from 430, i.e. surfaces that are not part of SGU's mountains today, coarse sediments or wetlands, i.e. land with other moisture regimes on everything from clay to moraine.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute that must be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as, where applicable, Semi-tall vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

**433 Open fresh-moist grassland (not semiaquatic)**

Definition

Open (433) or Wooded (733) healthy grassland with distinct distribution of wet meadow character areas too small to plot. There can also be drier elements, but it is the moist parts that predominate. This type of land is, as a rule, marked by heritage. The open land must have <10% tree cover, while the semi-open land must be clearly marked by trees and at the same time bear traces of ongoing or recently ceased grazing. Note that grassland includes both meadow-dominated (herbs and grass) and heath-dominated land (rice and narrow-leaved grass) according to the series concept (Påhlsson, 1998). An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 12 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Does not exist, but is probably retrieved from 430, i.e. surfaces that are not part of SGU's mountains today, coarse sediments or wetlands, i.e. land with other moisture regimes on everything from clay to moraine.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute that must be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as, where applicable, Semi-tall vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

*Figure 22. The open and semi-open semi-natural grasslands are often very varied and complex, which makes it difficult to do them justice. In BIOTOP SE, there is no detailed mapping below 0.1 ha, but the surface is described as clearly as possible in relation to the dominant character, both with regard to moisture type, but also regarding the cover of trees and semi-high vegetation and land use. The upper one is open and dry-healthy on the border with outcrop and the lower dry healthy and tree-bearing.*

**431 Field towards road (Step1-2_code)**

Definition

Automatically classified. These surfaces are simply the gaps with vegetation that occur between the block database cropland and a fusion of the national road database and the initial pixel classification's non-vegetation.

Applied area limitations and generalization principles

0.1 ha if the surface does not form a small island or an arable islet.

Status in the attribute field Step1_code

Where there is arable land that is active according to the block database, these must be found.

Status in the attribute field Step2_code

In the current version of BIOTOP SE, there is no direct plan for how these should be handled further. It is likely that the field cleaners can become a future add-on module if the customer wishes to know more about the qualities of the field cleaners. In the current version they are there to show where they are.

Status in the Biotope attribute field

As this is a common code for Stage 1 and Stage 2, the code in Biotop is the same as in Stage1_kod.

Other descriptive attributes specified for the class

There are probably no attributes here because land use according to the property map's built-up areas or construction areas are not set until the biotope type is set.

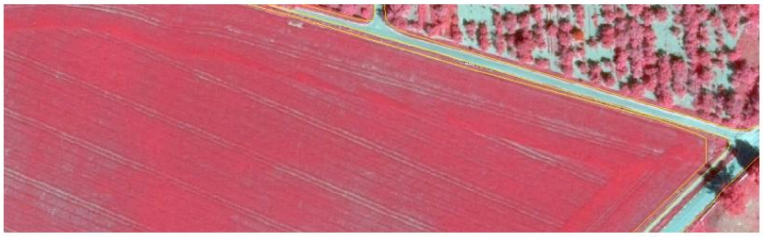


*Figure 23. Example of the field that is included in BIOTOP SE's automatic Step1 database. The surfaces arise from a mismatch between the block database's arable land and the road database's road width, including automatic widening of non-vegetation.*

**440 Other open semi-aquatic land (incl. marshes and bogs)**

Definition

This class includes all semi-aquatic land including marshes and bogs except dense reed vegetation. The surface must be permanently marked by semiaquatic conditions or by seasonal flooding. No division into wetland type is made because that it is relatively time-consuming and unsafe to do this in aerial images. Help is taken from the land map of the property map and the wetland inventory can also be used, even if it is not complete and detailed. In this class, there are not expected to be any significant amounts of semi-open heritage-marked land, which is why only the open form is present. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 12 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Not found, but mainly taken from 440, i.e. areas that are included in the SGU's/property map's wetlands.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute to be entered for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as in

where applicable Half-height vegetation and Tree layer. As a rule, all descriptive attributes are set during aerial image interpretation.

**447 Open dense reed vegetation (mostly on wetlands)**

Definition

This class includes all terrestrial semi-aquatic land that is dominated by dense overwater vegetation, usually reeds. The surface may, but need not, be characterized by semiaquatic conditions or by seasonal flooding. Help is taken from the land map of the property map, but usually the reed cover needs to be determined through aerial image interpretation. In this class, no active land use, which is why only the open form is present, if the bush cover >50% the surface turns into shrubland, if >10% tree cover and clearly marked by trees, the surface turns into forest. An overview of how the biotope relates to other biotopes in main class 400 is given in Figure 12 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Here, the general area limitation of >0.1 ha is used, with the exception of islands or åkerholme.

Status in the attribute field Step1_code

Not available, but picked up from the provisionally classified semi-open vegetatation which is adjacent to water. Note that if Step1-
the database has been developed on orthophotos that were taken before the end of May, so no classification of reeds has been possible or are strongly underrepresented due to the time of year. In that situation, it will primarily be caught from class 440 or to some extent 430 because reeds on land can also grow outside the spring field.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has assessed the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

The descriptive attribute that must be specified for the biotope is land use, from the group Cultivated landscape and semi-natural grassland (see Appendix 3), as well as, where applicable, Half-high vegetation, if the surface has 30-50% bush vegetation, usually willow or other deciduous shrubs and tree layers, in addition to dense reed cover.
As a rule, all descriptive attributes are set during aerial image interpretation.

**510 Half-height vegetation on SGU mountain during the day**
**520 Half-height vegetation on SGU coarse sediment**

**530 Half-height vegetation on land with other moisture regime**
**540 Half-height vegetation on SGU/FK wetland**

Definition

Land that has >50% coverage of semi-tall vegetation, which is hopefully shrubs of various types. Shrubs are all vegetation that is between 0.8-4.5 m high. In the initial work with the Stage 1 database, low and semi-high vegetation has been combined to avoid making the database too cluttered. If this class is present in the biotope database, it constitutes an automatic classification of larger contiguous lands with semi-tall vegetation on certain lands (401) that have been automatically classified from the elementary pixel classification containing the class semi-tall vegetation. This automatic classification is still under development and is not likely to be widespread. The class is a purely mechanically classified class and contains no information about the character of the vegetation or the type of scrub land. Even tall grass, reeds and other vegetation can due to the simple height criterion fall into this automatic class. All bushland must therefore be confirmed and characterized via aerial image interpretation. An overview of how the biotope relates to other biotopes in main class 500 Shrubland is given in Figure 13 and to other Stg1 biotopes is given in Figure 20. Detailed instructions on how the biotope is converted to Stage2_code are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

Insofar as there are areas, the general minimum mapping unit of 0.1 ha applies.

Status in the attribute field Step1_code

These are step 1 codes that must be aerially interpreted into the correct bushland. Note that if the Stage1 database has been developed on orthophotos taken before the end of May, the classes are strongly underrepresented due to the time of year. In that situation, it will primarily be captured from the open classes 410-440 and will involve more work in Step 2.

Status in the attribute field Step2_code

Does not exist.

Status in the Biotope attribute field

Enter Step1_code if no aerial image interpretation has taken place, otherwise enter Step2_code which is one of the classes 510 Coniferous shrubland (incl. one), 520 Mixed shrubland, 530 Thorny shrubland *(Rosaseae),* 540 Willow shrubland (moist semiaquatic), or 550 Other deciduous shrubland (incl. mixture of 530 -540).

Other descriptive attributes specified for the class

No attributes exist except possibly proposed land use 207 No land use, regrowth.

**511,521,531,541 Coniferous scrub land (including one) of various humidity**

Definition

As a rule, bushland must >50% bush cover. Coniferous shrub land must consist of >70% coniferous plants where the height is mainly below 5 m. It is always permitted with scattered trees, or wooded land <0.1 ha in a shrubland as long as the main character is that the bushes dominate. These can be junipers or genuine deciduous shrubs as well as small trees (conifers or leaves). The class thus makes no distinction between true shrubland and spontaneous overgrowth with trees <5 m high.
Overview of how the biotope relates to other biotopes in the main class
500 Shrubland is given in Figure 13 and against other Stage2 biotopes is given in Figure 18.
Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

The minimum mapping unit is generally 0.1 ha, but if scrubland the dominant vegetation is on a smaller area, e.g. ö or åkerholme gets the surface
be smaller. In areas where there are bush areas <0.1 ha, the bushes, if they are considered to be characteristic, can be mapped in the semi-tall vegetation attribute.
Bushland will always have to be a matter of judgment of the area as a whole and the nature of the bushes.

Status in the attribute field Step1_code

Not available, but probably picked up from 510-540, i.e. areas with presumed bush land in all moisture categories.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has drawn the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. The update of Biotop is not automatic.

Other descriptive attributes specified for the class

In the vast majority of cases, the land use should be No land use, regrowing (207) because scrub land is almost always formed by leaving a previously open land without land use.
Exceptions to this are planted
or spontaneously arising shrublands in the urban environment, energy forest in the cultivated land, and planted forest in the production forest. Of these, only bushland in an urban environment belongs to main class 500 Bushland.

**512, 522, 532, 542 Mixed shrubland of varying humidity**

Definition

As a rule, bushland must have at least 50% bush cover. Mixed shrubland consists of a mixture of deciduous and coniferous shrubs where each type must account for >30% but <70% of the proportion where the height must mainly be below 5 m. To avoid too many classes, there is only one mixed shrubland, i.e. the type of deciduous shrubs are not separated according to other classes where they can be thorny, willow, or other deciduous shrubs. It is always permitted with scattered trees, or wooded land <0.1 ha in a shrubland as long as the main character is that the bushes dominate. These can be junipers or genuine deciduous shrubs as well as small trees (conifers or leaves). The class therefore makes no distinction between true shrubland and spontaneous overgrowth with <5 m height. An overview of how the biotope relates to other biotopes in main class 500 Shrubland is given in Figure 13 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE

Part E).

Applied area limitations and generalization principles

The minimum mapping unit is generally 0.1 ha, but if scrubland the dominant vegetation is on a smaller area, e.g. island or åkerholme, the area may be smaller. In areas where there are bush areas <0.1 ha, the bushes, if they are considered to be characteristic, can be mapped in the semi-tall vegetation attribute.
Bushland will always have to be a matter of judgment of the area as a whole and the nature of the bushes.

Status in the attribute field Step1_code

Not available, but probably picked up from 510-540, i.e. areas with presumed bushland in all moisture categories.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has drawn the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. The update of Biotop is not automatic.

Other descriptive attributes specified for the class

In the vast majority of cases, the land use should be No land use, regrowth (207) because shrubland is almost always formed by leaving a previously open land without land use. If the shrubland has arisen in what is perceived as old, pasture land, the land use can be Exceptions to this are planted or spontaneously emerged shrublands in the urban environment, energy forest in cultivated land, and planted forest in

the production forest. Of these, only bushland in an urban environment belongs to main class 500 Bushland.

**513, 523, 533 Thorn scrub soil *(Rosaseae)* of different humidity**

Definition

As a rule, bushland must have at least 50% bush cover. Thorny shrub land is dominated >70% by deciduous plants, where the height must mainly be below 5 m. Of these, shrubs with thorny branches must dominate, e.g. sedges, rose bushes, hawthorn or similar species. It is always permitted with scattered trees, or wooded land <0.1 ha in a shrubland as long as the main character is that the bushes dominate. These can be junipers or genuine deciduous shrubs as well as small trees (conifers or leaves). The class thus makes no distinction between true shrubland and spontaneous overgrowth with trees <5 m high. An overview of how the biotope relates to other biotopes in main class 500 Shrubland is given in Figure 13 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE

Part E).

Applied area limitations and generalization principles

The minimum mapping unit is generally 0.1 ha, but if scrubland the dominant vegetation is on a smaller area, e.g. island or åkerholme, the area may be smaller. In areas where there are bush areas <0.1 ha, the bushes, if they are considered to be characteristic, can be mapped in the semi-tall vegetation attribute.
Bushland will always have to be a matter of judgment of the area as a whole and the nature of the bushes.

Status in the attribute field Step1_code

Not found, but probably picked up from 510-530, i.e. surfaces that are not on wetlands but rather in the drier direction.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has drawn the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. The update of Biotop is not automatic.

Other descriptive attributes specified for the class

In the vast majority of cases, the land use should be No land use, regrowth (207) because shrubland is almost always formed by leaving a previously open land without land use. Exceptions to this are planted or spontaneously arising shrublands in the urban environment, energy forest in the cultivated land, and planted forest in the production forest. Of

these are only bushlands in an urban environment that belong to main class 500 Bushland.

**524, 534, 544 Willow scrub land of varying humidity**

Definition

As a rule, bushland must have at least 50% bush cover. Willow scrubland is dominated >70% by deciduous plants, where the height must mainly be below 5 m. Of these, willow bushes must dominate.
Willow bushes grow mainly moist-semi-aquatic. It is always permitted with scattered trees, or wooded land <0.1 ha in a shrubland as long as the main character is that the bushes dominate. These can be junipers or genuine deciduous shrubs as well as small trees (conifers or leaves).
The class thus makes no distinction between true shrubland and spontaneous overgrowth with trees <5 m high. An overview of how the biotope relates to other biotopes in main class 500 Shrubland is given in Figure 13 and to other Stage 2 biotopes is given in Figure *21.*
*Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).*

Applied area limitations and generalization principles

The minimum mapping unit is generally 0.1 ha, but if scrubland the dominant vegetation is on a smaller area, e.g. island or åkerholme, the area may be smaller. In areas where there are bush areas <0.1 ha, the bushes, if they are considered to be characteristic, can be mapped in the semi-tall vegetation attribute.
Bushland will always have to be a matter of judgment of the area as a whole and the nature of the bushes.

Status in the attribute field Step1_code

Not available, but probably picked up from 520-540, i.e. surfaces that are not on mountains during the day but rather in the wetter direction.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has drawn the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used. The update of Biotop is not automatic.

Other descriptive attributes specified for the class

In the vast majority of cases, the land use should be No land use, regrowth (207) because shrubland is almost always formed by leaving a previously open land without land use. Exceptions to this are planted larger shrublands in the urban environment, energy forest in the cultivated land, and planted forest in the production forest.

**515,525,535,545 Other deciduous shrubland (incl. mixture of 5X0-5X4) of different humidity**

Definition

As a rule, bushland must have at least 50% bush cover. Other deciduous shrubland is dominated >70% by deciduous plants, where the height must mainly be below 5 m. Of these, neither thorny bushes nor willow bushes should dominate. It is always permitted with scattered trees, or wooded land <0.1 ha in a shrubland as long as the main character is that the bushes dominate. These can be junipers or genuine deciduous shrubs as well as small trees (conifers or leaves). The class thus makes no distinction between true shrubland and spontaneous overgrowth with trees <5 m high.

An overview of how the biotope relates to other biotopes in main class 500 Shrubland is given in Figure 13 and to other Stage 2 biotopes is given in Figure 21.

Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

The minimum mapping unit is generally 0.1 ha, but if scrubland the dominant vegetation is on a smaller area, e.g. ö or åkerholme, the area may be smaller. If the area is < 0.1 ha and forms part of another biotope, the area will be generalized away. Then the bushes can instead be used for mapping the semi-high vegetation attribute. Bushland will always have to be a matter of judgment of the area as a whole and the nature of the bushes.

Status in the attribute field Step1_code

Not available, but probably picked up from 510-540, i.e. areas with presumed bushland in all moisture categories.

Status in the attribute field Step2_code

If the code is present, it means that an aerial image interpreter has drawn the surface and assigned the code.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

In the vast majority of cases, the land use should be No land use, regrowth (207) because shrubland is almost always formed by leaving a previously open land without land use. Exceptions to this are planted or spontaneously arising shrublands in the urban environment, energy forest in the cultivated land, and planted forest in the production forest. Of these, only bushland in an urban environment belongs to main class 500 Bushland.

*Figure 24. Hazel forms part of the shrubland, other leaf type. It would of course have been interesting to be able to distinguish it from other bushland, but the assessment is that it is not feasible.*

*Figure 25. Shrubland of the type willow bushes on semiaquatic soil.*

**611, 621, 631, 641 Pine-dominated forest land/wooded land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-
the tree worm of the database, predominantly according to national land cover data, NMD consists of pine forest (target value >70%). The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. Overview of how the biotope relates to other biotopes in the main class
600 is given in Table 4 and against other Stage 1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles

causes the data to become generalized in a way that can affect the forest type in general. During the development of the Stage 1 database, the generalization has taken place so that for small pine areas, in the first place, they are generalized into mixed conifers, secondly into spruce, thirdly into mixed and, in the last case, to the tree-covered land that the surface is surrounded by or connects to .

Status in the attribute field Step1_code

According to NMD, pine forests are mapped with good accuracy. The problem is amplified in small and narrow groves located on urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

611 Pine-dominated forest/wooded land on SGU mountain in the day
621 Pine-dominated forest/wooded land on SGU coarse sediment
631 Pine-dominated forest/wooded land on other moisture regime
641 Pine-dominated forest/wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-year was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

*Figure 26. Forest can be a lot. In addition, the land use is often multiple. In this case, a pine forest which at the same time constitutes a popular outdoor area.*

**612, 622, 632, 642 Spruce-dominated tree-covered land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-the tree worm of the database, predominantly according to national land cover data, NMD consists of spruce forest (target value >70%). The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. An overview of how the biotope relates to other biotopes in main class 600 is given in Table 4 and to other Stage1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles causes the data to become generalized in a way that can affect the forest type in general. During the development of the Stage 1 database, the generalization has taken place so that for small spruce areas are first generalized into mixed conifers, secondly into pine, thirdly into mixed and in the last case to the wooded land that the area is surrounded by or connects to .

Status in the attribute field Step1_code

According to NMD, spruce forests are mapped with good accuracy. The problem is amplified in small and narrow groves located in urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

612 Spruce-dominated forest/wooded ground on SGU mountain in the day
622 Spruce-dominated forest/wooded land on SGU coarse sediment
632 Spruce-dominated forest/wooded land on other moisture regime
642 Spruce-dominated forest/wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-year was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**613, 623, 633, 643 Conifer mixed wooded soil of soil at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-the tree worm of the database, predominantly according to national land cover data, NMD consists of coniferous forest (target value >70%) where neither spruce nor pine is less than 30%. It is unclear whether the coniferous mixed forest is truly mixed or represents uncertain classification of spruce or pine as the classification is done in 10m pixels. The biotope database is therefore omitted because it can be both. The only thing that separates them is a rough estimate of the humidity regime and presumed location on outcrop. An overview of how the biotope compares to other biotopes in main class 600 is given in Table 4 and to other Stage 1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles causes the data to become generalized in a way that can affect the forest type i

large. During the development of the Stage 1 database, the generalization has taken place so that for small conifer mixed areas, in the first instance, they are generalized into the pine or spruce forest with which it shares the longest border, secondarily into the middle and, in the last case, into the wooded land that the area is surrounded by or connecting to.

Status in the attribute field Step1_code

According to the NMD, mixed conifer forests are mapped with good-tolerable accuracy where a mixture with purer spruce and pine forests can occur.
The problem is amplified by small and narrow groves located in urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry wet, and wetland are based on SGU's soil type map and, for the wetlands, also the bottom soil layer of the Property Map:

613 Conifer mixed forest/wooded land on SGU mountain in the day
623 Coniferous mixed forest/wooded land of SGU coarse sediment
633 Coniferous mixed wood forest/wooded land on other moisture regime
643 Coniferous mixed forest/wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-year was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**614, 624, 634, 644 Mixed-leaved conifer-dominated tree-covered land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-
the tree worm of the database, predominantly according to national land cover data, NMD consists of deciduous mixed coniferous forest where neither needles nor leaves are less than 30%. The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. An overview of how the biotope relates to other biotopes in main class 600 is given in Table 4 and to other Stage1-
biotopes are given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles result in the data being generalized in a way that can affect the forest type in general. During the development of the Stage 1 database, the generalization has taken place so that for small conifer mixed areas, in the first instance, they are generalized into the pine or spruce forest with which it shares the longest border, secondarily into the middle and, in the last case, into the wooded land that the area is surrounded by or connecting to.

Status in the attribute field Step1_code

According to NMD, mixed deciduous coniferous forest is mapped with acceptable accuracy.
The problem is amplified by small and narrow groves located in urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry wet, and wetland are based on SGU's soil type map and, for the wetlands, also the bottom soil layer of the Property Map:

614 Mixed-leaved conifer-dominated tree-covered land on SGU mountain in the day
624 Mixed-leaved conifer-dominated tree-covered land on SGU coarse sediment
634 Mixed-leaved conifer-dominated tree-covered land on other moisture regime
644 Mixed-leaved conifer-dominated tree-covered land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-
century was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a

production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**615, 625, 635, 645 Trivial leaf-dominated tree-covered land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-the tree worm of the database, predominantly according to national land cover data, NMD consists of trivial deciduous forest (target value >70% leaves). The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. An overview of how the biotope relates to other biotopes in main class 600 is given in Table 4 and to other Stage1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles causes the data to become generalized in a way that can affect the forest type in general. During the development of the Stage 1 database, the generalization has taken place so that for small leafy areas, in the first place, they are generalized into adjacent mixed leaves, secondarily into noble leaves, thirdly into mixed, and in the last case to the tree-covered land that the surface is surrounded by or connects to.

Status in the attribute field Step1_code

According to NMD, trivial deciduous forest is mapped with acceptable. The problem is amplified in small and narrow groves located in urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

615 Deciduous-dominated forest/wooded ground on SGU mountain in the day
625 Trivial leaf-dominated forest/wooded land on SGU coarse sediment
635 Trivial leaf-dominated forest/wooded land on other moisture regime
645 Deciduous-leaved dominated forest/wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting

up national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-year was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**616, 626, 636, 646 Deciduous-dominated tree-covered land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-the tree worm of the database, predominantly according to national land cover data, NMD consists of deciduous forest (target value >70% deciduous and >50% deciduous). The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. An overview of how the biotope relates to other biotopes in main class 600 is given in Table 4 and to other Stage1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion). The preparatory work and generalization principles causes the data to become generalized in a way that can affect the forest type in general. During the development of the Stage 1 database, the generalization has taken place so that for small noble leaf areas, in the first place, they are generalized into neighboring mixed leaves, secondarily into trivial leaves, thirdly into sometimes, and in the last case to the tree-covered land that the surface is surrounded by or connects to to. This generalization was carried out first of all in order to preserve, if possible, the noble leaf species in the landscape, which can typically consist of small limited areas that should not be allowed to disappear into e.g. coniferous forest.

Status in the attribute field Step1_code

According to the NMD, broadleaf forests are mapped with acceptable-inadequate accuracy. The problem is amplified in small and narrow groves located in urban or open land (Metria 2018). The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

616 Broadleaf-dominated forest/wooded land on SGU mountain in the day
626 Deciduous-dominated forest/tree-covered land on SGU coarse sediment 636 Deciduous-dominated forest/tree-covered land on other moisture regime 646 Deciduous-dominated forest/tree-covered land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting up national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-year was arable land, there are proposals for land use forestry, as well as forest phase 2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**617, 627, 637, 647 Mixed-leaved dominated (deciduous element) forest/ wooded land at different moisture regimes**

Definition

Tree-covered surfaces that, after vectorization and generalization during Step1-the tree worm of the database, predominantly according to national land cover data, NMD consists of trivial deciduous forest with elements of deciduous (target value >70% deciduous and 20-50% deciduous). The only thing that separates them is a rough estimate of the moisture regime and the supposed location on outcrop. Overview of how

the biotope's relation to other biotopes in main class 600 is given in Table 4 and to other Stage1 biotopes is given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion).

The preparatory work and generalization principles result in the data being generalized in a way that can affect the forest type in general. During development of Step1-
the database, the generalization has taken place in such a way that for small mixed-leaved areas it is first generalized into neighboring noble leaves, secondarily into leaves, thirdly into sometimes, and in the last case to the wooded ground that the surface is surrounded by or connects to. This generalization had the second highest priority in order to preserve, if possible, the noble leaf species in the landscape which may typically consist of small limited areas that should not be allowed to disappear into e.g. coniferous forest.

Status in the attribute field Step1_code

According to NMD, mixed deciduous forest is assessed to be mapped with insufficient accuracy. The problem is amplified in small and narrow groves located in urban or open land (Metria 2018). It is currently difficult to determine the value of this forest class. Hopefully this classification will be able to be improved, but it is not certain. The class is retained for the time being so that the forest types as a whole reflect the NMD. The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

617 Noble leaves mixed with trivial leaves dominated tree-covered land on SGU mountain in the day
627 Mixed-leaved dominated (noble-leaved elements) forest/wooded land on SGU coarse sediment
637 Mixed-leaved dominated (noble-leaved element) forest/tree-covered land on other moisture regime
647 Mixed-leaved dominated (noble-leaved elements) forest/wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. Reliability basically follows NMD because aerial image interpreters in Stage 2 do not have the task of correcting national land cover data. The aerial image interpreter can, if it goes quickly and the error is obvious, put a correct code in Step2_kod.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

For lower forests, <10 m, or forests that according to the economic map from 1950-
the number was arable land, there are proposals for land use forestry, as well as forest phase

2 Young to middle-aged trees, in the hope that the forest is a production forest. The height criterion is difficult to use in forests which, due to extreme position along the moisture gradient does not reach full tree height. Requires visual assessment.

Land use in forests is either forestry, traditional character, natural disturbance, or no clear land use at all, i.e. usually no clear traces of forestry.

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**618, 628, 638, 648 Hygge/other disturbed potentially tree-covered land at different moisture regimes**

Definition

This class is an attempt to secure all forest land that falls outside the treed land Step1 mask. It has been produced by combining the original tree mask from the object height of the aerial image with the forest mask of the property map and disturbed forest in the national land cover data, NMD. In this way, we are able to capture clearings, outcrops, wetlands and other proposed forest land not captured by the strictly mechanical selection criteria, >10% tree cover and >4.5 m tree height, which were set up in the automatic forest worm classification. An overview of how the biotope relates to other biotopes in main class 600 is given in Table 4 and to other Stage1-

biotopes are given in Figure 20.

Applied area limitations and generalization principles

National land cover data have been vectorized and processed to >0.1 ha under the project's tree mask. There are no smaller areas except smaller islands or arable islets (according to the Size criterion).

Status in the attribute field Step1_code

This is a distinct Step1_code where all surfaces must be assessed visually and delineated according to final biotope and other descriptive attributes. Here, the majority of clearings, low alluvial and wetland forests and other disturbed land are assessed as conduits. The four moisture classes rock in the day, coarse sediment, dry-wet, and wetland are based on SGU's soil type map and, for the wetlands, also the real estate map's subsoil layer:

618 Hygge/other disturbed wooded land on SGU mountain in the day
628 Hygge/other disturbed wooded land on SGU coarse sediment
638 Hygge/other disturbed wooded land on other moisture regime
648 Hygge/other disturbed wooded land on SGU/FK wetland

Status in the attribute field Step2_code

If the code is in the Step2_code field and Step1_code has the code 999, the surface is aerially interpreted and assessed as what the code says. The reliability of the class in Stage 2 is the highest.

Status in the Biotope attribute field

If aerial image interpretation has taken place, Biotop is updated, otherwise the code comes from Step1_kod.

Other descriptive attributes specified for the class

No other attributes are specified for this class.

Land use in disturbed forest/wooded land can be variable. Most often it is forestry, i.e. clear cutting, but it can also be cableways, ongoing exploitation etc.,

For optimized work in Stage 2 aerial image interpretation, there should be a preliminary land use and forest phase that needs to be checked and determined. It is primarily presumed full-grown forest that should be specified. This indication is, for obvious reasons, not found on alluvium-type forests, as this forest is often low-growing due to its natural substrate.

**700 Water unclassified (temporary stage1_code)**

Definition

This class should not appear in the Stage1 database as it is the crudest form of classification. This is simply the water mask from the Property Map. An overview of how the biotope relates to other biotopes in main class 700 is given in Figure 19 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces. According to the property map's smallest mapping unit, which is at least down to 80 m².

Status in the attribute field Step1_code

The only possibility that this class would be included in Step1_kod is that the current database is under construction and the Step1 work is not completed.

Status in the attribute field Step2_code

Does not exist.

Status in the Biotope attribute field

Occurs only if there is completely unclassified water in the database.

Other descriptive attributes specified for the class

None, this is a preliminary raw job class

**710, 711, 712 Water without aquatic vegetation**

Definition

Water according to the property map's water mask where no aquatic vegetation has been registered in the preparatory work for the Stage 1 database. The spectral analysis of orfototo shows that there is no aquatic vegetation in this class.
The exception is areas that are < 0.1 ha that may have been included initially but have been generalized away. An overview of how the biotope relates to other biotopes in main class 700 Water is given in Figure 19 and to other Stage 1 biotopes is given in Figure 20. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces. Here, all water surfaces that are in the surface layer of the property map are retained for water down to the smallest puddle. Note that no water from the property map's line layer is entered into the biotope database.

Status in the attribute field Step1_code

Water without aquatic vegetation fully follows the outer boundary of the property map's National Shoreline (NSL). The demarcation against vegetation-rich water can be diffuse depending on how successful the automatic classification of vegetation has been. There is no fixed limit for exactly how little vegetation may be on the surface because the biotope is generalized to 0.1 ha and the time of the orthophoto can have a large influence on how much aquatic vegetation has had time to develop.

If the orthophoto used in the Stage1 work is not too early in the season, this class corresponds very well to what is really water without aquatic vegetation. For areas >50 m from the shore in the Baltic Sea, it is highly unlikely to find any aquatic vegetation that meets the requirement of 0.1 ha, which is why all areas beyond this buffer have automatically been set to code 710 in the Step1 database.

Status in the attribute field Step2_code

Don't find.

Status in the Biotope attribute field

Enter Step1_code if no aerial image interpretation has taken place, otherwise enter Step2_code which is one of the classes 711 Open aquatic surface - without facility or 712 Open aquatic surface - with facility.

Other descriptive attributes specified for the class

Here, the following attributes are entered in the Stage1 database: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is below 1 have.

**711 Open water without facilities**

Definition

Water according to the property map's water mask where no aquatic vegetation has been registered in the preliminary work around the Stage 1 database and this has been confirmed by visual assessment by aerial image interpreters. An overview of how the biotope relates to other biotopes in main class 700 Water is given in Figure 19 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE
Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

Not found, probably the code for 710 Water without aquatic vegetation or 720 is given Water with aquatic vegetation, but it can also be a different code if new water has been added or existing water has not previously been registered.

Status in the attribute field Step2_code

If the code is entered, the surface has been visually assessed by aerial image interpreters as an open aquatic surface without facilities.

Status in the Biotope attribute field

Enters Step1_code if no aerial image interpretation has taken place, otherwise 711 is entered Open aquatic area - without facilities. Even in aerial image interpretation, the extent of water area without vegetation can be overestimated if the images used in aerial image interpretation are early in the season. Also note that classification of aquatic vegetation can differ significantly between different years even at the same time of photography.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use must also be specified as well as salinity and size for new objects.

**712 Open water with facility**

Definition

Water area with clear urban facilities out in the water. This can be bridge systems or piers that belong to marinas or larger harbor facilities, but also consist of bridge foundations, fish farming, or other clear permanent facilities out in the water. There is often a corresponding land use on the land side, which then probably consists of some form of urban

environment. An overview of how the biotope relates to other biotopes in main class 700 Water is given in Figure 19 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

Not found, probably the code for 710 Water without aquatic vegetation or 902 Water with aquatic vegetation is entered, but it can also be a different code if new water has been added or existing water has not previously been registered.

Status in the attribute field Step2_code

If the code is entered, the surface has been visually assessed by aerial image interpreters as an open aquatic surface without facilities. Even in aerial image interpretation, the extent of water area without vegetation can be overestimated if the images used in aerial image interpretation are early in the season. Also note that classification of aquatic vegetation can differ significantly between different years even at the same time of photography.

Status in the Biotope attribute field

Enters Step1_code if no aerial image interpretation has taken place, otherwise 712 is entered Open aquatic area - with facility.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use must also be specified as well as salinity and size for new objects.

**721 Water with overwater vegetation (helophytes)**

Definition

Water area covered to varying degrees by overwater vegetation. This includes all higher water vegetation such as e.g. reeds, sedum, sea horsetail, roller down and other tall helophytes. The degree of coverage of vegetation can be low to high and must be dominated by these plants rather than floating leaf vegetation (see 722).

The height can vary from approx. 0.5 m to several meters depending on the location. Usually these areas are not as dense as the semiaquatic surfaces which can also be completely covered by reeds and other overwater vegetation. An overview of how the biotope relates to other biotopes in main class 700 Water is given in Figure 19 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

This is a Step2_code so no surfaces with this code are in Step1. However, the majority of all vegetation-covered water will be automatically classified as 720-721 Water with aquatic vegetation in Step1_code.

Status in the attribute field Step2_code

The class arises through Stage 2 aerial image interpretation. The classification means that an aerial image interpreter has taken a position on the surface and assessed that the dominant vegetation composition is overwater vegetation. Even in aerial image interpretation, the extent of aquatic vegetation can be underestimated if the images used in aerial image interpretation are early in the season. Also note that classification of aquatic vegetation can differ significantly between different years even at the same time of photography.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use must also be specified as well as salinity and size for new objects.

**722 Water with floating leaf vegetation (hydrophytes)**

Definition

Water area covered to varying degrees by floating leaf vegetation. This includes all visible vegetation that floats on the surface, such as e.g. water lilies, some species of nate, leech bud, water hyacinth and other low hydrophytes. The degree of coverage of vegetation can be low-high and must be dominated by these plants over overwater vegetation (see 721). The height of the vegetation is almost non-existent because floating leaf vegetation basically consists of individual leaves and flowers that float just above the surface of the water.. Usually these areas are not as dense as the semiaquatic surfaces which can also be completely covered by reeds and other overwater vegetation. An overview of how the biotope relates to other biotopes in the main class 700 Water is given in Figure 19 and against the others Step2-

biotopes are given in Figure 21. Detailed instructions for how the biotope is assessed in Step 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

This is a Step2_code so no surfaces with this code are in Step1. However, the majority of all vegetation-covered water will be automatically classified as 720-721 Water with aquatic vegetation in Step1_code.

Status in the attribute field Step2_code

The class arises through Stage 2 aerial image interpretation. The classification means that an aerial image interpreter has taken a position on the surface and assessed that the dominant vegetation composition is above-water floating blade vegetation. Even in aerial image interpretation, the extent of aquatic vegetation can be underestimated

the images used in aerial image interpretation are early in the season. Also note that classification of aquatic vegetation can differ significantly between different years even at the same time of photography.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use must also be specified as well as salinity and size for new objects. Note that land use must always be specified, even if no land use is visible. For water, it corresponds to land use 401 No obvious land use, non-overgrowth, or 402 No obvious land use, overgrowth.

**723 Water with mixed aquatic vegetation (overwater/floating leaves)**

Definition

Water area covered to varying degrees by a mixture of overwater vegetation and floating leaf vegetation. This includes all higher water vegetation such as e.g. reeds, sedum, sea horsetail, roller down and other tall helophytes as well as e.g. water lilies, some species of nate, leech bud, water hyacinth and other low hydrophytes. The degree of coverage of vegetation can be low-high and must be dominated by these plants rather than floating leaf vegetation (see 722). The height can vary from approx. 0.5 m to several meters depending on the location.
Usually these areas are not as dense as the semiaquatic surfaces which can also be completely covered by reeds and other overwater vegetation. An overview of how the biotope relates to other biotopes in main class 700 Water is given in Figure 19 and to other Stage 2 biotopes is given in Figure 21. Detailed instructions for how the biotope is assessed in Stage 2 aerial image interpretation are given in a separate manual (BIOTOP SE Part E).

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

This is a Step2_code so no surfaces with this code are in Step1. However, the majority of all vegetation-covered water will be automatically classified as 720-721 Water with aquatic vegetation in Step1_code.

Status in the attribute field Step2_code

The class arises through Stage 2 aerial image interpretation. The classification means that a aerial image interpreters have taken a position on the surface and assessed that the dominant vegetation composition is a mixture of overwater vegetation and floating leaf vegetation.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use must also be specified as well as salinity and size for new objects.

**726 Water with high vegetation, overhanging or in permanent water**

Definition

Water according to the property map that is covered by tall vegetation or where trees from the land side lean out over water.

Applied area limitations and generalization principles

There is no lower area limit for water surfaces.

Status in the attribute field Step1_code

This is a Step2_code so no surfaces with this code are in Step1. However, the majority of all vegetated water will be automatically classified as 726 High vegetation over water in Step1_code.

Status in the attribute field Step2_code

The class arises through Stage 2 aerial image interpretation. The classification means that an aerial image interpreter has taken the position that the proposal is correct. In some cases, these surfaces are formed by an incorrectly drawn waterline. However, these are not corrected but maintained to minimize the change of the national shoreline.

Status in the Biotope attribute field

If the code is in Steg2_kod, it must also have been reclassified to the attribute field Biotop. It is important that the user makes sure that Steg2_kod has been transferred to Biotop. Otherwise, it is easy for details to be lost in an analysis of the entire landscape where the Biotope field is used.

Other descriptive attributes specified for the class

Pre-coded attributes: Salinity and, where applicable, Size where the surface constitutes a small body of water where the entire water area is less than 1 ha. When interpreting aerial images, land use, forest phase and tree layer must also be specified, as well as salinity and size for new objects.

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# 6. Attachments

Listed below are the appendices included in the document and which follow this page.

**Appendix 1** Total list of all biotopes in BIOTOP SE with instructions for description, as well as in PDF automatic page reference (coming towards the end)

**Appendix 2** Technical key for creating the Stage 1 database. The key indicates all Stage1 classes and their relationship in relation to each other and used data. For description of the method, see separate manual part D.

**Appendix 3** Complete list of land use classes in BIOTOP SE

**Appendix** 1. BIOTOP SE total list at biotope level specified in the attribute Biotop which is a combination of the Stage1 database codes and the Stage2 database codes. In this way, surfaces with different degrees of processing can be combined in the same database. The list of page numbers contains a hyperlink that can be clicked (hold down Ctrl) to quickly get to the biotope description in chapter 6.

Common Stage1 and Stage2 codes are marked with a bold number in the Biotop column. Work codes in Stage1 are marked in bold in the column Stage1_code, and unique codes for Stage 2 are marked in bold in the column Stage2_code.

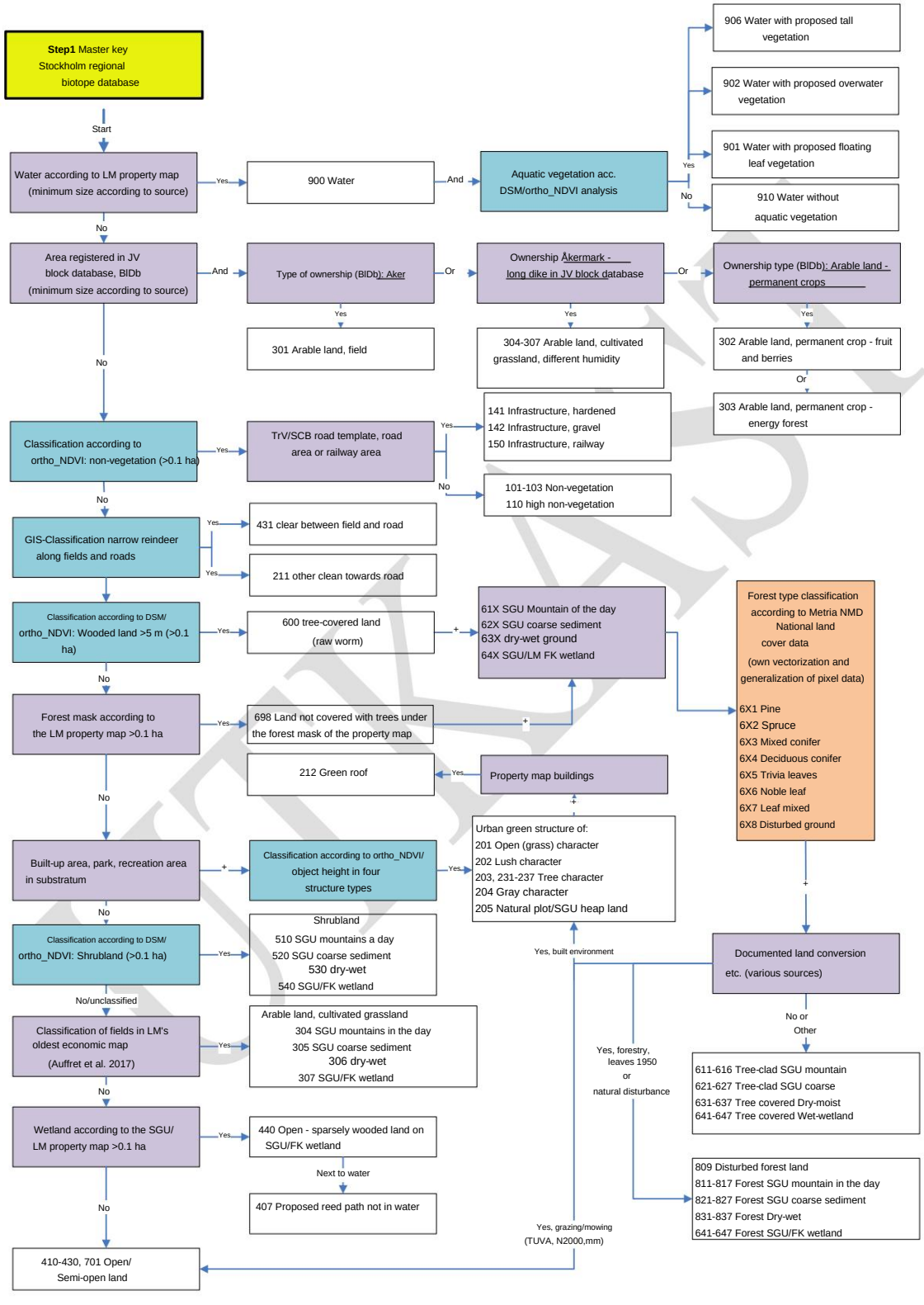
| Biotope | Step1_ code | Step 2_ code | Biotope class | Page |
|---|---|---|---|---|
| 100 | **100** | | Non-vegetation (temporary step1_code) | |
| 101 | **101** | | Non-vegetation, mainly urban gray structure (temporary stage1_code) | |
| **110** | | | High non-vegetation, mainly buildings | |
| **120** | | | Hardened ground | |
| **130** | | | Other land with removed vegetation (not hardened) | |
| **141** | | | Infrastructure, paved road area | |
| **142** | | | Infrastructure, road area gravel road | |
| **150** | | | Infrastructure, railway area | |
| 200 | **200** | | Urban green structure - unclassified (temporary stage1_code) | |
| **210** | | | Urban green structure of an open character | |
| **211** | | | Urban green structure refuse/slope | |
| **212** | | | Green roof: sedum, peat, grass, herbs etc | |
| **220** | | | Urban green structure of a leafy nature | |
| 230 | **230** | | Urban green structure of tree character (temporary step1_code) | |
| **231** | | | Urban green structure of tree character according to NMD pine | |
| **232** | | | Urban green structure of tree character according to NMD fir | |
| **233** | | | Urban green structure of tree character according to NMD mixed conifers | |
| **234** | | | Urban green structure of tree character according to NMD deciduous mixed conifer | |
| **235** | | | Urban green structure of tree character according to NMD leaves | |
| **236** | | | Urban green structure of tree character according to NMD noble leaf | |
| **237** | | | Urban green structure of tree character according to NMD mixed leaves | |
| 238 | **238** | | Urban green structure of a disturbed nature (temporary stage1_code) | |
| **240** | | | Urban green structure of gray character | |
| **250** | | | Urban green structure of natural plot character on SGU mountain | |
| **301** | | | Arable land - crop rotation | |
| **302** | | | Arable land - permanent fruit and berry crop | |
| **303** | | | Farmland - permanent crop, energy forest, Christmas tree cultivation | |
| **310** | | | Arable land - cultivated grassland, former goes on SGU mountain during the day | |
| **320** | | | Arable land - cultivated grassland, formerly plowed on SGU coarse sediment | |
| **330** | | | Cultivated land - cultivated grassland, formerly run on other moisture regime | |

| | | | | |
|---|---|---|---|---|
| **340** | | | Arable land - cultivated grassland, former fields on SGU/FK wetland | |
| **Biotope** | **Step1_ code** | **Step 2_ code** | **Biotope class** | **Page** |
| 410 | **410** | | Open - sparsely wooded land on SGU mountain (temporary stage1_code) | |
| 411 | | | Open outcrop-dominated land, mountains | |
| 412 | | | Open block-rock dominated ground | |
| 413 | | | Open gravel-sand dominated ground | |
| 420 | **420** | | Open - sparsely wooded land on SGU coarse sediment (temporary stage1_code) | |
| 421 | | **421** | Open dry grassland/grassland (unique step2_code) | |
| 430 | **430** | | Open - sparsely wooded dry-wet land (temporary step1_code) | |
| **431** | | | The fields towards the road | |
| 432 | | **432** | Open dry-healthy grassland | |
| 433 | | **433** | Open fresh-moist grassland | |
| 440 | | | Open - sparsely wooded land on SGU/FK wetland (temporary stage1_code) | |
| **447** | | | Dense reed vegetation not in water (usually semiaquatic) | |
| 499 | **499** | | Land that lacks input data and could not be classified in Step 1 | |
| 500 | **500** | | Semi-high vegetation unclassified (temporary step1_code) | |
| 510 | **510** | | Half-height vegetation on SGU mountain (temporary step1_code) | |
| 511 | | **511** | Conifers, incl. one, on SGU mountain (>50% BT) | |
| 512 | | **512** | mixed shrubs, conifers and leaves, on SGU | |
| 513 | | **513** | mountain thorn bushes, Rosaseae, on SGU | |
| 515 | | **515** | mountain Other deciduous shrubs, incl. mixture of 530-540, on SGU rock | |
| 520 | **520** | | Half-height vegetation on on SGU coarse sediment (temporary stage1_code) | |
| 521 | | **521** | Conifers, incl. one, on SGU coarse sediment mixed | |
| 522 | | **522** | shrubs, conifers and leaves, on SGU coarse sediment thorn | |
| 523 | | **523** | bushes, Rosaseae, on SGU coarse sediment willow bushes, | |
| 524 | | **524** | on SGU coarse sediment **525** other deciduous shrubs, incl. | |
| 525 | | | mixture of 530-540, on SGU coarse sediment soil Half-height vegetation on soil on other moisture regime (temporary step1_code) | |
| 530 | **530** | | | |
| 531 | | **531** | Conifers, incl. one, on dry-wet mixed | |
| 532 | | **532** | shrubs, conifers and leaves, on dry-wet thorn | |
| 533 | | **533** | bushes, Rosaseae, on dry-wet willow bushes, | |
| 534 | | **534** | on dry-wet other deciduous shrubs, incl. | |
| 535 | | **535** | mixture of 530-540, on dry-wet Semi-high vegetation on on SGU/FK | |
| 540 | **540** | | wetland (temporary stage1_code) | |
| 541 | | **541** | Conifers, incl. one, on SGU/FK wetland mixed | |
| 542 | | **542** | shrubs, conifers and leaves, on SGU/FK wetland willow | |
| 544 | | **544** | bushes, on SGU on SGU/FK wetland | |

| Biotope | Step1_ code | Step 2_ code | Biotope class | Page |
|---|---|---|---|---|
| 545 | | **545** | other deciduous shrubs, incl. mix of 530-540, on SGU/FK wetland | |
| 600 | **600** | | Wooded land (temporary step1_code) | |
| 610 | **610** | | Unclassified tree-lined land on SGU mountain in the day (temporary stage1_code) | |
| 620 | **620** | | Unclassified tree-lined land at SGU (temporary stage1_code) | |
| 630 | **630** | | Unclassified tree-laden land proposed dry-wet (temporary stage1_code) | |
| 640 | **640** | | Unclassified tree-laden land on SGU/FK wetland (temporary stage1_code) | |
| **611** | | | Pine-dominated tree-covered land on SGU mountain in the day | |
| **621** | | | Pine-dominated tree-covered land on SGU coarse sediment | |
| **631** | | | Pine-dominated tree-covered ground on other moisture regime | |
| **641** | | | Pine-dominated tree-covered land on SGU/FK wetland | |
| **612** | | | Spruce-dominated tree-covered land on SGU mountain in the day | |
| **622** | | | Spruce-dominated tree-covered ground on SGU coarse sediment | |
| **632** | | | Spruce-dominated tree-covered land on other moisture regime | |
| **642** | | | Spruce-dominated tree-covered land on SGU/FK wetland | |
| **613** | | | Coniferous tree-covered land on SGU mountain during the day | |
| **623** | | | Coniferous tree-covered ground on SGU coarse sediment | |
| **633** | | | Coniferous mixed tree-covered ground on other moisture regime | |
| **643** | | | Coniferous mixed tree-covered land on SGU/FK wetland | |
| **614** | | | Mixed-leaf conifer-dominated tree-covered ground on SGU mountain in the day | |
| **624** | | | Mixed-leaved conifer-dominated tree-covered land on SGU coarse sediment | |
| **634** | | | Mixed-leaved conifer-dominated tree-covered land on other moisture regimes | |
| **644** | | | Mixed-leaved conifer-dominated tree-covered land on SGU/FK wetland | |
| **615** | | | Trivial leaf-dominated tree-covered ground on SGU mountain in the day | |
| **625** | | | Trivial leaf-dominated tree-covered land on SGU coarse sediment | |
| **635** | | | Trivial leaf-dominated tree-covered ground on other moisture regime | |
| **645** | | | Common leaf-dominated tree-covered land on SGU/FK wetland Noble-leaf- | |
| **616** | | | dominated tree-covered land on SGU mountain in the day | |
| **626** | | | Deciduous-dominated tree-covered land on SGU coarse sediment Deciduous- | |
| **636** | | | dominated tree-covered land on dry-wet land | |
| **646** | | | Deciduous-dominated tree-covered land on wetland | |
| **617** | | | Mixed-leaved dominated (noble-leaved elements) tree-covered land on SGU mountain | |
| **627** | | | Mixed-leaved dominated (noble-leaved elements) tree-covered land on SGU coarse sediment | |
| **637** | | | Mixed-leaved dominated (noble-leaved elements) on land with other moisture regimes | |
| **647** | | | Mixed-leaved dominated (noble-leaved elements) tree-covered land on wetland | |
| 608 | **608** | | Non-tree-covered land under the forest mask of the property map | |

| Biotope | Step1_ code | Step 2_ code | Biotope class | Page |
|---|---|---|---|---|
| **618** | | | Hygge/other disturbed potentially tree-covered land on SGU mountain in the day | |
| **628** | | | Hygge/other disturbed potentially tree-covered land on SGU coarse sediment | |
| **638** | | | Hygge/other disturbed potentially tree-covered land on other moisture regime | |
| **648** | | | Hygge/other disturbed potentially wooded land on SGU/property map wetland | |
| 700 | **700** | | Water unclassified (temporary step1_code) | |
| 710 | **710** | | Water without aquatic vegetation (temporary step1_code) | |
| 711 | | **711** Open water without facility | | |
| 712 | | **712** Open water with facility | | |
| **721** | | | Water with overwater vegetation (helophytes) | |
| 720 | **720** | | Water with proposed floating leaf vegetation | |
| 722 | | **722** Water with floating leaf vegetation (hydrophytes) | | |
| 723 | | **723** Water with mixed aquatic vegetation (overwater/floating leaves) | | |
| **726** | | | Water with high vegetation (overhanging or in permanent water) | |

**Appendix 2** Technical key for creating the Stage 1 database. The key indicates all Stage1 classes and their relationship in relation to each other and used data. For detailed method description, see Part D (Skånes 2021).




*Biotope database template 2020-06-26 Helle Skånes*

**Appendix** 3. Complete list of land use classes. The list's code system is designed so that it should be expandable if municipalities wish to add their own land use. Note that the land use list should be kept to a minimum to avoid excessive work during stage 2 aerial image interpretation. However, some land use classes can be advantageously taken from the municipality's existing data or other sources.

| Land use | Code | Main source |
|---|---|---|
| **Forestry** | | |
| Proposed (automatic) impact of forestry | 100 | Any proposal in Step 1 is not specified in Step 2 |
| Clear traces of forestry | 101 | Any suggestion in Step 1, otherwise visually in Step 2 |
| No clear traces of forestry or other land use | 102 | Any suggestion in Step 1, otherwise visually in Step 2 |
| Land that was arable according to the oldest economic map, automatic | 103 | Proposals in Step 1, not specified in Step 2 |
| **The cultivated landscape and semi-natural grassland** | | |
| Arable land in rotation, including hedgerow, fallow and | 201 | Proposal in Stage 1 from Jordbruksblok + visual |
| pasture Arable land with permanent crops | 202 | Proposal in Stage 1 from Jordbruksblok + visual |
| Traces of ongoing or discontinued (non-regrowing) grazing or mowing | 203 | Possible suggestion in Step 1 from Jordbruksblock + visual |
| Overgrowth with traces of old growth, broad-crowned trees, secondary or delayed overgrowth of shrubs and trees, pasture-like forest, etc. | 204 | Mainly visual in Stage 2 |
| Equestrian facility/meat farm, trotting track, etc. Not | 205 | Mainly visual in Step 2 |
| overgrown, no obvious land use (no traces of clearing) | 206 | Mainly visual in Stage 2 |
| Overgrown, no obvious land use (no evidence of clearing) | 207 | Any suggestion in Step 1, otherwise visually in Step 2 |
| Known or suspected restoration or other conservation measures, e.g. clearing, reed control, | 208 | Any suggestion in Step 1, otherwise visually in Step 2 |
| **Natural disturbance** | | |
| Traces of fire (forest fire, grass fire), storm droppings, beaver bites, etc | 301 | Mainly visual in Stage 2 |
| Traces of flood or beaver dam | 302 | Mainly visual in Stage 2 |
| Traces of insect infestation, bird colony etc | 303 | Mainly visual in Stage 2 |
| **Urban exploitation** | | |
| Ongoing exploitation, e.g. road construction, new establishment or other ongoing activities | 401 | Any suggestion in Step 1, otherwise visually in Step 2 |
| Landfill, waste plant, etc., ongoing/former Roofing | 402 | Proposal in Step 1 from the Property map + visual |
| operations, mine, etc., ongoing/former Ledningsgata | 403 | Proposal in Step 1 from the Property map + visual |
| | 404 | Proposal in Step 1 from the Property map + visual |
| **Other urban land use** | | |
| Mechanical mowing or other extensive open management | 501 | Mainly visual in Step 2 |
| Sports/recreation area, exercise facility/camping/school/playground/castle/park, including private land, and other community function (502) | 502 | Mainly visual in Stage 2 |

| **Other urban land use, cont.** | | |
|---|---|---|
| Golf course | 504 | Proposal in Step 1 from the Property Map |
| Ski slope, toboggan run or ski track facility | 505 | Proposal in Step 1 from the Property Map |
| Bathing area, on land and inside flanges or markings in water | 506 | Mainly visual in Stage 2 |
| Colony garden/cultivation plot/commercial garden and other horticulture | 507 | Proposal in Step 1 from the Property Map |
| Church area including cemetery/burial ground | 508 | Proposal in Step 1 from the Property Map |
| Airport/airfield | 509 | Proposal in Step 1 from the Property Map |
| Marina, permanent facility on land and docks and boats in water | 510 | Mainly visual in Step 2 |
| Port, wharf, lock area, or other urban infrastructure related to water | 511 | Proposal in Step 1 from the Property Map |
| Treatment pond/sedimentation pond | 512 | Proposal in Step 1 from the Property Map |
| Pond, pool or water-filled mine hole/pit | 513 | Proposal in Step 1 from the Property Map |
| Fish farming/aquaculture | 514 | Mainly visual in Stage 2 |
| Parking space | 515 | Mainly visual in Stage 2 |
| Surface with artificial grass (various types), usually football field or unspecified sports field | 516 | Mainly visual in Stage 2 |
| Motorsport facility | 517 | Proposal in Step 1 from the Property Map |
| Lawn, short cut intensively maintained surface | 518 | Mainly visual in Stage 2 |
| Football field, tennis court and unspecified sports field 519 | | Proposal in Step 1 from the Property Map |
| Apparent urban impact, undetermined or other than 501-515 | 599 | Visually in Stage 2 when land use is missing in Step 1 |
| Low development/villa development | 601 | Proposal in Step 1 from the Property Map |
| High-rise buildings/multi-storey buildings | 602 | Proposal in Step 1 from the Property Map |
| Dense built-up area/Centre/town center/square | 603 | Proposal in Step 1 from the Property Map |
| Industrial area or other form of facility, private/community function | 604 | Proposal in Step 1 from the Property Map |
| Scattered development/villa development/farm development/ unknown type outside LM's built-up areas often in rural areas) | 605 | Suggestions from beat betting in presteg1 of the property map's property boundaries and buildings. |
| Building | 611 | Proposal in Step 1 from the Property Map |
| Railway, railway station, train station | 701 | Proposal in Stage 1 from SCB + visual |
| Infrastructure road | 702 | Proposal in Stage 1 from SCB + visual |
| Clear traces of other land use not listed | 900 | Mainly visual in Stage 2 |
| No land use assigned yet | Zero | All surfaces must have a land use |