

# Visualizing the data

2.0

2024-09-11

```
library(terra)
```

```
## terra 1.7.78
```

## load in the datasets

New Hanko data

```
hanko2 <- read.csv("../data/hanko2/velmu.to.Obama.2024-09-05.csv", header = TRUE)
```

```
head(hanko2)
```

```
##      X ID      sal surf_expo      turb seashare depth_classes      ruov
## 1 66  1       NA        NA       NA        NA       NA       NA
## 2 67  2 5.789645       0 0.8166231 0.7780032       1 2.963745e-05
## 3 68  3 5.789249    83380 0.8146456 0.7769692       1 0.000000e+00
## 4 69  4 5.789249    83380 0.8146456 0.7769692       1 0.000000e+00
## 5 71  5 5.759631   204020 1.0428280 0.8691219       2 0.000000e+00
## 6 72  6 5.759962   212604 1.0429304 0.8696885       2 0.000000e+00
##      scientificName RecordID     Method      Date Project SamplingDesign
## 1 Acrosiphonia arcta 648001 Transect 2012-09-06 Velmu          5
## 2 Acrosiphonia arcta 648002 Transect 2012-09-06 Velmu          5
## 3 Acrosiphonia arcta 648015 Transect 2012-09-06 Velmu          5
## 4 Acrosiphonia arcta 648016 Transect 2012-09-06 Velmu          5
## 5 Acrosiphonia arcta 723924 Transect 2020-09-01 Velmu          5
## 6 Acrosiphonia arcta 723936 Transect 2020-09-01 Velmu          5
##      LooseSurfaceSediment TransectId Cover Group      MethodCategory Source
## 1                      1       614373  5.0 Algae Vegetation mapping LajiGIS
## 2                      1       614373  5.0 Algae Vegetation mapping LajiGIS
## 3                     NA       614373  0.1 Algae Vegetation mapping LajiGIS
## 4                     NA       614373  5.0 Algae Vegetation mapping LajiGIS
## 5                      0      672237 10.0 Algae Vegetation mapping LajiGIS
## 6                      0      672250 10.0 Algae Vegetation mapping LajiGIS
##      X_coord Y_coord
## 1 275234.2 6638427
## 2 275236.2 6638426
## 3 275304.1 6638420
## 4 275304.1 6638420
## 5 305669.5 6637843
## 6 305665.2 6637828
```

Turn into shapefile for plotting, add also some background map

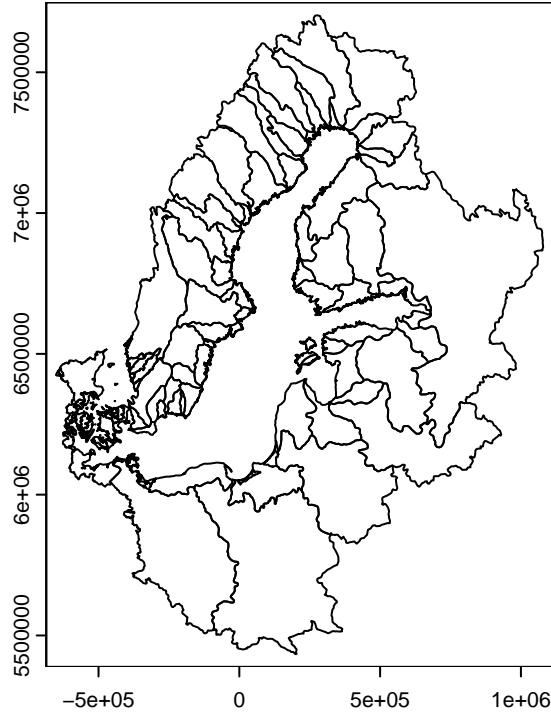
```
baltic.vect <- vect("../baltic_sea_shapefile/DrainageBasin_1.shp")
```

```
baltic.vect <- project(baltic.vect, "EPSG:3067")
```

```
baltic.vect
```

```
##  class      : SpatVector
##  geometry   : polygons
##  dimensions : 190, 6 (geometries, attributes)
##  extent     : -651092, 1078815, 5433686, 7702238  (xmin, xmax, ymin, ymax)
##  coord. ref. : ETRS89 / TM35FIN(E,N) (EPSG:3067)
##  names      : BASINS_ID MAJID SUBID          DESCRIPT Shape_Leng Shape_Area
##  type       : <num> <int> <int>          <chr>    <num>    <num>
##  values     :           2     1    10 Bothnian Bay Su~ 3.624e+06 2.825e+11
##               3     1    12 Bothnian Bay Su~ 3.629e+06 3.481e+11
##               4     1     6 Bothnian Bay Su~ 2.496e+06 1.732e+11
```

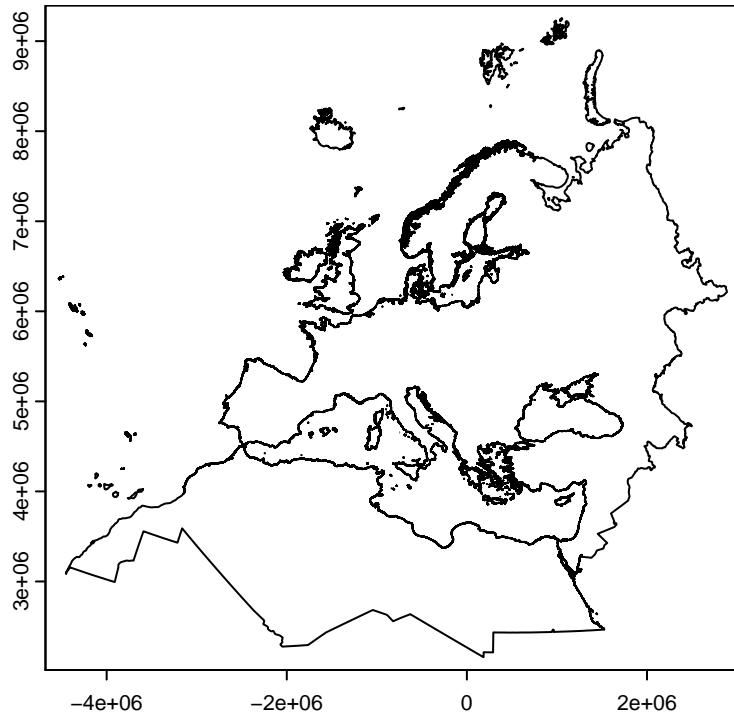
```
plot(baltic.vect)
```



```
europe.vect <- vect("../europe_coastline_shapefile/Europe_coastline_poly.shp")
```

```
europe.vect <- project(europe.vect, "EPSG:3067")
```

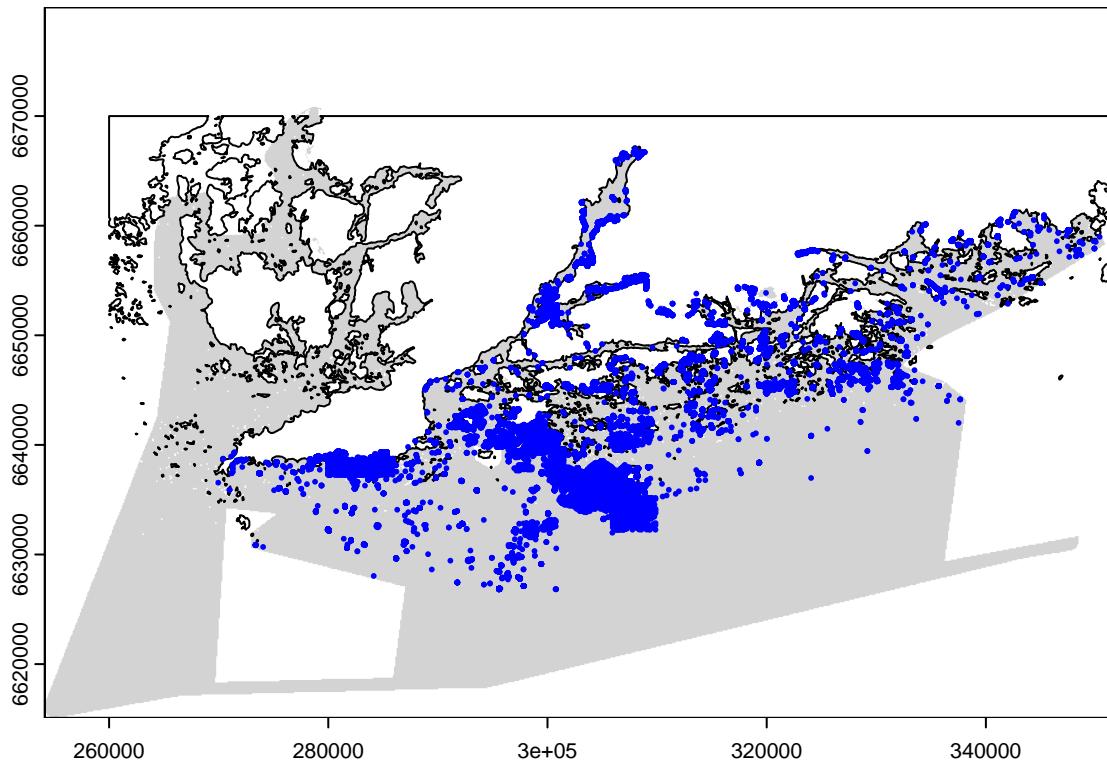
```
plot(europe.vect)
```



```
ext_vec <- c(260000,355000,6610000,6670000)
baltic.vect.cut <- crop(baltic.vect, ext_vec)
europe.vect.cut <- crop(europe.vect, ext_vec)
#plot(baltic.vect.cut)
#plot(europe.vect.cut)

sal.rast <- rast("../data/hanko1/sal_rasters_Obama.2023-06-19.tif")
hanko2.vect <- vect(hanko2,geom=c("X_coord","Y_coord"),crs=crs(sal.rast))
plot(sal.rast, main = "Hanko new observations", col = "lightgrey", legend = FALSE)
plot(europe.vect.cut, add = TRUE)
plot(hanko2.vect,add=TRUE,cex=0.4,col="blue")
```

## Hanko new observations



How many species do we have in the data?

```
head(unique(hanko2[, "scientificName"]), 10)
```

```
## [1] "Acrosiphonia arcta"           "Aegagropila linnaei"  
## [3] "Aglaothamnion roseum"        "Drifting Fucus (alive)"  
## [5] "Drifting Fucus (dead) sp."    "Drifting filamentous algae"  
## [7] "Alisma plantago-aquatica"    "Audouinella"  
## [9] "Battersia arctica"           "Bolboschoenus maritimus"
```

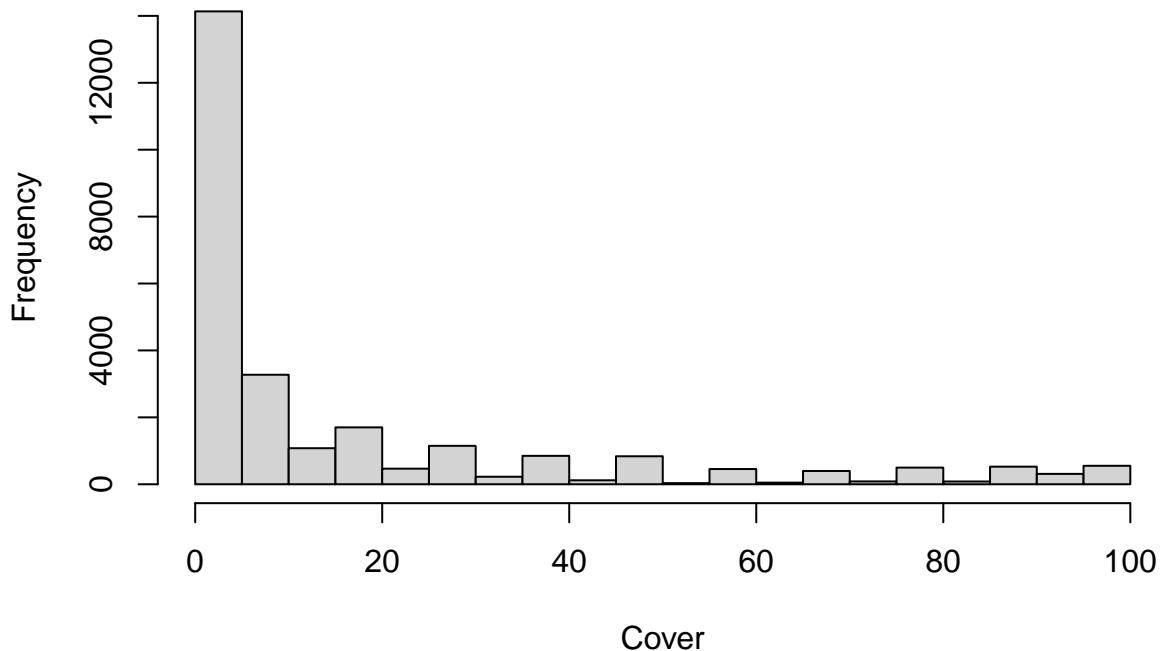
```
length(unique(hanko2[, "scientificName"]))
```

```
## [1] 189
```

What are the prevalences for each species? I assign absence if the cover is under 1%

```
hist(hanko2[hanko2[, "Cover"] <= 100, "Cover"], main = "Histogram of the covers, all species", xlab = "Co")
```

## Histogram of the covers, all species



```
for (sp_name in unique(hanko2[, "scientificName"])) {  
  df_sp <- hanko2[hanko2[, "scientificName"] == sp_name, ]  
  prev <- mean(df_sp[, "Cover"] >= 1)  
  print(paste0(sp_name, ": ", round(prev, 3)))  
}
```

```
## [1] "Acrosiphonia arcta: 0.857"  
## [1] "Aegagropila linnaei: 0.956"  
## [1] "Aglaothamnion roseum: 0.227"  
## [1] "Drifting Fucus (alive): 0.957"  
## [1] "Drifting Fucus (dead) sp.: 0.798"  
## [1] "Drifting filamentous algae: 0.859"  
## [1] "Alisma plantago-aquatica: 0.8"  
## [1] "Audouinella: 0.75"  
## [1] "Battersia arctica: 0.825"  
## [1] "Bolboschoenus maritimus: 1"  
## [1] "Bryophyta: 0.864"  
## [1] "Butomus umbellatus: 0.667"  
## [1] "Calla palustris: 0"  
## [1] "Callitrichete: 0.9"  
## [1] "Callitrichete cophocarpa: 1"  
## [1] "Callitrichete hermaphroditica: 0.87"  
## [1] "Callitrichete palustris: 0.929"  
## [1] "Caltha palustris: 0.75"  
## [1] "Ceramium: 0.95"  
## [1] "Ceramium tenuicorne: 0.898"  
## [1] "Ceramium virgatum: 0.889"  
## [1] "Ceratophyllum demersum: 0.842"  
## [1] "Chara: 0.822"  
## [1] "Chara aspera: 0.77"
```

```

## [1] "Chara baltica: 0.778"
## [1] "Chara canescens: 0.82"
## [1] "Chara globularis: 0.893"
## [1] "Chara tomentosa: 0.943"
## [1] "Chara virgata: 0.867"
## [1] "Chara virgata/globularis: 1"
## [1] "Chara/Nitella: 0.75"
## [1] "Chorda: 0.25"
## [1] "Chorda / Halosiphon: 0.698"
## [1] "Chorda filum: 0.688"
## [1] "Cladophora: 0.887"
## [1] "Cladophora fracta: 1"
## [1] "Cladophora glomerata: 0.888"
## [1] "Cladophora rupestris: 0.788"
## [1] "Climacium dendroides: 1"
## [1] "Coccotyphus / Phyllophora / Furcellaria: 0.75"
## [1] "Coccotyphus truncatus/ Phyllophora pseudoceranoides: 0.517"
## [1] "Dictyosiphon: 0.636"
## [1] "Dictyosiphon chordaria: 1"
## [1] "Dictyosiphon foeniculaceus: 0.911"
## [1] "Dictyosiphon foeniculaceus / Stictyosiphon tortilis: 0.857"
## [1] "Drepanocladus: 0.975"
## [1] "Drepanocladus aduncus: 0.786"
## [1] "Drepanocladus sordidus: 1"
## [1] "Ectocarpus siliculosus: 0.946"
## [1] "Elachista fucicola: 0.865"
## [1] "Eleocharis: 0.909"
## [1] "Eleocharis acicularis: 1"
## [1] "Eleocharis mamillata: 0.667"
## [1] "Eleocharis palustris: 0.667"
## [1] "Eleocharis parvula: 0.769"
## [1] "Eleocharis uniglumis: 1"
## [1] "Elodea canadensis: 1"
## [1] "Equisetum arvense: 1"
## [1] "Equisetum fluviatile: 0.5"
## [1] "Equisetum palustre: 0.5"
## [1] "Eudesme virescens: 0.817"
## [1] "Fontinalis: 0.956"
## [1] "Fontinalis antipyretica: 1"
## [1] "Fontinalis hypnoides: 1"
## [1] "Fucus: 1"
## [1] "Fucus vesiculosus: 0.905"
## [1] "Furcellaria lumbricalis: 0.632"
## [1] "Halosiphon tomentosus: 1"
## [1] "Hildenbrandia: 0.916"
## [1] "Hildenbrandia rubra: 0.949"
## [1] "Hippuris: 0.5"
## [1] "Hippuris vulgaris: 1"
## [1] "Attached red membraneous algae: 0.9"
## [1] "Attached brown membraneous algae: 0.984"
## [1] "Attached green membraneous algae: 0.9"
## [1] "Attached red filamentous algae: 0.887"
## [1] "Attached brown filamentous algae: 0.897"
## [1] "Attached green filamentous algae: 0.898"

```

```

## [1] "Attached filamentous algae < 5 cm: 0.938"
## [1] "Attached filamentous algae > 5 cm: 0.985"
## [1] "Leathesia marina: 0"
## [1] "Lemna minor: 1"
## [1] "Lemna trisulca: 0.963"
## [1] "Leptodictyum riparium: 1"
## [1] "Limosella aquatica: 1"
## [1] "Lysimachia maritima: 0.824"
## [1] "Lysimachia thyrsiflora: 0.9"
## [1] "Lysimachia vulgaris: 0.933"
## [1] "Mougeotia: 1"
## [1] "Myriophyllum: 0.839"
## [1] "Myriophyllum alterniflorum: 0.909"
## [1] "Myriophyllum sibiricum: 0.907"
## [1] "Myriophyllum spicatum: 0.903"
## [1] "Myriophyllum verticillatum: 0.879"
## [1] "Myriophyllum/Ceratophyllum: 0.5"
## [1] "Najas marina: 0.93"
## [1] "Nitella: 0.974"
## [1] "Nitella flexilis: 1"
## [1] "Nitella wahlbergiana: 1"
## [1] "Nitellopsis obtusa: 0.971"
## [1] "Nuphar lutea: 0.985"
## [1] "Nymphaea alba: 1"
## [1] "Nymphaea alba -group: 0.833"
## [1] "Nymphaea candida: 1"
## [1] "Nymphaeaceae: 0.909"
## [1] "Oxyrrhynchium speciosum: 1"
## [1] "Persicaria amphibia: 1"
## [1] "Persicaria hydropiper: 1"
## [1] "Persicaria lapathifolia subsp. lapathifolia: 1"
## [1] "Persicaria lapathifolia subsp. pallida: 0.75"
## [1] "Phragmites australis: 0.966"
## [1] "Phyllophora pseudoceranoides: 0.333"
## [1] "Polysiphonia: 0.562"
## [1] "Polysiphonia fibrillosa: 0.765"
## [1] "Polysiphonia fucoides: 0.619"
## [1] "Pot pect/Pot fili/Ruppia sp./Zannichellia sp.: 0.844"
## [1] "Potamogeton: 0.88"
## [1] "Potamogeton berchtoldii: 0.941"
## [1] "Potamogeton crispus: 1"
## [1] "Potamogeton friesii: 0.938"
## [1] "Potamogeton gramineus: 1"
## [1] "Potamogeton lucens: 1"
## [1] "Potamogeton natans: 1"
## [1] "Potamogeton obtusifolius: 1"
## [1] "Potamogeton perfoliatus: 0.896"
## [1] "Potamogeton praelongus: 0.857"
## [1] "Potamogeton pusillus: 0.8"
## [1] "Protohalopteris radicans: 0.4"
## [1] "Pseudolithoderma: 1"
## [1] "Pseudolithoderma / Hildenbrandia: 0.857"
## [1] "Pylaiella littoralis: 0.855"
## [1] "Pylaiella littoralis / Ectocarpus siliculosus: 0.978"

```

```

## [1] "Racomitrium lanuginosum: 1"
## [1] "Ranunculus: 0.569"
## [1] "Ranunculus baudotii: 0.737"
## [1] "Ranunculus circinatus: 0.884"
## [1] "Ranunculus confervoides: 0.6"
## [1] "Ranunculus repens: 1"
## [1] "Ranunculus schmalhausenii: 0.857"
## [1] "Rhizoclonium: 0.889"
## [1] "Rhodochorton purpureum: 1"
## [1] "Rhodomela confervoides: 0.723"
## [1] "Rhynchosstegium riparioides: 0.917"
## [1] "Filamentous epiphytic algae: 0.966"
## [1] "Filamentous algae: 0.997"
## [1] "Ruppia: 0.756"
## [1] "Ruppia maritima: 0.951"
## [1] "Ruppia spiralis: 1"
## [1] "Sagittaria: 1"
## [1] "Sagittaria sagittifolia: 0.917"
## [1] "Schoenoplectus: 0.857"
## [1] "Schoenoplectus lacustris: 1"
## [1] "Schoenoplectus tabernaemontani: 0.929"
## [1] "Sparganium: 0.933"
## [1] "Sparganium emersum: 1"
## [1] "Sparganium gramineum: 1"
## [1] "Spergularia marina: 1"
## [1] "Sphacelaria: 0.8"
## [1] "Sphagnum riparium: 1"
## [1] "Spirogyra: 0.948"
## [1] "Spongomorpha: 1"
## [1] "Spongomorpha aeruginosa: 0.667"
## [1] "Stictyosiphon tortilis: 0.947"
## [1] "Stuckenia: 1"
## [1] "Stuckenia filiformis: 1"
## [1] "Stuckenia pectinata: 0.902"
## [1] "Subularia aquatica: 0"
## [1] "Tolypella: 1"
## [1] "Tolypella nidifica: 0.707"
## [1] "Tracheophyta: 0.714"
## [1] "Triglochin: 1"
## [1] "Triglochin maritima: 1"
## [1] "Typha: 1"
## [1] "Typha angustifolia: 0.947"
## [1] "Typha latifolia: 1"
## [1] "Ulva: 0.754"
## [1] "Ulva flexuosa: 1"
## [1] "Ulva intestinalis: 0.694"
## [1] "Ulva linza: 0"
## [1] "Utricularia: 0.923"
## [1] "Utricularia vulgaris: 1"
## [1] "Vaucheria: 0.91"
## [1] "Zannichellia: 0.696"
## [1] "Zannichellia major: 0.863"
## [1] "Zannichellia palustris: 0.951"
## [1] "Zannichellia palustris var. palustris: 0.929"

```

```

## [1] "Zannichellia palustris var. pedicellata: 0.792"
## [1] "Zostera marina: 0.944"
## [1] "Zygnema: 1"
length(unique(hanko2[, "TransectId"]))
## [1] 354

```

### Estonia data

```

library(readxl)
estonia <- read_excel("../data/estonia/2024_QuantitativeSamplesCoverKeySpecies.xlsx")
estonia <- as.data.frame(estonia)
head(estonia)

##   MainID PrID Transekt latitude longitude      date year depth silt clay
## 1    1669  3343 Kõiguste  58.36128 22.99390 2000-07-21 2000  0.5  0  0
## 2    1670  3344 Kõiguste  58.36125 22.99385 2000-07-21 2000  0.7  0  0
## 3    1671  3345 Kõiguste  58.36000 22.99350 2000-07-21 2000  1.4  0  0
## 4    1672  3346 Kõiguste  58.35750 22.99260 2000-07-21 2000  2.4  0  0
## 5    1673  3347 Kõiguste  58.35660 22.99230 2000-07-21 2000  3.8  0  0
## 6    1684  3350 Kõiguste  58.35490 22.99220 2000-07-18 2000  6.0  0  0
##   finesand mediumsand coarsesand gravel smallboulder bigboulder rock clayplate
## 1       0        40        0       30        30        0     0     0
## 2       0        0        10       20        40        30     0     0
## 3       0        30        0       40        20        10     0     0
## 4       0        20        0       40        30        10     0     0
## 5       0        20        0       20        40        20     0     0
## 6       0        60        0       10        10        20     0     0
##   Amphibalanus improvisus Ampullaceana balthica Asellus aquaticus
## 1                      0                      0                      0
## 2                      0                      0                      0
## 3                      0                      0                      0
## 4                      0                      0                      0
## 5                      0                      0                      0
## 6                      0                      0                      0
##   Bathyporeia pilosa Bithynia tentaculata Ceramium tenuicorne
## 1                      0                      0                      0
## 2                      0                      0                      0
## 3                      0                      0                      0
## 4                      0                      0                      0
## 5                      0                      0                      0
## 6                      0                      0                      0
##   Cerastoderma glaucum Chara aspera Chara canescens Chara connivens
## 1                      0                      0                      0                      0
## 2                      0                      0                      0                      0
## 3                      0                      0                      0                      0
## 4                      0                      0                      0                      0
## 5                      0                      0                      0                      0
## 6                      0                      0                      0                      0
##   Chara tomentosa Chorda filum Cladophora glomerata Coccotylus truncatus
## 1                      0                      0                      0                      0
## 2                      0                      5                      5                      0
## 3                      0                      0                      0                      0
## 4                      0                      0                      0                      0

```

## 5	0	0	0	0
## 6	0	0	0	0
## <i>Dreissena polymorpha</i> <i>Ecrobia ventrosa</i> <i>Fucus radicans</i> <i>Fucus vesiculosus</i>				
## 1	0	0	0	0
## 2	0	0	0	1
## 3	0	0	0	10
## 4	0	0	0	0
## 5	0	0	0	1
## 6	0	0	0	0
## <i>Furcellaria lumbricalis</i> <i>Furcellaria lumbricalis</i> loose form <i>Gammarus duebeni</i>				
## 1	0	0	0	0
## 2	0	0	0	0
## 3	0	0	0	0
## 4	10	0	0	0
## 5	20	0	0	0
## 6	20	0	0	0
## <i>Gammarus oceanicus</i> <i>Gammarus salinus</i> <i>Gammarus tigrinus</i> <i>Gammarus zaddachi</i>				
## 1	0	0	0	0
## 2	0	0	0	0
## 3	0	0	0	0
## 4	0	0	0	0
## 5	0	0	0	0
## 6	0	0	0	0
## <i>Halicryptus spinulosus</i> <i>Hediste diversicolor</i> <i>Idotea balthica</i> <i>Idotea chelipes</i>				
## 1	0	0	0	0
## 2	0	0	0	0
## 3	0	0	0	0
## 4	0	0	0	0
## 5	0	0	0	0
## 6	0	0	0	0
## <i>Jaera albifrons</i> <i>Leptocheirus pilosus</i> <i>Macoma balthica</i> <i>Marenzelleria neglecta</i>				
## 1	0	0	0	0
## 2	0	0	0	0
## 3	0	0	0	0
## 4	0	0	0	0
## 5	0	0	0	0
## 6	0	0	0	0
## <i>Monoporeia affinis</i> <i>Mya arenaria</i> <i>Myriophyllum spicatum</i> <i>Mytilus trossulus</i>				
## 1	0	0	0	0
## 2	0	0	1	0
## 3	0	0	0	5
## 4	0	0	0	30
## 5	0	0	0	0
## 6	0	0	0	0
## <i>Palaemon adspersus</i> <i>Palaemon elegans</i> <i>Peringia ulvae</i> <i>Potamogeton perfoliatus</i>				
## 1	0	0	0	0
## 2	0	0	0	0
## 3	0	0	0	0
## 4	0	0	0	0
## 5	0	0	0	0
## 6	0	0	0	0
## <i>Pylaiella/Ectocarpus</i> <i>Rangia cuneata</i> <i>Ranunculus peltatus</i> subsp. <i>Baudotii</i>				
## 1	0	0	0	0
## 2	60	0	0	0

```

## 3          70          0          0
## 4         100          0          0
## 5         100          0          0
## 6          0          0          0
##   Ruppia maritima Stuckenia pectinata Theodoxus fluviatilis Tolypella nidifica
## 1         25           5          0          0
## 2          0          0          0          0
## 3          0          10          0          0
## 4          0          0          0          0
## 5          0          0          0          1
## 6          0          0          0          0
##   Ulva intestinalis Vertebrata fucoides Zannichellia palustris Zostera marina
## 1          0          0          0          0
## 2          0          0          0          0
## 3          0          0          10          0
## 4          0          0          0          0
## 5          0          0          0          0
## 6          0          0          0          0

```

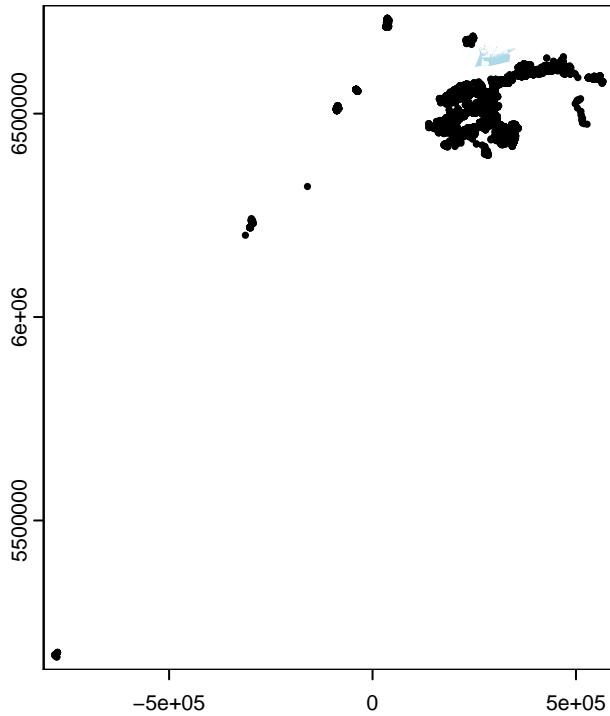
Turn to shapefile, use same projection as with Hanko data

```

estonia.vect <- vect(estonia, geom = c("longitude", "latitude"), crs = "EPSG:4326") #original data is in
estonia.vect <- project(estonia.vect, "EPSG:3067")
plot(estonia.vect, cex = 0.5, main = "Estonia observations")
plot(sal.rast, add = TRUE, col = "lightblue", legend = FALSE)

```

## Estonia observations



Let's crop the Estonia data

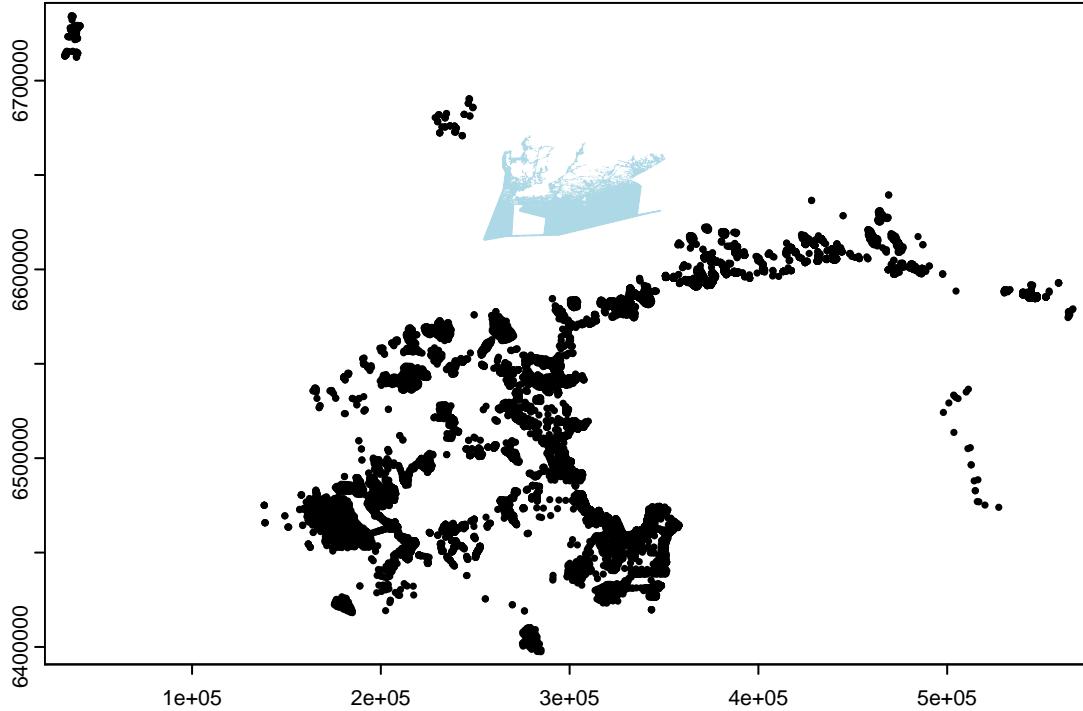
```

ext_vec <- c(0, 566613.8, 6000000, 6734429)
estonia.vect.cut <- crop(estonia.vect, ext_vec)
plot(estonia.vect.cut, cex = 0.5, main = "Estonia observations cropped")

```

```
plot(sal.rast, add = TRUE, col = "lightblue", legend = FALSE)
```

Estonia observations cropped



And plot it with the Hanko data and background.

```
ext_vec <- c(10000,650000,6350000,6800000)
baltic.vect.cut <- crop(baltic.vect, ext_vec)
europe.vect.cut <- crop(europe.vect, ext_vec)
plot(europe.vect.cut)
#plot(baltic.vect.cut)
plot(hanko2.vect, add = TRUE, col = "blue", cex = 0.4)
plot(estonia.vect.cut, add = TRUE, col = "red", cex = 0.4)
```

