Instruction for seashore inventory in MOTH, 2013

Henrik Hedenås, Hans Gardfjell and Åsa Hagner
Department of Forest Resource Management
SLU
901 83 Umeå, Sweden

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Introduction to MOTH Sea shore field inventory

The aim of MOTH's seashore inventory is to estimate the occurrence, the total areal coverage and conservation status of terrestrial habitat types listed in Annex I of the EU Habitats Directive and occurring along the Swedish coast. The Swedish coastline is an important environment for many animal and plant species. However, it is also an attractive envrionment for recreational and residental development, which means that an increasing part of the coastline is subject to exploitation and undeveloped areas are decreasing (Törnquist and Engdal, 2012). Many coastal municipalities, for example, are involved in processes of reducing coastal protection policies to allow residential development in coastal areas (LIS; landsbygdsutveckling i strandnära lägen). Increased exploitation poses a threat to habitats occurring on the coast. Knowledge of the abundance and status of these habitats will therefore be crucial background data in planning for maintaining existing biodiversity (EU habitatdirective; Törnquist and Engdal, 2012).

MOTH Seashore inventory is the first nationwide survey of the Swedish coastline involving both remote sensing and field-based stages that has been performed. The seashore inventory is carried out according to a two-phased sampling design, where the first phase consists of aerial photo interpretation and the second phase of a field survey. MOTH developed a novel sampling design for the purpose of targeting coastal habitats. The Swedish National Land Survey's SWEREF 5x5 km map sheets were used to define the MOTH seashore sampling frame. The map sheets were divided by half (corresponding to the area that is sampled in MOTH terrestrial habitat inventory) to create a 2,5 x 5 km sampling unit. Of these, the 3021 sampling units containing Swedish shoreline (defined by conditions set by SMHI and the Swedish property map[7]) were selected and comprised the population of sampling units for the seashore inventory. A 250 unit subset, distributed evenly along the coast, was considered to be an appropriate sampling effort over a five year period, with 50 units being sampled each year. Based on the knowledge that seashore habitats follow a linear distribution a line-intercept method was developed where a hexagonal grid of separate line-segments was

overlain each seashore sampling unit. The intersections between these line segments and the shoreline generates the starting point of the shore transect that form the basis for the assessment area in this survey and from which data is gathered.

The need to define the start and end point of the seashore and the position of the shoreline has been an important part of the project and subject of recurring discussions. We have chosen to define the *seashore* or the littoral zone as the part of the shore that is directly influenced by marine water, i.e. either periodically submerged or influenced by waves or sprinkled with water (i.e the splash zone). The *shoreline* was delineated at the mean sea level, which is defined as the average level (of high and low water levels) of the ocean's surface measured over a period of 30 years (SMHI). During photo interpretation the mean sea level typically translated to the actual interface between land and water, thus and arbitrary delineation at the point in time of the available photo, as it normally is difficult to estimate whether or not the water levels seen in the aerial photo deviates from the mean sea level. However, the method allows for adjusting the intersection point if the interpreter detects evident indications of high or low water in the aerial photograph. The same definitions for the seashore and the shoreline are used in the field, however during field work the seashore is subdivided in different zones.

Field inventory has been performed in 2012 and 2013, and this manual is a translation of the revised Swedish version used in 2013. It describes the variables collected along the sea shore transect, and the methods used in determine zones, how to collect the data etc. During field work data has been collected on a handheld Android tablet device, using software developed by the MOTH-project. The field manual is following the structure within the software. In this version of the Sea shore manual text within figures are in Swedish.

1. Aim of the inventory and shore terminology

1.1. Aim of the inventory

This inventory aims to estimate occurrence and status of specific Annex 1 habitat types found along the Swedish coast. The information is recorded within and around a 10 m wide transect, extending through the geo- and supralittoral zones and sometimes even beyond – into an area we have chosen to call the extralittoral zone (not a part of the actual shore). Figure 1 illustrates the different shore zones. Table 1 presents an overview of the data collected in each transect zone. Most variables are estimated and recorded within the transect , either within a specific zone or for the transect as a whole. Some variables describe the area beyond the transect, either in the water or further inland.

Table 1. Overview of variables collected in MOTH seashore inventory, according to which zone the variable is recorded in. The transect starts at the mean water mark and extends through the geo- supra- and extralittoral zones.

	Below the hydrolittoral zone	Hydrolittoral zone	Geolittoral zone	Supralittoral zone	Extralittoral zone	Above the transect
Coast type						
Shore type						
Exposure						
Tree presence			Only for islands and islets			
Jetty/pier						
Depth at 3 m						
Length						
Slope						
Land use						
Field layer						
Tree layer						
Substrate						
Field/bottom layer species			occurrence			
Shrub species			Species, abundance + position			
Tree species			Species, diameter + position			
Drift rolls			Position + detail description			
Habitat			Position/length (start and stop)			
Debris/waste			Fractions, amount			
Thinning						
Time since thinning						
Recreation type						
Cliff height						
Fence						
Phragmites belts:	Length and cover					

1.2. Inventory design

The seashore inventory is a two-phase estimation based on aerial photo interpretation (phase 1) and field inventory (phase 2). This instruction manual focuses on the method of field inventory.

The areas selected for field inventory are originally based on a subset of shores randomly selected for aerial photo interpretation. Depending on the classifications from the aerial photo interpretation, a second subset is selected for field inventory.

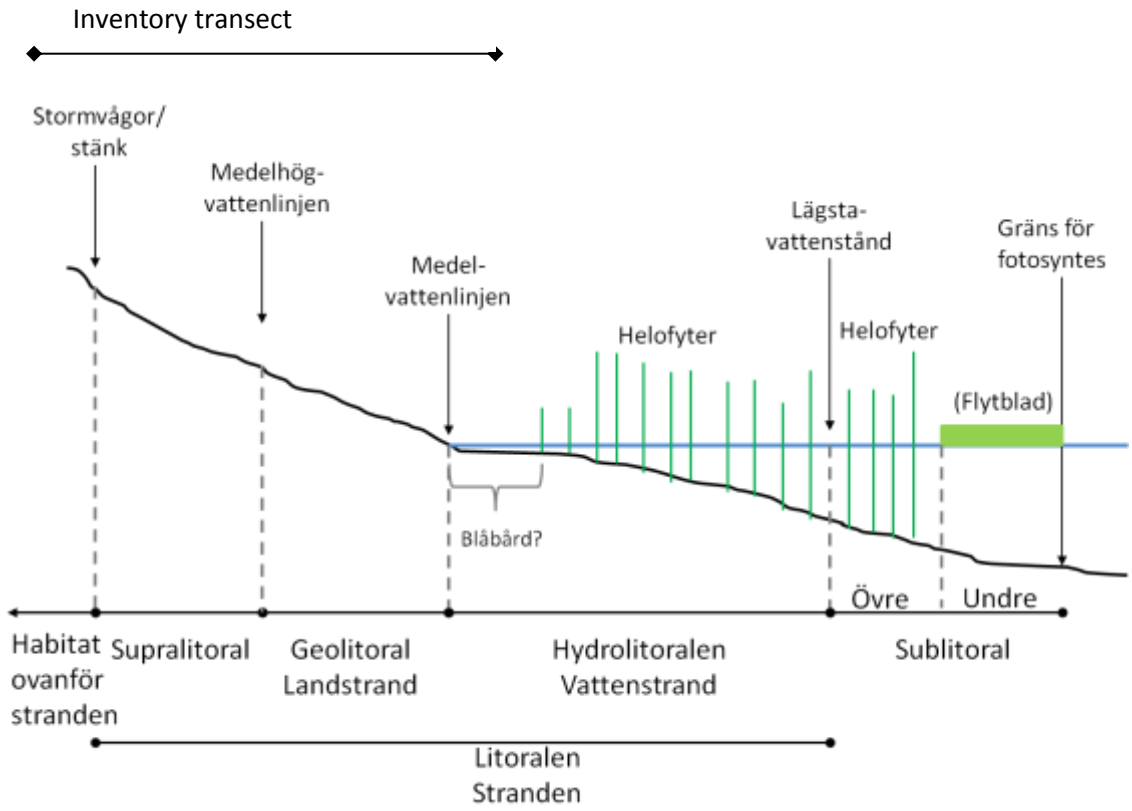

Figure 1. A hypothetical shore. The majority of variables are recorded within the inventory transect, which includes the mostly dry area of the shore reaching from the mean sea water level where the geolittoral starts, throughout the supralittoral zone (which is frequently affected by waves or splashing). If any of the listed Annex 1 habitats (in table 2) is found in connection to upper part of the Littoral the inventory transect proceeds into the area above the shore called the extralittoral zone ("habitat ovanför stranden") and finally stop where this habitat ends . Some information is also collected in the area around the actual transect.

During field inventory, a 10 m wide transect is established. The transect starts at the mean water mark and ends at the transition from the extralittoral zone to another terrestrial habitat type. The transect is inventoried in detail, and some general information of the surroundings is also recorded. For instance, the area above the transect is photographed and the Annex 1 habitat type is recorded.

If jetties or piers are present in the water just outside the starting point of the transect, they are also photographed and recorded.

1.3. Terminology and definitions

There is no conclusive definition of a shore. Different authors have defined shores in different ways, and a specific term may have a somewhat different meaning on another shore type. In MOTH seashore inventory, the geolittoral zone (the terrestrial shore), the supralittoral zone and the area we call “extralittoral zone” are included in the actual transect (figure 1).

The supralittoral zone is the area affected by storm waves and splashing, i.e. above the high water mark.

The extralittoral zone follows directly above the supralittoral zone and is not located on the actual shore. Inventory in this zone is only done on boulder- and gravel dominated banks, dune areas, sea cliffs/cliff shores or in primary successional forest on land upheaval coasts. For practical reasons, most of the measurements and estimations are performed within the geo- and supralittoral zones. On cliff/bedrock shores, a clear zonation is often visible: the white belt, the black zone, the orange belt and the bare zone. We have chosen to use these zones as differentiators between the different shore zones as explained below.

> ***The littoral zone (the shore)*** includes, in MOTH seashore inventory, the hydro- (water), geo- (terrestrial) and supralittoral zones.
>
> ***The hydrolittoral zone (the water)*** is the part of the shore which is only periodically dry. The hydrolittoral zone is delineated by the low water mark at the lowest point and by the mean water mark at the highest point (se definitions below).
>
> ***The geolittoral zone (the terrestrial shore)*** is the part of the shore which is periodically flooded. On most shores, the geolittoral zone is delineated by the mean water mark at the lowest point, and by the mean high water mark at the highest point (figure 1). On cliff/bedrock shores it is often difficult to locate the mean water mark since the normal fluctuation of waves reaches above this line. The highest point of the geolittoral zone on bare rock is instead delineated by the normal wave fluctuation. This means that the height of the geolittoral zone on cliff shores depends on the amount of exposure. Within the geolittoral zone on cliff/bedrock shores, two reasonably clear zones based on the composition of organisms can usually be found: the **white belt** and the **black zone** (see definitions below and figure 2).
>
> ***The supralittoral zone*** follows directly above the geolittoral zone and is affected by storm waves, extreme high water levels or splashing. This zone is delineated downwards by the mean high water mark, and upwards where influence from storm waves, extreme high water or splashing no longer exists (figure 1). The supralittoral zone on cliff/bedrock shores can be separated into three reasonably clear zones based on the composition of organisms: the **orange belt**, the **bare zone** and the area hereafter referred to as the “**upper supralittoral zone**” (see definitions below and figure 2).
>
> ***The extralittoral zone*** is the area directly above the supralittoral zone. This area can be more or less influenced by salt aerosols. The extralittoral zone is included in the inventory transect if

rock- or gravel banks, sea cliffs/cliff shores, dune areas or primary successional forest on land upheaval coasts are present.

"Above the inventory transect" indicates the area directly above the extralittoral zone. If no extralittoral zone exists, this indicates the area directly above the supralittoral zone. Classification of Annex 1 habitat type is performed in this area and land use is recorded. No upper delineation is required for this area.

The white belt is found in the lower part of the geolittoral zone on bare rock shores (figure 2), mainly on the west coast but occasionally also on the east coast. The mean water mark usually corresponds to the bottom line of the white belt. The white belt consists of barnacles, which do not occur in northern Sweden, consequently the white belt is not found in most parts of the Gulf of Bothnia.

The black zone is found in the upper part of the geolittoral zone (just above the white belt if present) on bare rock shores on all Swedish coasts. The black zone consists of cyanobacteria of the genus *Calothrix* and "Salt lichen" *Hydropunctaria Maura.*

The orange belt is found in the lowest part of the supralittoral zone, on bare rock shores mostly on the west coast, just above the geolittoral black zone (figure 2). The orange belt consists of orange lichens (genus *Caloplaca*) which are resistant to severe salt water splashing.

The bare zone follows directly above the supralittoral orange belt, on bare rock shores on all Swedish coasts (figure 2). This is an area where neither marine nor terrestrial organisms are able to live. This area may be created by a combination of ice formation and extreme high water levels.

"The upper supralittoral zone" is found in the supralittoral zone on bare rock shores on all Swedish coasts, just above the bare zone (figure 2). This area is periodically affected by storm waves, extreme high water levels or splashing, but terrestrial organisms are able to live here. Organisms consist mainly of well-developed lichen communities.

Mean water mark, mean water level. The annual mean water level is calculated by using the method described on this page: http://www.smhi.se/kunskapsbanken/oceanografi/arets-medelvattenstand-1.10047. The mean water level according to the oceanographic definition is not only based on the actual measurements from each specific year, but is a calculated value based on several years of measurements. At least 30 years of measurements is needed in order to achieve a reliable estimate based on regression. Thus, the mean water level is fundamentally an oceanographic definition as opposed to an ecological one. However, organisms present on the shore provide an indication of this line.

Mean high water mark and ***mean high water level*** are calculated values based on measurements of high water levels from several years.

Sea level is the difference (in cm) above or below the calculated mean water level for the current year. Sea level observations are found on the SMHI website: http://www.smhi.se/vadret/hav-och-kust/havsobservationer/havsvst_tab.htm. Prognoses based on the HIROMB model for upcoming water levels are found on the SMHI Oceanic

web page: http://produkter.smhi.se/OceanWeb/. Click on HIROMB followed by “Sea levels” and choose your nearest location on the provided map.

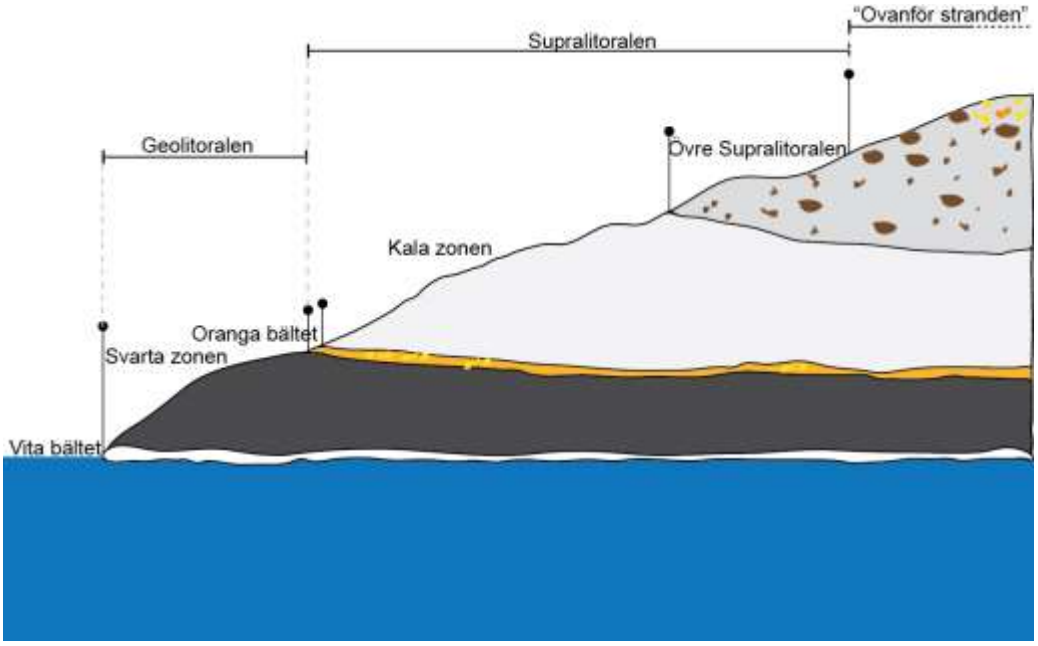

Figure 2. A cliff/bare rock shore. The lower part of the geolittoral zone includes the white belt, which consists of barnacles, followed by the black zone which consists of cyanobacteria (genus Calothrix*) or black lichens (*Verrucaria maura*). The lower supralittoral zone consists of orange lichens (genus* Caloplaca*) – the orange belt – followed by the bare zone and higher still, a zone with well-developed lichen communities – the upper supralittoral zone – which is mainly affected by splashing. Above the supralittoral zone the inventory transect continues if targeted Annex 1 habitats are encountered (in this case it might be a 1230 Sea cliff). The extralittoral zone ends where other habitats/plant communities not affected by aerosols take over.*

1.4. Measurements and accuracy

Cover is recorded in percent (e.g. extent of a transect zone) or as an area in m^2 (with one decimal accuracy for areas smaller than 1 m^2). Very small occurrences (<0.1 m^2) are recorded as 0.1 m^2. Separate areas for a species/fraction are added together, with an accuracy of one decimal for areas smaller than 1 m^2, with 0.5 m^2 accuracy for areas up to 3 m^2, and with 1 m^2 accuracy for larger areas.

Distance (or position) from the start of the transect (i.e. the mean water mark) is recorded for several variables. Distance is measured in meters, with one decimal accuracy for small distances (e.g. between zones where the incline is steep). In most other cases, 1 m accuracy is sufficient (e.g. for detailed shrub measurements and positions of trees).

Depth is measured in decimeters and is recorded in the hydrolittoral zone, 3 m from the mean water mark.

Caliper data is recorded in millimeters.

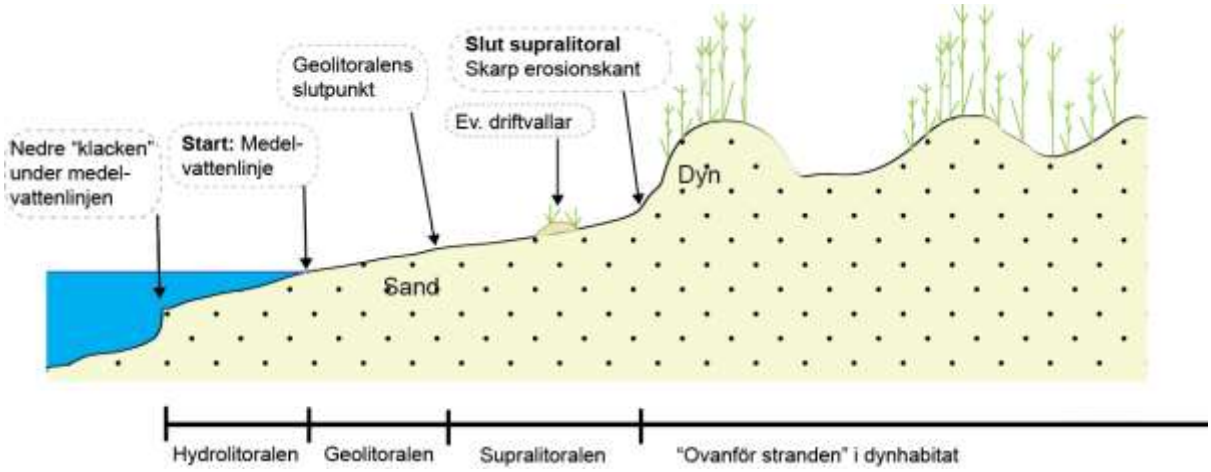

Figure 3. Profile of a sandy shore transitioning into a dune area. See chapter 3.10.4 Detailed classification of dune habitats, and figure 5 for specifics regarding the extension of the transect into the extralittoral zone (here dune habitats).

1.5. Where to find different shore types

On exposed shores, fine sediment particles have been washed out by waves while coarse materials remain. The fine sediments – sand and gravel – have been deposited either on the sea bed just beyond the shore or have travelled with the current and been deposited in the calmer waters of bays. For this reason, sand- and clay shores are often found in bays while cliff- and rock shores are found on capes (Strahler 1975, Loberg 1980, SGU 2012.). Therefore, the shore environments included in the Annex 1 habitat types (table 2) are found on active or relic coastal shores where these fractions have been deposited.

Table 2. Annex 1 habitat types that may occur within a transect. Each habitat type may occur in more than one section of a transect.

Code	Annex 1 habitat/target habitat	Smallest mapping unit
1210	Drift lines	
1220	Boulder- and gravel dominated banks	0.1 ha
1230	Sea cliffs	
1239	Cliff shores	
1310	*Salicornia* seashores	0.1 ha
1330	Atlantic coastal meadows	0.1 ha
1610	Baltic esker islands	0.25 ha
1620	Baltic islets	0.1 ha
1630	Baltic coastal meadows	0.1 ha
1640	Sandy shores	0.1 ha
1952	Boulder or gravel on land upheaval coast	0.1 ha
2110	Embryonic shifting dunes	0.1 ha together
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	

2140	Decalcified fixed dunes with *Empetrum nigrum*	
2170	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariea)*	
2180	Wooded dunes of the Atlantic, Continental and Boreal region	0.25 ha
2190	Humid dune slacks	0.1 ha
9030	Primary successional forest on land upheaval coast	0.25 ha

2. Establishing a transect and identifying shore zones

The basis of the inventory is a 10 m wide transect starting at the mean water mark and extending through the geo- and supralittoral zones, hereafter referred to as the shore or the shore zone. If the shore includes a dune area, a boulder- or gravel dominated bank, land upheaval forest or a cliff, the transect extends above the shore. This part of the transect is referred to as the extralittoral zone, although the area itself is not part of the actual shore. Detailed inventory is performed throughout the transect. Some variables also call for inventory in the hydrolittoral zone beyond the starting point of the transect. Additional information is also collected in the area beyond the end point of the transect: photo documentation, determining Annex 1 habitat type and recording current land use.

2.1. Establishing a transect

The starting point of the transect is the mean water mark. The transect/measuring tape is then drawn more or less vertically from the water line, by moving perpendicular to the elevation lines. Mark the end points of the geo- and supralittoral zones. At the end of the supralittoral zone, determine if an extralittoral zone is present. If so, the transect ends at the upper boundary of the extralittoral zone. If no extralittoral zone is present, the transect ends at the upper boundary of the supralittoral zone.

1. Are any of the following Annex 1 habitat types present above the supralittoral zone: 1220 Boulder- and gravel dominated banks, 1230 Sea cliffs (including 1239 Cliff shores), 2100 Dunes or 9030 Primary successional forest of land upheaval coast? If so, the transect extends through the extralittoral zone. The transect then ends where another habitat type takes over, or at the highest peak on shallows, islets or capes.
2. If none of the above listed habitat types are present above the supralittoral zone, the transect ends at the upper boundary of the supralittoral zone.

Below is a description of how to delineate between zones and identify the start and end points of the transect.

2.2. Identifying shore zones

The shore zones are usually defined by the water level. However, since the water level varies, one or more indicators are needed in order to identify the mean water mark. Suitable indicators are determined by the shore type.

A combination of three indicators is generally used:

1. ***The water level.*** The current water level can be obtained from the sea level observations made by SMHI (http://www.smhi.se/vadret/hav-och-kust/havsobservationer/havsvst_tab.htm) and prognoses based on the HIROMB model for upcoming water levels found on the SMHI oceanic web page (http://produkter.smhi.se/OceanWeb/). Click on HIROMB followed by “Sea levels” and choose your nearest location on the provided map. A table of historic observations in water level variations at each location is provided in Appendix 1.
2. ***Organisms.*** On certain shores, specific grass species can be used as indicators of the mean water level. Most grasses will not grow below the mean water level (with exception for the common reed, *Phragmites australis*). On the Swedish west coast, barnacles are a clear

indication of the mean water mark. On the northern coast, the distance between a visible black zone and macrophytic green algae such as *Cladophora glomerata* may be used for this purpose.

3. ***Structures.*** On sandy shores and coastal meadows, erosion structures and drifts present at the time of inventory may be used as delineators between e.g. the hydro- and geolittoral zones, or the geo- and supralittoral zones.

2.2.1. Identifying the transect starting point

The starting point of the transect is placed at the mean water mark. Check the daily water level in order to estimate if the water line is higher or lower than the mean water level. Also consider the time of day in areas with apparent tidal fluctuations.

Cliff/rock/gravel shores on the mainland or islets in the Gulf of Bothnia

The mean water level is assumed to lie just beyond the outermost specimens of *Calamagrostis stricta,* while individual tussocks of *Deschampsia bottnica* may occur further into the water. Time of day may be important to consider in areas with apparent tidal fluctuations.

Cliff shores on the west coast

Barnacles are a clear indication of the mean water mark, which is located in the lower part of the barnacle belt. Green and brown algae mostly grow below the mean water mark.

Other cliff shores

Barnacles and algae can – if present – also be used as mean water level indicators on the east coast. If they are absent, the mean water level is found at the lowest point of the black zone.

Certain coastal meadows on the west coast and along the Baltic coast

Combinations of 1: dense vegetation of e.g. *Pucinellia* species (constituting a dense field layer which extends to just above the mean water mark) and if present, 2: barnacles (which may occur on boulders/rocks at approximately the mean water mark). In other cases, see above, concerning *Calamagrostis stricta* and *Deschampsia bottnic.*

Sandy shores

Finding a suitable and clear indicator for the mean water mark on sandy shores is difficult (figure 3). The starting point of the transect should be positioned somewhat above any visible wave erosion bank in the hydrolittoral zone, i.e. above structures formed by waves on the sea bed (e.g. ripple marks). When the tide pulls back, drift lines remain and the starting point should therefore be positioned below a drift that has been deposited on the same day, while considering any deviations of the current water level.

2.2.2. Identifying the end of the geolittoral zone

On coastal meadows and sand- or gravel shores, the upper boundary of the geolittoral zone (the terrestrial shore) is defined by the high water mark. On cliff shores, this line is defined by the high water mark created by wave fluctuations. Thus, the “proxy” (or type of indicator) will vary depending on shore type and vegetation. Appendix 1 shows how high above the mean water level the high water usually rises.

Cliff shores

The end of the geolittoral zone coincides with the upper boundary of the black zone.

Sandy shores

The upper boundary of the geolittoral zone is usually vague. Structures on the shore may change on a daily basis depending on wind and wave movement.

Other shore types

Drift lines may indicate the border between the geo- and supralittoral zones. Sizeable drift lines are deposited by waves above the high water mark and consequently the upper boundary of the geolittoral zone is located just below a large drift line. These drift lines may remain several years (but may be moved during extreme high water) and are important structures for plant colonization.

2.2.3. Identifying the end of the supralittoral zone

The upper boundary of the supralittoral zone is found where storm waves, extreme high water or splashing no longer affects the environment. Appendix 1 shows how high above the mean water level the extreme high water (the highest high water) usually rises. However, storm waves may reach higher up on the shore than extreme high water.

Sand/gravel/rock/cliff shores and coastal meadows

The upper drift line, i.e. the extreme high water mark, can be used as an indicator of the high water mark and thus the upper boundary of the supralittoral zone. *NOTE: The entire drift line is included in the shore and consequently also in the supralittoral zone.*

Sandy shores transforming into dunes

The upper boundary of the supralittoral zone is located at the more or less distinct erosion bank just below the first dune with perennial vegetation (figure 3).

Cliff/bare rock shores

The supralittoral zone begins just above the black zone. Then follows several more or less developed zones:

*The **orange belt*** consists of orange lichens which may occur in the uppermost part of the black zone (affected by waves during a majority of the day). The orange belt is distinct on the west coast, but becomes more and more diffuse as the water becomes less salty on the east coast.

The following ***bare zone*** is often very clear on cliff shores. Waves have a profound influence on this zone, but the area is usually completely dry. The upper boundary of the bare zone is found where lichens start to form more or less well-developed colonies.

Above the bare zone is the ***upper supralittoral zone***. The vegetation in this zone consists of lichens, e.g. *Xanthoria parietina*, orange lichens (genus *Caloplaca*), *Anaptychia runcinata*, genus *Ramalina* and salt-tolerant grey crustose lichens.

At the ***upper boundary*** of the supralittoral zone, salt-sensitive yellow map lichens (genus *Rhizocarpon*) and genus *Lasallia* are found. In some cases where the cliff levels

out, drift lines formed by storm waves may occur in the supralittoral zone. A combination of lichen species composition and drift lines can be used in order to define the upper boundary of the supralittoral zone. Note that the end of the supralittoral zone within the transect always reaches above the bare zone.

2.2.4. Identifying the extralittoral zone and its boundaries

If dune areas, rock- or gravel drifts, primary successional forest on land upheaval coast or sea cliffs/cliff shores are found above the supralittoral zone, these are inventoried within a part of the transect called the extralittoral zone. Per definition, primary successional forest on land upheaval coast ends at 3 m above sea level, but depending on the incline, this transect area may be quite extensive. The same may be true of a transect in a dune area. The upper boundary of the extralittoral zone is found where the extralittoral habitat type changes into a different habitat type (fulfilling the criterion for smallest mapping unit). Note: if the extralittoral habitat type is interrupted by a smaller area (e.g. a residential area) but continues beyond this area, the transect is also continued.

The inventory transect is extended into the extralittoral zone since the habitat types found in these areas are difficult to incorporate in other types of national inventory (i.e. NILS, the National Forest Inventory and MOTH sample plot inventory).

The end of the extralittoral zone is marked and should be visible on the photo documentation recorded in the direction of the transect, overlooking the area above the transect.

2.3. Criteria for islet as separate units

No sample points should have been selected if located on a shallow (< 0.1 ha) or an islet (≥0.1 ha to < 0.25 ha). The selection of sample points is normally limited to the mainland or islands.

If the sample point nevertheless is located on a shallow (< 0.1 ha) or an islet (≥0.1 ha to < 0.25 ha), the following should be considered:

- If the distance to the mainland (or another islet/island) is at most 2 m, the islet is considered to belong to the mainland. The transect continues over the islet and up towards the high water mark of the mainland/island.

- If the distance to shore is more than 2 m at mean water level, please *call the office* for a discussion.

3. The computer program “Strand”

Below is an explanation of the symbols in the computer program “Strand” (eng: Shore), used in the MOTH seashore inventory.

Grey triangle in the right corner	Scroll-list: choose option
?	Yes or No
Pencil	Field for entering text/numbers
List	Variable description followed by a scroll-list with options

Long, grey box/row Continue to sub-menu

3.1. Start view: Sample plot identity and inventory status

When the program starts, the current version of the Strand program is shown, as well as entry fields for Team number, Inventory person, Landscape square and Sample plot.

When Landscape square and Sample plot have been entered, a box will be shown with the generated sample plot ID and the status "new". The sample plot ID consists of 11 digits, denoting Year (4), Landscape square (4) and Sample plot (3).

In the box with the sample plot ID, inventory type is chosen from the scroll-list.

- Inventory type is recorded according to the same criteria as in NILS (chapter 4.3 version 2014), with the addition of the option "Not inventoried".
- Enter inventory type as follows:
    1. **Inventoried in the field.** Normal field inventory of the entire transect.
    2. **Inventoried from a distance.** Only entered if the transect is inventoried from a distance.
    3. **Not inventoried.** Only entered if the transect is not inventoried at all. A photograph is taken towards the area and the reason for not inventorying the transect is noted.
    4. **Finished.** Entered when the sample plot is complete.

- When the choice is made, press "Utför" (Eng: execute) to start the inventory or move forward in the program. Simultaneously, the transect status is changed to either "Started (normal)", "Started (distance)", "Started (not inventoried)" or "Finished (normal)".

Table 3. Reasons not to perform field inventory of the transect.

Reasons not to perform field inventory of the transect	
05 No, temporarily flooded >30 cm	The sample plot/section cannot be visited. No further inventory.
06 No, inaccessible wetland	The sample plot/section cannot be visited for safety reasons, (quagmire etc.), determined from the edge of the sample plot/section. No further inventory.
07 No, field with annual crops	Growing or newly seeded annual crop or recently plowed. The sample plot/section cannot be visited. No further inventory.
08 No, hayfield	Field with seeded hay crop, regularly plowed, harvested (not grazed). The sample plot/section cannot be visited. No further inventory.
09 No, inaccessible non-arable outcrop	The sample plot/section cannot be visited. No further inventory.
10 No, island less than 0,1 ha	The island is not visited. No further inventory.

11 No, inaccessible steep terrain	Steep or impassable terrain. More than 25 degree angle for areas with rocks, bare bedrock etc. More than 35 degree angle for overgrown well rooted perennial vegetation.
12 No, risk of landslide	Land with obvious risk of landslide or erosion etc.
13 No, built-up area, industrial site	Fenced in or in other ways privately owned land close to housing or other construction, industrial land etc. that cannot be visited.
14 No, no trespassing	Land with no trespassing, e.g. military areas.
15 No, other reason (file report)	A written non-conformance report must be submitted.

3.2. Photo view

In order to describe the transect, it must first be established. The starting point along the shore line is determined by using the aerial photograph. The different zones along the measuring tape are marked (e.g. with wooden sticks) and the GPS-coordinates are fixed in the hand-held computer. The transect is photo-documented from different directions. Also, the areas beyond the transect are photo-documented, both towards the sea and towards land.

Note: Drift lines are documented in a separate menu. If a drift line is present, the photograph is taken lengthwise. Two drift lines may be recorded per transect.

- ***GPS easting/GPS northing:*** Use the GPS in the hand-held computer and fix the coordinates of the transect starting point. Enter the numbers with meter-accuracy. *Note: The SWEREF coordinate system is used during shore inventory. If the GPS in the hand-held computer is out of order (or takes too long to stabilize), use the "normal" GPS and enter the values in a non-conformity report ("blålapp", Eng: blue form) available at the top right corner in every menu in the inventory program.*

- ***Bearing:*** Compass bearing along the transect (from start to finish) is recorded in whole degrees. Use a 360 degree compass.

Photographs

In order to illustrate the extent of the transect, the mid-point is marked with the measuring tape. All photographs should be taken with landscape orientation, in order to show as much of the surroundings as possible while documenting the transect. Branches blocking the camera view should be held back. The images are numbered in the hand-held computer. If another camera is used, note which images belong to which view in a non-conformity report (blue form). It is vital that the images are saved in this manner to facilitate the post-production of saving and storing the images. Make sure that the images are clear and sharp and that there are no water drops on the camera lens.

1. ***OUT (view towards the sea).*** A landscape view showing as much of the water as possible. If possible, the photograph should also show the transect starting point (marked with a stick) and 5 m on either side. The purpose of his image is to show the exposure of the shore, and if there are jetties/piers etc. It is also used as an aid in finding the starting point at re-inventory

or control inventory.

2. ***Left (view from the left side).*** A landscape view from the left side (as seen from the starting point). *The transect starting point should be visible in the right side of the image.* If the water level is low and the water is shallow, the water line may be a long way out. In this case, it is more important that the image depicts the starting point of the transect rather than the actual water line.

3. ***Up (view towards land).*** Take a photograph towards land when standing at the starting point of the transect (depicting the geolittoral zone).

4. ***Right (view from the right side).*** A landscape view from the right side (as seen from the starting point). *The transect starting point should be visible in the left side of the image.*

5. ***SUP (the supralittoral boundary).*** At the border between the geo- and supralittoral zones, a photograph is taken towards land, depicting the supralittoral (and possible extralittoral) zone.

6. ***End (above the transect).*** A landscape view photographed towards the end point of the transect when standing in the supralittoral zone (or, if present, the extralittoral zone). If possible, the photograph should show the transect end point (marked with a stick) and 5 m on either side. The purpose of this image is to show what lies beyond the transect, and can also be used to find the end point at re-inventory or control inventory. Adjust the camera position if the view is obstructed or the perspective is skewed.

3.3. Zone view

The zone view contains ten menus: four in which the different transect zones are described (the hydro-, geo-, supra- and extralittoral zones), and six detail menus where objects are recorded by their distance from the transect starting point or by their area cover (often in m^2) within the transect. By clicking on a menu box, the variables to be recorded are shown. Some variable lists are recurring in several menus (e.g. Substrate and Species, which are recorded in all transect zones).

3.3.1. Hydrolittoral zone menu

- ***Shore type.*** Choose the dominating shore type in the area around the sample plot/starting point.
    - Cliff/bedrock
    - Boulder/gravel
    - Sand
    - Coastal meadow/wetland
    - Man-made/constructed

- ***Coast type.*** Enter type of coast where the sample plot is located.
    - Mainland
    - Island (≥ 2 ha)

- Islet (≥ 0.1 to < 2 ha)
- Shallow (< 0.1 ha)

- ***Wave exposure.*** Consult the wave exposure map and estimate if the model value class is realistic.
  - Ultra-sheltered
  - Extremely sheltered
  - Very sheltered
  - Sheltered
  - Moderately exposed
  - Exposed
  - Very exposed
  - No change

- ***Water depth.*** Stand at the marked mean water level and measure the water depth at 3 m out into the water. If the current water level is 2 dm below normal, add 2 dm to the measured depth. Avoid measuring on single, large rocks or boulders on the bottom. Round off to nearest 0.1 m. *Note: This estimation of water depth is somewhat different than in NILS. The water depth in seashore inventory is estimated in relation to the mean water mark (not in relation to current water level as in the NILS inventory).*

- ***Jetty/pier within 30 m.*** Inventoried in the extension of the transect (into the water). Answer yes or no.

- **Phragmites *belts*.**
  - **Length of *Phragmites* belt.**
    The total length of the reed belt is estimated from the transect extension in the hydrolittoral zone (*Phragmites* extending outside the hydrolittoral zone is also included) and up onto the shore. Round off to nearest meter.
  - ***Phragmites* area cover.**
    Estimate the area cover in % within the area (length) entered above. The density may vary.

3.3.2. Geo-, supra- and extralittoral zone menus

These three menus are identical.

- ***End distance.*** The distance is measured with the Vertex or a measuring tape in the horizontal plane from the transect starting point to the end of the current zone. If the distance is great (>100 m), the GPS accuracy is sufficient. For distances shorter than 1 m, round off to the nearest 0.1 m (primarily small zones).

- ***Incline.*** The incline per zone is measured from the top down to the boundary of the zone "below". Use the Vertex and enter whole degrees.

- **Geolittoral zone incline**
  Measured from the top of the geolittoral zone to the transect starting point.

- **Supralittoral zone incline.**
  Measured from the top of the supralittoral zone to the top of the geolittoral zone (on cliff shores, the area measured includes the orange belt, the bare zone and the upper supralittoral zone).

- **Extralittoral zone incline.**
  Measured from the top of the extralittoral zone to the top of the supralittoral zone.

- **Land use.** Estimate the dominating land use/land type for the geo-, supra- and extralittoral zones respectively. The area above the transect is also inventoried and land use is recorded (as specified in the Annex 1 habitat type menu). Choose the appropriate land use from the provided list. "Land use" (table 4) is a combination of codes used in the menu Land use in NILS (2014). The first number represents the NILS variable "Main type" and the second number represents Land use. Shaded fields in the table represent combinations of Main type and Land use which are unlikely to occur on shore habitats. However, if the combination should exist, the code is used.

- **Cover of field vegetation.** This variable refers to strict cover (in %) of all vegetation in the field layer (including herbs, ferns, dwarf shrubs and graminids). Cover is estimated for each zone respectively (i.e. the geo-, supra and extralittoral zones). All living leaves and shoots are included, as well as recently yellowed/dead parts. Note: Graminid litter is not included.

- **Cover of trees.** This variable refers to diffuse canopy cover (in %) for each zone respectively. All trees taller than 0.5 m are included.

Table 4. Combined Main type and Land use. The shaded combinations are unlikely to occur on sea shores.

Code	Combined Main type and Land use	Geo	Supra	Above
10	Arable land - Fallow/no visible land use			
11	Arable land – Recently plowed/seeded			
12	Arable land – Annual crops			
13	Arable land – hay field/ley			
14	Arable land – Grazed land			
15	Arable land – Energy forest			
16	Arable land – Fruit/berry plantation			
20	Man-made/paved land – No visible land use			
21	Man-made/paved land –Allotment garden			
22	Man-made/paved land –Recreation (man-made)			
23	Man-made/paved land – Residential area (at most 5 houses)			
24	Man-made/paved land – Urban area (at least 6 houses)			
25	Man-made/paved land – Farm buildings			
26	Man-made/paved land – Industrial park			

27	Man-made/paved land – Transport area			
28	Man-made/paved land – Current exploitation/road/building site			
30	Forest – Potential forestry, no signs			
31	Forest – Forestry			
32	Forest – Forestry, conservation area			
33	Forest – Clear-felled area			
34	Forest – Seed orchard			
35	Forest – Power line corridor			
36	Forest – Forest grazing (forestry included)			
37	Forest – Recreation (forestry included)			
38	Forest – Newly planted fields			
40	Other/natural land use – No visible land use			
41	Other/natural land use – Animal husbandry (natural)			
42	Other/natural land use – Animal husbandry (fertilized)			
43	Other/natural land use – Hay-making/mowing			
44	Other/natural land use – Recreation (natural)			
45	Other/natural land use – Residential area (natural)			
46	Other/natural land use - Excavation			
50	Water			

3.4. Substrate menu

The aim of the variables included in this menu is to describe the substrate of what the shore consists (table 5). This primarily refers to the inorganic substrate. However, on certain coastal meadows or wetlands with thick organic materials, the soil probe does not reach the mineral soil. In MOTH shore inventory, no distinction is made between types of organic materials (compare to classes in NILS) and this type of ground is classified simply as “organic. The composition of the substrate is estimated in %, where all included classes must add up to 100 %. In the menu “Substrate”, the percent distribution within each zone may either be entered numerically, or by moving the marker of each substrate until the proportions seem correct. A combination of these methods may also be used. The option “finjustering” (Eng: fine adjustment) may be used in order to achieve the total sum of 100 %.

- ***The hydrolittoral zone (hydro).*** This refers to an estimate of the bottom type/bottom substrate from the water line and 3 m out into the water. Estimate the percentage of the different substrate classes listed in table 5. The total sum of all classes should be 100 %. While estimating substrate, it is important to remember the purpose of the variable. The characterization should be as accurate as possible and it is most important to determine the dominating substrate. If clams (freshwater or marine) or barnacles are found on the substrate, they are not included in the estimation. If this is the case, a non-conformity report (blue form) should be submitted.

- ***The geolittoral zone (geo).*** This refers to an estimate of the shore substrate from the mean water mark (the transect starting point) to the upper boundary of the geolittoral zone. While estimating substrate, it is important to remember the purpose of the variable. The characterization should be as accurate as possible and it is most important to determine the dominating substrate. Estimate the percentage of the different substrate classes listed in

table 5.

- ***The supralittoral zone (supra).*** This refers to an estimate of the shore substrate from the upper boundary of the geolittoral zone to the upper boundary of the supralittoral zone. While estimating substrate, it is important to remember the purpose of the variable. The characterization should be as accurate as possible it is most important to determine the dominating substrate. Estimate the percentage of the different substrate classes listed in table 5.

Table 5. Substrate classes are estimated for each zone respectively.

Estimate in %	Substrate	Description
0-100%	Organic	Used when abundant vegetation, leaves, branches, peat etc. obscure the inorganic substrate
0-100%	Clay	<0,02 mm φ
0-100%	Sand	0,02-2 mm φ
0-100%	Gravel	2-20 mm φ
0-100%	Rock	20-200 mm φ
0-100%	Boulder	> 200 mm φ
0-100%	Bedrock	>4000 mm φ
0-100%	Artificial	Other type of artificial substrate (concrete, asphalt etc).

Control function: All classes should add up to 100 %.

3.5. Presence of species

Presence of species according to the provided list is recorded. Some species also call for additional information, i.e. number of plants, number of tussocks or total area cover. Area cover is recorded in m^2, with 0.1 m^2 as the finest fraction. Only species found within the transect boundaries are recorded. Note if they occur in the geo-, supra- or extralittoral zones.

If drift lines are present, only species occurring on drift lines intersecting with the mid-point of the transect are recorded. In the geolittoral zone, such occurrences are recorded twice: presence is noted both in the drift line and geolittoral zone columns.

If a species is present on a drift line not intersecting with the mid-point of the transect, this species is only recorded in the appropriate shore zone column (i.e. the geo- or supralittoral zones).

Roegneria canina is new to the species list. *Puccinellia capillaris* and *P. distans* are recorded as a group. The three yellowish *Racomitrium* mosses found on shores are also recorded as a group; *Racomitrium canescens* coll.

Note: Species occurring on drift lines intersecting with the transect mid-point are recorded twice, i.e. as occurring on the drift line and as occurring in the geo-/supralittoral zone.

3.6. Shrub menu

The aim is to describe the composition of the vegetation in the transect. The cover of the field- and tree layer is recorded in the zone menu for each zone respectively. A detailed description of the shrub cover is recorded specifically in the menu "Buskarter" (Eng: shrub species) rather than for the entire transect. Shrubs are inventoried by measuring length (m), width (m) and density (%), as well as the distance from the transect starting point for each individual thicket (and species).

The shrub "species" in question are found in table 6. Enter name and cover for each shrub type respectively. Measure the distance from the transect starting point/the mean water mark, the width and length (in m^2 with 2 decimals) and the cover density (in whole %) for each individual thicket (and species). The distance is recorded in meters from the transect starting point.

Table 6. Shrub species

Code	Shrub type	Code	Shrub type
00	Dead deciduous shrubs	35	*Crataegus spp.*
01	*Juniperus communis*, living	36	*Prunus spinosa*
02	*Juniperus communis*, dead	40	*Cytisus scoparius*
10	*Salix* (partly)	50	*Evonymus europaeus*
11	*Salix myrsinites*	51	*Rhamnus catharticus*
12	*Salix glauca/lanata/lapponum*	52	*Frangula alnus*
13	*Myrica gale*	60	*Daphne mezereum*
14	*Betula nana*	61	*Hippophae rhamnoides*
15	*Corylus avellana*	70	*Cornus sanguinea*
16	*Berberis vulgaris*	71	*Cornus alba ssp. stolonifera*
20	*Ribes* (partly)	72	*Hedera helix*
21	*Ribes uva-crispa*	80	*Ligustrum vulgare*
22	*Ribes alpinum*	81	*Syringa vulgaris*
25	*Spiraea spp.*	85	*Sambucus racemosa*
26	*Rubus idaeus*	86	*Sambucus nigra*
27	*Rubus caesius*	87	*Viburnum opulus*
28	*Rubus* (partly)	88	*Symphoricarpos rivularis*
30	*Rosa* (partly)	90	*Lonicera periclymenum/caprifolium*
31	*Rosa rugosa*	91	*Lonicera xylosteum*
32	*Potentilla fruticosa*	92	*Lonicera caerulea*
33	*Amelanchier spp.*	99	Other shrubs
34	*Cotoneaster spp.*		

3.7. Tree menu

A detailed description of the tree layer is made by calipering the diameter at breast height (DBH, i.e. 130 cm), counting seedlings taller than 50 cm but lower than 130 cm, and recording their positions in respect to the transect starting point.

3.7.1. Calipering (trees ≥10 cm DBH and < 10 cm DBH)

- The handle of the caliper should always point towards the mid-point of the transect.
- A tree is included if the growing point is located within the transect boundaries.
- Only living trees are counted and measured.

- Diameter at breast height (DBH) is recorded in mm.
- Measure the distance from the transect starting point. The distance is recorded in whole meters (e.g. a tree found between 9 and 10 meters from the transect starting point, is recorded at 10 m, and if a tree is found within 1 m from the starting point, it is recorded at 1 m).

3.7.2. Calipering large trees (≥ 10 cm DBH)

Large trees, i.e. with DBH more than 10 cm, are calipered only on the right side of the transect (as seen from the starting point, figure 4). This means that the left boundary of the caliper transect consists of the measuring tape marking the middle of the main transect, while the right caliper boundary coincides with the boundary of the main transect, 5 m from the center.

3.7.3. Calipering smaller trees (≥ 130 cm tall but < 10 cm DBH)

Smaller trees, i.e. trees with DBH less than 10 cm but at least 130 cm tall, are calipered in a 1 m wide transect, directly to the right (as seen from the starting point, figure 4) of the center of the main transect. This means that the left boundary of the caliper transect consists of the measuring tape marking the middle of the main transect, while the right boundary is 1 m to the right. The distance from the transect starting point is recorded (in m). Caliper data is recorded in mm.

3.7.4. Calipering small trees (between 50 and 130 cm tall)

These smaller trees are counted in the 1 m wide transect, directly to the right (as seen from the starting point, figure X) of the center of the main transect. This means that the left boundary of the caliper transect consists of the measuring tape marking the middle of the main transect, while the right boundary is 1 m to the right. The number of seedlings are recorded per species, and the distance from the transect starting point is recorded (in m). No caliper data is recorded since these trees are not tall enough to reach DBH.

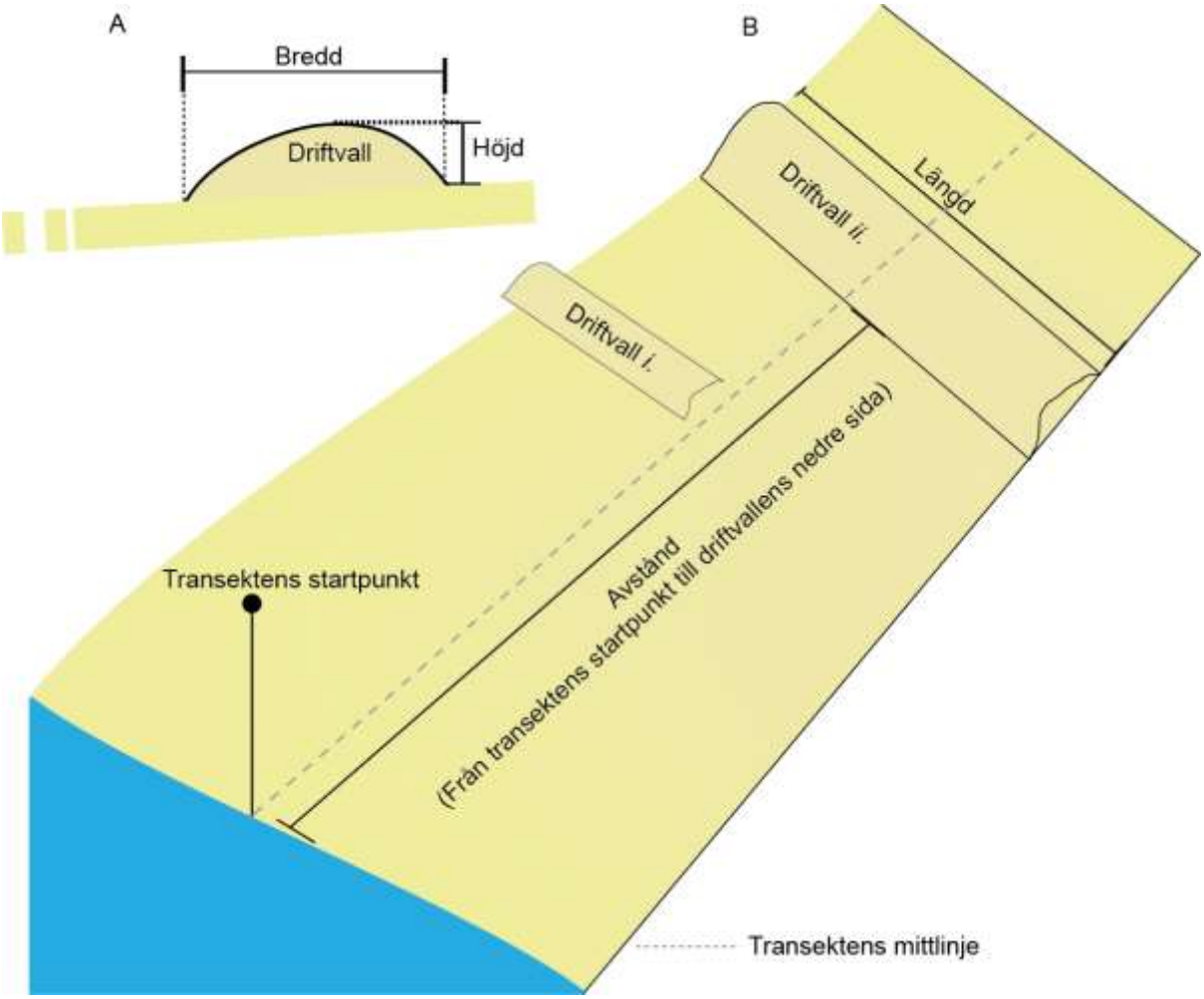

Figure 4. The correct way of measuring height, width, distance and length of the drift line. Drift line i. intersects with the transect mid-point and is included in the inventory. Drift line ii. is not included, since it does not intersect with the transect mid-point.

3.8. Drift line menu

This menu includes a detailed description of drift lines. Note: The drift line is only inventoried if any part of it intersects with the mid-point (i.e. the measuring tape) of the transect. If the drift line does not intersect with the mid-point, it is not included in the inventory. The distance from the transect starting point to the first drift line (measure to the lowest part of the drift line) is measured with the Vertex in the horizontal plane. Enter the distance to the nearest 0.1 m (i.e. with one decimal).

- The ***length***, ***width*** and ***height*** of the drift line are estimated (figure 4). The width and height are generally estimated where the drift line intersects with the mid-point of the transect. If this point of the drift line is not representative, the variables are instead estimated where the drift line intersects with the boundary of the transect, i.e. 5 m to each side. Width and height are entered with 0.05 m accuracy. Length is entered with an accuracy of 0.1 m and relates to the entire length of the drift line, including parts outside the transect itself (figure 4).

- The ***contents*** of the drift line are estimated over a 10 m stretch of the drift line, closest to the transect mid-point. The contents are estimated in volume percent in the following classes:
    1. Seaweed, 0-100 %
    2. Other vegetation (reeds, herbs, other algae, twigs etc.), 0-100 %
    3. Branches/twigs/driftwood, 0-100 %
    4. Plastic, 0-100 %
    5. Other waste, 0-100 %

- ***Vegetation*** on the drift line is entered in m^2, and includes annual and perennial plants living on the drift lines included in the transect.

- The transect is ***documented with a photograph***.

- Repeat for the next drift line.

Species on drift lines are recorded in the species list (see chapter 4 below). *Note:* Species occurring on drift lines are recorded twice, i.e. as occurring on the drift line and as occurring in the geo-/supralittoral zone.

3.9. Deposition/accumulation menu

Area cover of deposited and accumulated materials is estimated for the entire transect. Drift lines are included even if they have been recorded separately (see above). Strict cover is estimated in m^2 (with 0.1 m accuracy for areas smaller than 1 m^2). Very small areas (< 0.1 m^2) are recorded as 0.1 m^2. Small areas of the same fraction are added together and entered with 0.1 m^2 accuracy if the sum is below 1 m^2. Areas between 1-3 m^2 are entered with an accuracy of 0.5 m^2. For larger areas, 1 m^2 accuracy is sufficient.

3.10. Annex 1 habitat type

The distance to the transect starting point is measured for all habitat types occurring within the transect. Furthermore, the habitat code for the area just above the transect is also recorded.

3.10.1. Annex 1 habitat types within the transect

The distance to the transect starting point is measured for all habitat types occurring within the transect. Observations and estimations are performed in the area within and around the transect.

1. **Use the classification key** provided in the "Instruction for Inventory of Habitats in NILS and MOTH". However, there are two exceptions:
    i. Dune habitats are only classified as Dunes (2100). A detailed classification of dune habitats is made further on.
    ii. For sample plots on Baltic esker islands (1610) or Baltic islets (1620), note if the transect is located on an island, islet or a shallow in Coast type (see chapter 3.1.

Sample plot identity and inventory status). Continue with the classification into a single habitat type.

2. Read the **habitat type description**.

3. Estimate if the criterion for the **smallest mapping unit** is fulfilled. If not, see below.

4. Estimate if the habitat type fulfills the **criteria for natural conditions**. If not, and the habitat code 9999 is entered, the program will prompt for a reason. Choose one or more reasons in the provided list.

5. **Choose habitat code** in the scroll-list. The habitat type is always entered as if on the mainland, i.e. classified as a single habitat type (see 1. above).

If a habitat type within the transect does not fulfill the criterion for smallest mapping unit, it is included in the surrounding habitat type. For instance: The first few meters of the transect are located on a sandy shore, but the entire expanse of the sand is smaller than 0.1 ha. The sand part of the shore is then merged with e.g. the surrounding moraine shore for classification purposes.

In the hand-held computer:
Enter the distances (in meters, with one decimal accuracy) in the horizontal plane of the transect between which a specific habitat type is present. Choose the appropriate habitat type in the scroll-list and press "+" in order to enter start- and end positions. The first habitat type chosen will automatically feature the start position 0 m. If more than one habitat type is found within the transect, the procedure is repeated (choose habitat type, press "+" and enter distances). One transect may intersect with several habitat types, e.g. a boulder or gravel shore on land upheaval coast (1952) followed by a Baltic coastal meadow (1630).

Important notes!

- *The area just above the transect is always classified and the habitat code is entered in the computer program. However, detailed inventory in the extralittoral zone is only performed if one of the following habitat types are present above the supralittoral zone: Boulder- and gravel dominated banks (1220), Sea cliffs (1230, including 1239 Cliff shores), Dunes (2100) or Primary successional forest of land upheaval coast (9030). The transect is then extended until this habitat type is replaced. Sea cliffs (1230) are an exception, and are included even if they occur further away and with no direct contact with the end point of the transect.*

- *In most cases the shore fulfills the criteria for an Annex 1 habitat type. Only a few shore types will be excluded, for instance a man-made/artificial shore or a shore completely covered in reeds.*

- *Even if there are "only" low smooth rock surfaces or cliffs, these are classified as Cliff shores (1239).Remember to also estimate their height (i.e. "Tallest cliff in the transect").*

3.10.2. Habitat type above the transect

Enter the code for the habitat type directly above the transect. All habitat types (except those found in alpine regions) may be present. Consider the criteria for smallest mapping unit, natural conditions and possible deviations from the habitat descriptions. Consult the field manual “Instruction for Inventory of Habitats in NILS and MOTH”.

3.10.3. Non-Annex 1 habitat type (code 9999)

If code 9999 is used, the reasons for this are recorded. The reasons listed are based on the criteria for natural conditions for each habitat type.

Note: The same list of reasons is shown if the habitat type above the transect is entered as 9999. However, the reasons may be quite different (e.g. the forest may be naturally regenerated but the age criterion, the layering or the amount of dead wood is not sufficient). If the listed reasons are inadequate, other reasons may be submitted on a non-conformity report (“blue form”, available at the top right corner in all views in the Strand-program).

3.10.4. Detailed classification of dune habitats (2100)

Dunes occur above the actual shore zone, in the extralittoral zone (figure 3 and 5). Dunes are mostly formed by wind and often consist of a mosaic of different dune habitats (table 7, figure 5). Young dunes are often relatively white or pale in color (containing few humus particulates). They may also be sparsely colonized by vegetation resistant to sand movement, mainly *Leymus arenarius* and *Ammophila arenaria*, and correspond to the dune habitat “Shifting dunes along the shoreline with *Ammophila arenaria* (White dunes) (2120)”.

With time, the dunes are stabilized by vegetation and leaching occurs in the top layers, giving the sand a greyish hue. Dunes covered with vegetation are classified by the dominating plant species (see the Instruction for Inventory of Habitats in NILS and MOTH). Along the transect, diffuse cover and expanse (i.e. distance in meters along the measuring tape) is estimated for each dune habitat.

Presence of dunes within the transect is recorded in the variable “Habitats in the transect”. Subsequently, the entry field for “dune habitats” is shown, and inventory is performed in the same manner as for habitats above the transect: Choose the appropriate habitat type in the scroll-list and press “+” in order to enter start- and end positions. If more than one dune habitat type is found within the transect, the procedure is repeated. After each recorded habitat type, the distance is added to the total distance of Dune habitats (2100) in the “Habitats in the transect”-list. Note: The habitat type Embryonic shifting dunes (2110) should never be entered, since it is both a temporary habitat type and also not occurring in the extralittoral zone.

The amount of bare sand is also recorded (in meters along the transect). Add up the total distance of bare sand along the measuring tape. The entered value should represent the amount of sand in the dune area.

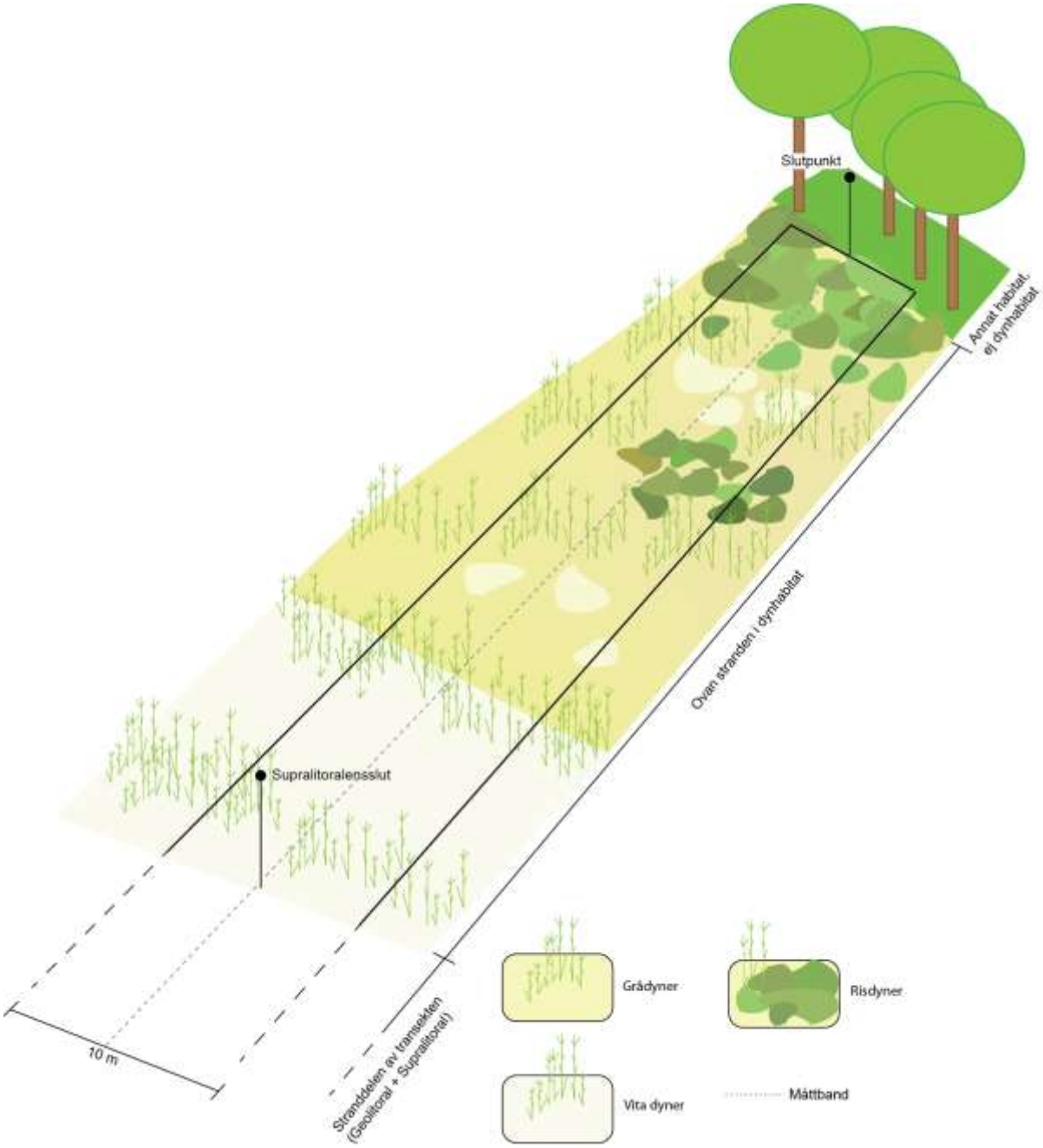

*Figure 6. Transect showing how dune habitats may succeed one another within the extralittoral zone. The distribution of dune habitats is estimated as the distance along the measuring tape (the transect mid-point) for each habitat type. Bare sand within the dune area is estimated in the same manner. The end-point of the transect is found where the dune area ends (in this case at the perimeter of a forest **not included** in the habitat type Wooded dunes of the Atlantic, Continental and Boreal region (2180)).*

Code	Dune habitat	Smallest mapping unit
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	0.1 ha together
2130	Fixed coastal dunes with herbaceous vegetation (grey	

	dunes)	
2140	Decalcified fixed dunes with *Empetrum nigrum*	
2170	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariea)*	
2180	Wooded dunes of the Atlantic, Continental and Boreal region	0.25 ha
2190	Humid dune slacks	0.1 ha

3.11 Other variables

The aim for the variables in this section is to describe the human impact on the shore. This is a complement to the information recorded in Land use in the different transect zones.

- ***Recreation (table 8).***If any of the land use types involving recreation is found within the transect, the type of recreation is recorded. If recreation is absent, this section is omitted.

- ***Clearing/thinning.*** Estimated throughout the entire transect. Type of clearing is chosen from the provided list. This includes all manner of removal of trees and shrubs (as well as road-side mowing if wooded plants are affected). If both small and large trees have been removed, the dominating category is entered (with regard to area cover). The delineator between small and large trees is a stump diameter of 10 cm. Heavy clearing requires removal of more than 50 % of the trees/shrubs, while light clearing calls for removal of 5-50 %. If the area has been kept open during a long period of time (continuous clearing), stumps may not be found. Compare with adjacent, similar areas in order to ascertain if trees or shrubs would have been present in the area without active removal.

- ***Time of clearing/thinning.*** Estimate the timing of when removal of trees or shrubs has been performed according to table 10.

- ***Tallest cliff in the transect.*** If the habitat type Sea cliffs (1230) or Cliff shore (1239) is found within the transect, the height and incline of the tallest cliff are estimated. *Even if there are "only" low smooth rock surfaces or cliffs, these are classified as Cliff shores (1239, and "Tallest cliff in the transect" is recorded. Note: Sea cliffs fulfilling the criteria for natural conditions are included even if they occur with no direct contact to the end point of shore.*

- ***Fence.*** Is any type of fence or stone wall present within the transect? Enter yes or no.

Table 8. Type of recreation.

Code	Type of recreation	Description
1	Bathing site	Cleared natural ground, man-made and/or paved ground in

		a fenced in area, or area frequently used for bathing.
2	Golf Course	Cleared natural area, man-made and/or paved ground within a golf course.
3	Camping site	Commercial or otherwise designated site used for camping, e.g. nature reserve or open air area.
4	Ski slope	Cleared or man-made area used for downhill skiing, often with ski-lifts.
5	Other sport/exercise area	Other sport or exercise area, such as jogging tracks, soccer fields or tennis courts.
6	Park	Large green recreational area close to built-up area or manor house that often contains different sizes of man-made areas, lawns, planted trees etc.
7	Other recreational area	Other area permanently reserved for recreational use.

Table 9. Type of clearing/thinning

Code	**Type of clearing/thinning**
0	No clearing /thinning ≤ 5 %
1	Heavy clearing of large trees, ≥ 50 %
2	Light clearing of large trees, 5-50 %
3	Heavy clearing of small trees, ≥ 50 %
4	Light clearing of small trees, 5-50 %
5	Heavy clearing of shrubs, ≥ 50 %
6	Light clearing of shrubs, 5-50 %

Table 10. Time of clearing/thinning

Code	**Time of clearing/thinning**
00	Current year or season
01	Last year or season
02	Year or season 2
05	Year or season 3-5
06	> 5 years

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Appendix 1. Water level variation

Table A1. The water level variation registered at different monitoring stations (Swedish Maritime Administration 1992). Water level (cm).

Station	HHVi	MHVi	MVi	MLVi	LLVi
Kalix(1974-1983)	+181	+100	0	-80	-140
Furuögrund(1916-1981)	+153	+79	0	-70	-120
Ratan(1892-1983)	+137	+78	0	-70	-122
Draghällan/Spikarna(1898-1983)	+132	+68	0	-56	-90
Björn(nedlagd)(1892-1975)	+136	+73	0	-52	-81
Forsmark(1889-1983)	+160	+75	0	-55	-90
Stockholm(1889-1983)	+120	+61	0	-46	-68
Landsort(1887-1983)	+99	+54	0	-44	-68
Marviken	+101	+60	0	-45	-75
Visby	+88	+48	0	-40	-70
Ölandsnorraudde(1887-1983)	+135	+65	0	-42	-80
Kungsholmsfort(1887-1983)	+133	+74	0	-65	-94
Simrishamn	+160	+85	0	-85	-135
Ystad(1887-1983)	+167	+90	0	-93	-144
Klagshamn	+140	+86	0	-74	-102
Viken	+160	+90	0	-70	-120
Varberg(nedlagd)(1887-1980)	+145	+96	0	-64	-116
Ringhals	+145	+95	0	-65	-120
Göteborg/Torshamnen	+150	+100	0	-70	-120
Smögen(1911-1983)	+148	+94	0	-69	-112
Kungsvik	+150	+100	0	-70	-120