Trelleborg Marine Inventory 16- 30 August 2009

Summary & Overall Assessment

Trelleborg's coastal inventory of 16 to 30 August 2009 was carried out by an international team of marine biologists from Russia and Sweden. The objective of the inventory was to explore the marine habitats and valuable species of the municipality's coastal area. The inventory also wanted to indicate which areas of the coastline have high environmental value and therefore should be excluded from the collection of algae biomass, and to highlight where algae biomass can be collected without harming the marine environment. Furthermore, an estimate of the quantity of algae there may be on Trelleborg's beaches was also required. The completed inventory is very extensive and there are large amounts of data that can be used in the future.

The inventory was part of a Baltic Sea cooperation between the Russian Academy of Sciences in St. Petersburg, Russian Federation, and Trelleborg Municipality.
In the main the Russian experts carried out the inventory, while the Swedish marine biologists worked on project management and helped with planning and logistics. They also participated as observers in parts of the investigation. This implies that, in some cases, the inventory may differ methodologically from those normally performed in Swedish coastal areas. Despite this, the Trelleborg coastline has been documented very carefully by skilled experts and the general conclusions drawn in the report are substantiated.

An overall result is that Trelleborg's coastline, from Vellinge municipal border (Fredshög) to Stavsten, has a large natural value. The area from the western municipal limits to Skåre is especially rich in algae (wrack and toothed wrack), benthic fauna and fish. This beautiful marine area, which is characterized by being a transition zone between the Baltic Sea and the saline North Sea, continues into Vellinge municipality. In this area there should be no interference or collection of algae, as the algae forests are of such high quality that they should be protected as a municipal marine reserve. The second area along the coastal strip which should not be disturbed by algae collection is the Skateholmsans (Tullstorpsåns) estuary area at the eastern municipal limits, as it is especially valuable for fish and is probably a fish regeneration area. Other stretches of coastline contain no sensitive natural marine values and it should be possible to collect algae in these areas without the disruption of marine life. An appropriate area for algae collection is east from Gislövs until Smygehuk. A location outside Böste noted unusual bottom structures of polychaetes, and some bladder, which should not be subjected to interference. The next area that is well suited for algae collection is the area east of Smygehamn, throughout Beddingestrand, until Skateholm. During the investigation there were also large quantities of algae below the golf course, from Stavsten to Trelleborg.

During the inventory an estimate of the amount of fresh seaweed that washed up along a 30 km long coastal strip of the municipality was made. The results show that, during the survey period, there were 10 500 tonnes of algae biomass on the beaches. No calculation of the amount of algae in the water has been made, but also in the water there were large quantities of algae which subsequently washed up on beaches. There is thus great potential for the collection of algae in the riparian zone and on the beaches of Trelleborg municipality.

The inventory also carried out visits to sites identified as possible eelgrass beds, from a flight based survey in 2007.
None of the highlighted sites had eelgrass and the sites that had no eelgrass were not identified in this inventory. Instead, areas designated as eelgrass consisted of stringy red algae, which is the base for the drifting algae found in large quantities along the coast. The conclusion is that aerial photography alone cannot be used to

make an inventory of marine plant communities on Skåne's south coast and that diving of sites is therefore required.

Introduction

Trelleborg Municipality is the initiator of the "Kretsloppet" project, which aims to improve the environment in the Baltic Sea, whilst building a society based on renewable energy. This is done by the surplus of filamentous algae, that are produced along the coast, being gathered and digested for biogas production.

There are several advantages of harvesting the raw material (the algae) used for the production of biogas from the Baltic Sea. For locals, the reward is obvious as the huge algae masses that are washed up on beaches around Trelleborg, that emit an unpleasant smell as they rot, are removed. In many places the beaches have so much algae on them that they are unusable for swimming and recreation. If it is possible to harvest the algae, and also get a useful product, it would be much appreciated.
To achieve this Trelleborg Municipality is in cooperation with the Royal Institute of Technology in the portion of the project which aims to produce biogas from algae. A collaboration has also begun with the city of Sopot in Poland, Trelleborg's neighbor across the Baltic Sea, which also has major problems with filamentous algae on its beach.

There are advantages not only for people but also for the Baltic Sea. With the algae removed, nitrogen and phosphorus taken from the sea can be returned to the land. The soil at Skåne's coast is amongst the most fertile in the world, but with an intensive and industrialized agriculture also comes a large loss of nutrients to the Baltic Sea. Eutrophication stimulates the growth of, among others, stringy algae in the coastal area. Harvesting of algae from the Baltic Sea may therefore be a good way to pick up nutrients such as nitrogen, up to 85 percent of which can be attributed to diffuse emissions from transport and agriculture. Perhaps in the future there may be a need for large-scale harvesting of biomass from the Baltic Sea to halt the downward spiral caused by increased eutrophication. Other advantages of harvesting may include increasing the potential for fish reproduction and the re-creation of valuable marine habitats that may be lost due to the "suffocating" algae masses. "Suffocation" is caused by the stringy algae decomposing and therefore a large amount of oxygen being consumed.

The Industrial Ecology research group of the Royal Institute of Technology is working with interdisciplinary systems analysis and evaluations, from a durability aspect. It can range from projects with high environmental ambitions, such as Hammarby Sjöstad in Stockholm, to various coastal zone planning projects around the Baltic Sea. The project in Trelleborg contains several elements which are interesting for the research group. During the summer of 2009 several sub-projects are underway, including an inventory of algae and attempts to harvest it.

A major advantage of using algae as bio-gas substrate is that valuable agricultural land need not be used to produce renewable fuels.

The Industrial Ecology research team has the ability to monitor and evaluate the biogas projects , and various sub-projects, in terms of sustainability. This work will study the ecological, technological, economic and social aspects of the project.

This report summarizes the marine survey, carried out between 16 and 30 August 2009 in a cooperation between Russian and Swedish biologists. Valuable habitats and species have been determined on Trelleborg's entire coastal strip. The focus has been on algae, marine plants, fish and invertebrates. An estimate of the amount of algae biomass on the beaches has also been made, as have results of the different coastal areas biological values. The obtained results (raw data) are

attached as Excel files in English, while the main findings and conclusions are summarized in the Swedish report.

Implementation

Trelleborg's entire coastline, from the municipal border with Vellinge in the west (Fredshög) to the municipal border with Skurup in the east (Skateholm), has been surveyed from the shore out to a depth of 2-3 m. The inventory was carried out between 16 and 30 August 2009. Some of the coastal strip area outside the Port of Trelleborg has not been inventoried. The total length of the inventoried coastal strip, when you take away the port and urban areas, is about 30 km.
The aim was to establish an inventory of areas that may be affected by a future collection of filamentous red and brown algae. The focus has been on the valuable marine habitats and important species that may be affected by the collection / harvesting of algae.
The inventory was carried out by an international team consisting of 9 Russian biologists and 2 Swedish marine biologists. The group was made up of experts on fish, invertebrates, algae and rare plants. In addition to the inventory, data has been collected to calculate the amount of algae biomass that existed along the beaches during the field research. In turn, this gives an indication of how much algae biomass that may exist along the coastal strip of Trelleborg.
All testing locations are reported with coordinates in SWEREF 99, or with WGS 84.

The inventory was carried out in very fine weather conditions, but some days were windy, which clouded the water. The windy weather had the most impact on fish surveys. Basic hydrographic data, such as salinity and temperature, has been taken at all locations.

Figure 1. Map of Trelleborg's coast with the additions of sampling points.
Red dots are benthic and fish test sites, the green points mark the areas where line assessments were carried out.

Results & Discussion

Coastal Zone Description

Editor: E. Nesnerova

Coastal zone description consists of a cursory analysis of maps and charts, as well as a geological and geomorphological inventory with a detailed description of the entire coastal zone. The coastal zone has been documented in a photographic atlas, which is annexed to this report (Annex 1).
To make a description of the sea bottom at depths greater than 1.5m a side scan sonar was used.
An analysis of side-scan sonar images allows the user to distinguish and identify various elements of the marine landscape, for example sand flats, erosion areas, areas of sediment accumulation and other dynamic zones. This makes it possible to classify the different areas and to create a lithographic map of the underwater coastal zone landscape.

The main work carried out in this coastal zone description consisted of sediment sampling, and photographing various objects in the coastal zone of the beach and in the shallow sea area where the inventory was conducted. In connection with this investigation the thickness and extent of algal biomass found on the beaches was documented and then used to calculate the amount of algal biomass present along the coastal strip of Trelleborg.
For the classification of sediment a structure in accordance with Rukhin (1962) was used. Which classifies sediment types in the following manner: large stones (1000-100 mm), smaller stones (100-10 mm), gravel (10-2 mm), coarse sand (2-0,5 mm), semi-coarse sand (0.5 -0.25 mm) and fine sand (0,25-0,1 mm).

Results

The result for the entire coastline is attached as a separate file, including photographs and lithographic maps (Appendix 1).

The following types of coastal zones have been identified (Figure 2):
Pebble beach's which are located at the headlands and adjacent areas.
Sandy beaches in the central areas.
Beaches in transition between sand and pebble beach's, in the areas west and east of the sandy beaches.
Populated coastal sections, such as ports and marinas.

Figure 2. Map showing the most common beach types

To illustrate how the coastal zone atlas looks an example from transect 1, which is close to Fredshög (Vellinge municipal border), is presented here All other transects are described in a similar manner but are annexed (Annex 1).

<table>
<tr><td colspan="2">Done by Elena Nesterova</td></tr>
<tr><td>18.08.2009, water downward</td><td>Transects 1</td></tr>
<tr><td>latitude</td><td>Longitude</td></tr>
<tr><td>55^{0} 23,074</td><td>13^{0} 01,265</td></tr>
<tr><td></td><td>Boulder-pebble coastal zone (beach)</td></tr>
<tr><td> 
Fig.1</td><td>Structure of the beach:

1-(close to shoreline) boulder-pebble beanch: boulders, pebbles (limestones, cherts, granites) and sands (medium grained, light grey, unsorted) – 1-1.5 meters (fig.2);

2- wrecks - 4-5 meters:2^{a}-zone accumulation of fresh wrecks, 2^{b} zone accumulation of old wrecks, thickness -15-20 cm (fig.3,4);

3- pebbles and boulders - 2 meters, scarp - 0.5 meter (fig. 5,6);

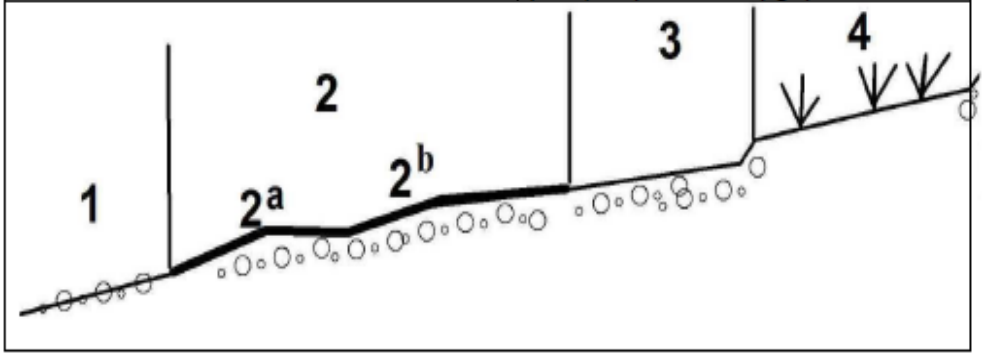
4 -beach slope, covered by nitrophilous plants, scarp - 0.4 meter (fig.7).</td></tr>
<tr><td colspan="2"> 
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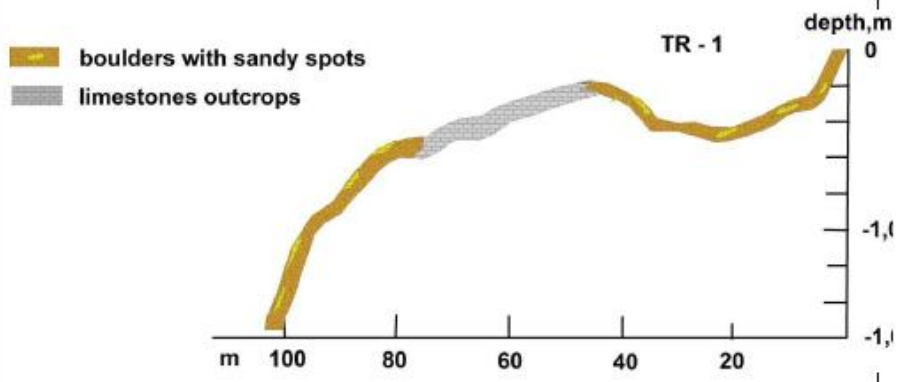
Fig.2	Fig.3
	
Fig.4	Fig.5
	
Fig.6	Fig.7
width of the beach – about 12-13 meters height of the beach – 1.8 – 2 meters incline – about 8^{0}	
Nearshore zone	Boulders with sandy spots made up of nearshore zone. The limestones outcrops are marked by distance 45 – 75 m. Small boulders and pebbles (limestones) cover by surface of

outcrops.



The limestone outcrop to the east of transects-1.

The limestone contains much nodules of amorphous silicon.

Algal biomass on Trelleborg's coast

Editor: Fredrik Gröndahl

The coastal zone inventory measured the width, length and thickness of the algae masses found along the 30 km coastal strip.
The largest zones of algal mats were found in the western coastal areas along the golf course and outside Gislövs, and in the eastern coastal areas outside Beddingestrand.
Biomass was calculated using the collected values for width and thickness of the algal mats, as well as the longitude and latitude of the measured beach stretch.
The length of the shorelines seaweed mats was calculated from given values for the longitudes and latitudes (from Trelleborg 18_1 to Trelleborg 24_18) with the "Great Circle calculator" by Ed Williams (see reference list).

Density values of 0.3 ton/m3 ashore floating "semi-arid" algae were obtained from the report "Inventory of the need and possibilities for restoration of eutrophic

coastal bays and coastal lakes" of the southern Baltic water authority. The following formula was used to calculate the total algal biomass:

$m = \rho * l*b*h$

Where ρ = density, l = length, b = width, h = height, of algae cover

Total algal biomass along the coast of Trelleborg.

Coastline (km)	30
Total Algae Biomass (ton)	10500

The summed amount of algae from 30 km of Trelleborg's coast have been estimated at 10 500 tonnes during the two inventory weeks. This figure can be related to the amount of algae which is currently collected from the public beaches, which is about 2,000 m3. Earlier theoretical calculations for the entire coastal strip has reached the figure of 10 000 m3, of which the weight is in the same region as this study (Detox, 2008). Of course there are significant amounts of algae floating in the sea and constantly washing up on beaches, this algae has not been calculated in this study. This is because the system is dynamic and it is difficult to calculate the total amount of algae that may exist in the area.
One conclusion one can draw is that there certainly is much more than 10 500 tonnes and therefore there are large amounts of algae biomass which can be used as raw material for future biogas production. To obtain a more accurate figure of the amount of stray seaweed in Trelleborg's coastal waters would require further studies and careful planning regarding the methodology used for this calculation. It is important to emphasize that one should make use of the stray and beach algae instead of reaping the attached algae on the sea bottom, which can be harmful to marine life.

Algae are released continuously from the bottom during the growing season and will push toward the shore. To act as an effective biogas substrate, it is important that the algae is fresh and has not undergone degradation. Thus, it is not advisable to pick up the dry and degraded algal residues that are higher up the beaches.

Rare Plants on the Beach
Editor: Elena Glazkov

In addition to the amount of algae carpets being measured, a botanical survey of riparian plants was also carried out. This is not part of the mission but the results are still of interest. Some rare plants to Scania and Sweden were found and it will be useful that they are now recorded and identified. Some of the species are new to Trelleborg's coastline and one of the more interesting finds was an example of Beta maritima (Strandbeta) found in the middle of the Gislövs harbour area. The plant is very rare in Sweden. Pictures and coordinates of all the rare plants are reported in English in a separate document (Annex 2).

Figure 3. Photo at the locality of the rare Beta maritima (Strandbeta).

Macroalgae, Zostera and Ruppia

Editor: Nikolay Kovalchuk

A total of 17 line assessments were carried out along the Trelleborg coastline, from the beach to 100 meters into the sea (Figure 1). The distance between observations was 5 meters and transects were stopped at about 2 meters water depth. Coverage and occurrences were registered according to established methods (Environmental Protection Agency, 2004). Snorkeling was also carried out at depths to give a more qualitative assessment. All areas with potential eelgrass beds that had been identified by the Marine Monitoring (2007) using aerial photography were also visited. The results are presented in the attached Excel sheet in English (Annex 3). A summary and interpretation of results is given in this report.

The western part of Trelleborg's coastline from Fredshög (Vellinge municipality) to Stavsten is significantly richer in both macro-algae, eelgrass Zostera marina and Ruppia spiralis than the eastern part of Trelleborg city (Figure 1). A number of valuable plant communities that are threatened, according to HELCOM, were found during the survey of this area. There was a relatively high abundance of eelgrass Zostera marina, Furcellaria lumbricolis; toothed wrack Fucus serratus and Fucus vesiculosu bladder wrack, all of which are considered important species in the Baltic Sea.

It was found that kelp Fucus vesiculosus was generally covered with large amounts of fouling (epiphytes) which can be a sign of eutrophication and cause problems for the host plant.
The best area for Ruppia spiralis and eelgrass Zostera marina was found to be at the end of the transect 4, where broad and wide belts of eelgrass and much Ruppia spralis are present in the shallow water (Figure 1).

No examples of the red-listed Charales algae (Chara sp) were found during the inventory. It is most likely that the Trelleborg coastal strip is too exposed for them to thrive. In the western coastal areas, where there are some protective stone reefs, careful studies of water were made to try to find Charales algae.

The inventory examined all the locations of Trelleborg's coastline identified by Marine Monitoring in 2007, through aerial photography, as having eelgrass Zostera marina. None of the areas in the Marine Monitoring report have been interpreted as possible locations of eelgrass or had any abundance of eelgrass, instead there was a huge mass of stringy red algae that covered the bottom (Figure 5). In the western part of Trelleborg's coastline (transect 4, Figure 1) where the present study found large stocks of eelgrass there were no reports of eelgrass from aerial photography. This indicates that the method of aerial photography and associated identification of plant communities has very limited use on Skånes coast. In conclusion, the report from Marine Monitoring cannot be used for the assessment of natural values on Trelleborg's coastline.

Some dives were also conducted in deeper water (5-10 m) and these confirmed the shallow water (2-4m) observations. Vast areas of Trelleborg’s shallow coast, from a depth of 1.5 to 11 m, are covered with large bodies of stringy red algae (e.g. Polysiphonia sp) that grows on rocky bottoms (Figure 5). These supplementary items are a result of nutrients leaking from the agricultural landscape and the general eutrophication, which can be found in the Baltic Sea. In windy weather these algae are released from the bottom and move towards the beach, forming the shoreline "algae soup" which in turn is washed up on shore (Figure 4). The vegetation masses found on Trelleborg’s coastal strip are thus largely produced in these very suitable algae environments found in the coastal waters.

Figure 4. A typical beach picture from Trelleborg's coastline with algae masses on the beach, but also a thick soup of algae in the water, which consists of filamentous red algae and can extend 50 m or more into the water. Studies have shown that these algae masses are suitable feedstock for biogas production and are the easiest for harvesting. Photo by Fredrik Gröndahl.

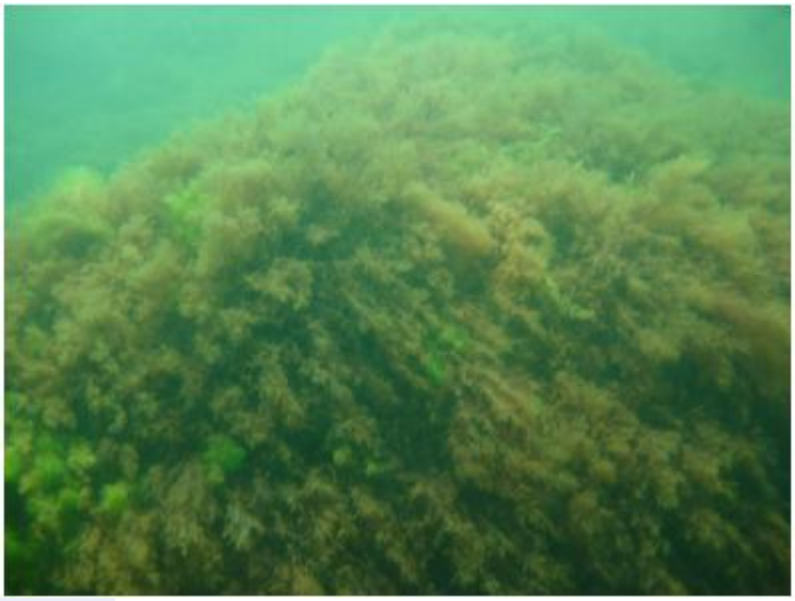


Figure 5. A background image from the stony and shallow south coast. On these vast stone areas grow large quantities of stringy red algae, which are fattened by nutrients leaching from agriculture. In windy weather they detach and move towards the beach. Photo by Fredrik Gröndahl.

List of algae species collected along the coastal strip of Trelleborg.
(See also Annex 3).

Chlorophyta, Green Algae
1. Cladophora glomerata
2. Cladophora rupestris
3. Ulva intestinalis

Phaeophyta, Brown Algae
4. Ectocarpus siliculosus
5. Pilayella littoralis
6. Pseudolithoderma subextensum
7. Sphacelaria cirrosa
8. Elachista fucicola
9. Chorda filum
10. Chorda tomentosa
11. Fucus vesiculosus
12. Fucus serratus

Rhodophyta, Red algae
13. Ceramium nodulosum
14. Ceramium tenuicorne
15. Chroodactylon ornatum
16. Coccotylus truncatus
17. Furcellaria lumbricalis
18. Hildenbrandtia rubra
19. Polysiphonia nigrescens

Fish Surveys

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The objective of this part of the inventory was to describe and analyze fish stocks along the Trelleborg coastline. Generally, there are very few studies of coastal fisheries along the Swedish south coast, which means that this survey is a pilot study. The fishing study was conducted to see the species composition of different habitats and the abundance, size and weight of the fish. The survey also wanted to show if there may be any problems, and the impact on fish, as a result of harvesting / collecting algae.
Data from the study is reported in a separate Excel file (Annex 4) and the intention is that there is basic material to facilitate a comparison with future studies of fish stocks.
The examined areas are the same as those used for the study of plants / algae and invertebrates, as well as a few extra sites (Figure 1).

Method
The investigation was carried out using a seine net method, with 3 m long “wings” and a depth of 3 m. The mesh size was 10 mm in the wings and 5 mm in the collection bag. The net was in the sea at a distance of 25 m from the shore. Sampling was started from 1.5 m deep which was also the depth of the seine. At each station three samples were taken. The stations were selected to represent different habitats. For each locality the number of individuals, of each species, was defined as follows: Less than 10 individuals were considered to be scarce, 10 -29 individuals were regarded as common and more than 30 individuals were defined as abundant.

Results

Sites 1 to 4, 9, 11 to 13, 16, and 20 (Figure 1) could not be used in the analysis because of difficult wind and wave conditions at the time of sampling. Wind and waves complicate the analysis because the fish will leave the shallow areas and move towards deeper water. Overall, one can say that Trelleborg's coastal waters are relatively productive and have a relatively large number of fish species (18 species).

List of the 18 species of fish found at Trelleborg's coastline (also see Annex 4)

Anguilla anguilla	European eel
Belone belone	garfish
Clupea harengus	Baltic herring
Sprattus sprattus	European sprat
Engraulis encrasicolus	European anchovy
Abramis brama	bream
Rutilus rutilus	roach
Salmo trutta	brown trout
Gasterosteus aculeatus	three-spined stickleback
Pungitius pungitius	nine-spined stickleback
Spinachia spinachia	sea stickleback
Syngnathus typhle	broad-nose pipefish
Ammodytes tobianus	Lesser sand eel
Pomatoschistus microps	common goby
Pomatoschistus minutus	sand goby
Psetta maxima	Turbot
Platichthys flesus	Flounder
Solea solea	Sole

The greatest number of species per site was found to be 10 species in three different localities, and the lowest number was 4 species in 2 localities. (Appendix 4). There is a tendency for the number of species to decrease from west to east, possibly explained by a decrease in salinity from west to east.

One species, Platichthys flesus (flounder), was found at 15 sites and is therefore the most common occuring species of Trelleborg's coastal strip, although it is not the kind that had the greatest number of individuals. A number of juvenile flounder were found at many localities with sandy bottoms around the river mouth.

Three species were found in 13 locations; Common goby, three spined stickleback and sprat. Common goby is associated with sandy sea bottom areas, there were both adult and young fish present and newly hatched larvae of the species were also very common. Of the young sprats surveyed most were yearlings.

Garfish and Sole are two marine species which were represented by few individuals, but Sole seems able to reproduce in Trelleborg's coastal waters as young yearlings were found. Eels were caught, with a trap, and therefore cannot be used for comparison with the other species caught by seine. But it may be that eels are still fairly common in Trelleborg coastal waters. Of the seven eels that were caught, two had a skin disease on the head (Figure 6).

Figure 6. Eel with an unidentified skin disease on its head, collected outside Trelleborg.

The occurrence of anchovy (Engraulis encrasicolus) is rare in Öresund and the Baltic Sea, but they have previously been found in southern Sweden and even, on a single occasion, in the Stockholm archipelago.
Roach (Rutilus rutilus) and Bream (Abramis brama) were found in a river mouth, these two species probably migrate back and forth from the river to the Baltic Sea. An important local fishery is the Skateholmsåns estuary at the municipal border with Skurup (Figure 1). Another important area for fishing is in the western part of the municipality, from Fredshög (Vellinge) to Skåre, and this area also has other important biological values.

Invertebrates
Editor: Nick Aladin

At the 20 locations where fish and algae transects were conducted, studies of invertebrates also took place (Figure 1). The results are reported in the attached excel file (Annex 5), but a summary is given in this report. A table with the animals attached to the different habitats will also be presented.

In the western areas of Trelleborg's coast between Fredshög and Skåre (Figure 1) a number of large shore crabs (Carcinus maenas) have been captured and observed, this is an indication that they are likely to multiply and to grow in the area. Trelleborg's coastline, and especially the western part, has many different species and elements from the more marine Kattegat area. The western area of Trelleborg's coastline (Figure 1) can be considered as a transition zone between the North Sea and Baltic Sea. Another example of this is the discovery of sea snails (Littorina sp.)

Another interesting observation was the structure of the ground created by the polychaete worm Pygospio elegance. These areas were found outside Böste and relatively large areas of the bottom structure consisted of elevated cellular "sediment pads". Sampling of these structures confirmed large quantities of

Pygospio elegance. The species itself is not unusual in the southern Baltic, but the extent of these structures was striking and not found anywhere else.

Otherwise, no special conservation value species were found along the coast, but most species can be expected in the different habitats (Annex 5). The table below gives only a qualitative picture of the species found in the different habitats. More information on weight and individual volume for the various species can be found in Appendix 5. Methods of collecting the organisms are so diverse that a quantitative assessment should not be made. For example, kelp bunches were picked up and shaken so then the animals that emerged could be counted and weighed. The same applies to rocks with fouling that were collected to identify, count and weigh the present species. The aim of the study was to see if some rare and worthy of protection species, that may be damaged by seaweed collection, could be found, which was not the case.

Table of common species found in different habitats (see also Annex 5)

Eelgrass & Other Marine Grasses	**Algae**	**Stones**
Chironomid ae gen. sp.	Palaemon sp.	Littorina sp.
Hediste diversicolor	Mytilus edulis	Balanus improvisus
Crangon crangon	Teodoxus fluviatilis	Mytilus edulis
Idothea balthica	Littorina sp.	Teodoxus fluviatilis
	Crangon crangon	Gammarus sp.
Corophium volutator	Gammarus sp.	Sphaeroma hookeri
Gammarus sp.	Jaera albifrons	Corophium volutator
Neomysis integer	Tabanidae gen. sp.	Hydrobia ulvae
Sphaeroma hookeri	Idothea baltica	Idothea baltica
Jaera albifrons	Mya arenaria juv.	Neomysis integer
Balanus improvisus		Crangon crangon
Electra pilosa		Corophium volutator
Mytilus edulis		
Macoma balthica		
Teodoxus fluviatilis		
Littorina sp.		
Hydrobia ulvae		

Conclusions

Coastal zone inventory with record of algae and rarer plants

A distance of 30 km from the western to the eastern city limits was investigated to determine the beach type that dominated the and the presence of algae, and other plants, on the beach. The result is a coastal zone atlas accompanying this report, as Appendix 1. During this investigation, observations of rarer plants in the riparian zone were also made. The results are presented in a plant atlas (Appendix 2). Both annexes consist of a thorough documentation of Trelleborg's coastline with photos and beach profiles. An estimate of algal biomass along the beaches has also been made. The estimated amount of algae, in the two week inventory period, was 10 500 tonnes. The amount of algae mass in the coastal water has not been calculated but is a significant amount. Overall there are good opportunities for the collection of algae in Trelleborg Municipality.

Inventory of underwater plants

In total 17 transects were carried out along the Trelleborg coastline. The most interesting and valuable areas of underwater plants were found in the western part of the study area. In these locations fine seaweed forests of wrack and toothed wrack were found. There was also an abundant presence of eelgrass and other marine grasses in these areas. All of these plant communities are very important habitats in the Baltic Sea, as they are living and breeding areas for many invertebrates and fish. The investigation also made visits to the sea areas previously identified, by an aerial survey, as being key areas for eelgrass. However the results showed that air photos were misinterpreted, and instead of eelgrass there were large areas of stringy red algae.

Inventory of benthic fauna and fish

The inventory of benthic fauna and fish also showed that the western areas of Trelleborg's coastline are the most valuable from a biological point of view. The area is a frontier zone to the North Sea and there is an element of marine species, such as periwinkle and shore crabs, that show this. The western parts of the coast also had an abundant presence of various fish species. One of the important local fish areas was also the outlet of Skateholmsån at the eastern municipal boundary, which is an important spawning ground for fish.

Overall, the fish surveys showed that some parts of Trelleborg's coastline is relatively rich in fish species.

A general conclusion is that algae should not be collected in the western coastal areas. While much of the eastern coast (with a few exceptions), from the City of Trelleborg to the eastern municipality boundary, is well suited for algae collection without the risk of damaging some important marine habitats.

Attachments

A number of detailed maps showing the localities where samples were taken have been annexed to the report.

Annex 1. Coastal zone inventory
Annex 2. Rare Plants on the Beach
Annex 3. Excel sheet with the results from the algae inventory
Annex 4. Excel sheet with the results from fish inventory
Annex 5. Excel sheet with the results from the benthic fauna inventory

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