BEYOND KIEL BAY: BEACH WRACK AND SEAGRASS IN AN INTERNATIONAL AND CIRCULAR ECONOMY CONTEXT

This is the second E-Zine from the INNOVA Innovation Hub Kiel Bay, Germany. The first Kiel Bay E-Zine describes the region of the innovation hub and introduced the aspect of beach wrack with different approaches how communities deal with this natural issue. This second edition is all about beach wrack and seagrass in an international and circular economy context. It demonstrates how the issue of beach wrack and seagrass as a nuisance and potential resource is handled in different countries.

The E-Zine also reports on the INNOVA project and presents activities such as first results from an expert workshop and the presentation of a video series dealing with seagrass and beach wrack, called ‘Seagrass & Co’.

The international examples used in the Ezine is located in the Baltic Sea region. It also highlights the final conference of the POSIMA beach wrack project, where in cooperation with INNOVA English versions of the video series ‘Seagrass & co.’ were made available.

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WHAT IS HAPPENING WITH THE INNOVA PROJECT – PROGRESS IN KIEL BAY

CLIMATE CHANGE AND BEACH WRACK - WORKSHOP
The changing climate of the Baltic Sea and its impact on the distribution and volume of beach wrack was the topic of an expert workshop, organized in Eckernförde (near Kiel) on 12 June 2019. It is clear from published research studies and interviews with many stakeholders, including scientists, that the relationship between climate change and beach wrack is not evident. The INNOVA project invited experts from the fields of climate science, coastal science, biologists and others to this workshop to discuss the state of knowledge on the relationship between climate change and beach wrack.

During the workshop, all participants were asked to contribute to a sketch of the different aspect of the Baltic coast. This sketch or model contained the elements important to the topic of beach wrack. For example, experts agreed (with a high degree of confidence) that climate conditions such as temperature, sunshine and turbidity, will have a strong influence on the distribution and volume of beach wrack. However, how big this influence is, is not clear and it remains impossible to predictably quantify the change in beach wrack occurrence on the Baltic shoreline. Even if one could project the ocean-climate change, the impact on the beach wrack is very difficult to quantify. This is due to the inherent uncertainty of climate variables, and persistent knowledge gap on the interaction between physical, biological and ecological parameters.

More Information about the workshop can be found here.

VIDEO SERIES: SEAGRASS & CO
The POSIMA (Pilot region Baltic Sea coast Schleswig-Holstein: Initiation of a value chain beach wrack as a measure for adaptation to climate change) project, in cooperation with INNOVA developed an informative videos series on beach wrack and seagrass. The series ‘Seagrass & Co.’ deals with different aspects of the problems and solutions of beach wrack and seagrass at the Baltic coast of Schleswig-Holstein. Throughout the E-Zine, we will present some of the very relevant video material.

A HISTORY OF BEACH WRACK & CO IN THE BALTIC
Did you know that in the past, beach wrack played a major economic role in coastal regions of the Baltic?

As early as 1913, 8 million tons of dry seaweed were processed in Denmark. This corresponded to three times the volume of the total hay harvest of the same year. Moreover, over an entire period of more than 40 years (until 1959), the Danish “Kalvehave Tangexport” processed up to 500 tons of seaweed per year from the Danish coasts. This material was collected, dried and exported by ship and rail to many European countries. In those days, it was common to find pillows and matrasses in houses throughout Europe filled with Danish seaweed, or houses in remote areas in the Alps insulated with seaweed, to name a few examples.

On the island of Møns in Danish Ulvshale the remains
of a 150-year-old beach wrack dyke can be found, which was originally built to protect against flooding and was later used as a border between grazing areas. Its restoration is part of the EU LIFE Environment programme.

In Brittany (France) on the shore of the Atlantic Ocean, there is an equally long relationship between humans and seaweed. Traditionally the collection was left to the poorest of the society to allow them to earn a modest income in fall and spring, when the ocean usually was rough and beach wrack washed ashore in great quantities. Therefore, it is not surprising to see the practice of seaweed harvesting depicted in paintings and engravings from that time.

Probably the most famous works of art depicting Breton beach wrack collectors was painted by the impressionist painter Paul Gauguin in 1888. Other less known painters of seaweed collecting, includes Henry Moret, who specialised on depicting such scenes. Even today, villages in Brittany celebrate this custom and practice in festivals and artistic interpretations. Communities such as that of Le Pouldu, once made a living from collecting seaweed and other objects that the sea washed ashore.

Outside Europe, other examples of beach wrack use can be found in Australia and in the United States where beach wrack is still collected for various purposes. It is still sold as animal feed and garden fertilizer in these places. In the north-west of the United States, the collection and usage of beach wrack for commercial purposes is regulated at the State level.

This testifies to the many examples of the use of beach wrack worldwide. In contemporary public debate, however, its potential has so far been little discussed. Through the efforts of the INNOVA project in the Kiel Hub, the climate knowledge is potentially helping inspiring citizen and authorities to revive the good old tradition of utilizing natural resources.

WISE MANAGEMENT OF BEACH WRACK – CIRCULAR ECONOMY

In the INNOVA E-Zine #3, the Kiel Bay INNOVA team presented aspects of wise management of beach wrack. The wise use of beach wrack (or components thereof) is an activity that could contribute to a “circular economy” where this naturally occurring organic material becomes a net benefit rather than a loss. Two videos from ‘Seagrass & Co’ series portray the new beach wrack entrepreneurs. In Video episode #3: ‘Seagrass for cozy nights’, the focus in on the small business called ‘Strandmanufaktur’. This company uses seagrass to produce hypoallergenic pillows and mattresses. Video #6 ‘Insulating with seagrass’, is an interview with an architect and a seagrass trader to discuss the possibilities of introducing seagrass as an alternative to common ecological building materials.

These two videos are a good example of ‘circular economy’ in the context of beach wrack and seagrass. The aspects if wise beach management and circular economy are also topics in the research projects POSIMA and CONTRA.
POSIMA PROJECT – FINAL CONFERENCE

POSIMA is a German research project initiated by the Christian Albrechts University in Kiel, Germany. This project was concluded with a final conference late 2019. The conference was held in Lübeck-Travemünde in conjunction with the project CONTRA. The work of the CONTRA project is also closely related to that of POSIMA. The results of both projects were presented to the 50 participants of the conference. The presentations were followed by discussions on management options, public/private cooperation to deal with large volumes of beach wrack, as well as public awareness. Aspects of circular economy were discussed, e.g. business model for using beach wrack as packaging material, and about the possibilities of using beach wrack for composting purposes.

POSIMA also pursued, as part of its objectives, the goal of creating a value chain for beach wrack. Together with communities, tourism agencies, coastal managers and local companies, it also promoted nature-based climate adaptation including coastal protection along the Baltic coast of Schleswig-Holstein.

Using information campaigns, workshops, and thesis, the project increased awareness of beach wrack management among different stakeholders. One of the legacies of the project is, for example a constructed beach wrack dune in one of the local communities. POSIMA provided information and advice on the construction and maintenance of the artificial dune to the local coastal community.
CONTRA PROJECT

**CONTRA**, an EU Interreg project initiated in 2019, is an acronym for ‘Baltic Beach Wrack: Conversion Of a Nuisance To a Resource and Asset.’ The research was driven by the question of whether or not it is possible to protect the environment whilst also meeting the public’s demand for clean beaches. The project aimed to find balance between environmental, and economic and social aspects of dealing with beach wrack. CONTRA conduct evaluations in seven case studies along the Baltic coastline. The project established an international network for knowledge exchange, capacity building, awareness raising and promotion of low-treatment or no-treatment options for beach wrack. The project consortium comprises of public authorities, businesses, academia and NGOs coming from six countries (Denmark, Germany, Estonia, Poland, Sweden, Russia).

One of the CONTRA case studies examined the possibility of recycling beach wrack for the production of fertilizers and for use in soil improvement for agriculture. The case study involved the assessment of market opportunities in study and reference areas in Western Mecklenburg, Germany. Another case study in the Køge Municipality, Denmark tested a methodology for gathering and composting beach wrack for use as a landfill bio-cover solution. On the shores of Kaliningrad Oblast (Russia), another case study was used to assess the opportunities to use beach wrack for dune restoration. It also analyzed administrative and legislation constraints, beach wrack availability and the demand for dune restoration.

In all CONTRA case studies, beach tourists have recently been asked about their knowledge of, and attitude towards beach wrack. The main focus of this questionnaire is to assess the public’s knowledge about beach wrack and to find out just how much organic material can be left on resort beaches before it affects visitor activity and destination choices. Moreover, a long-term study over the course of the project is analysing the composition and residence times of beach wrack on beaches. The study is still ongoing and results will be made available on the project website.
CLIMATE SERVICE – ENVIRONMENTAL SERVICE

Developing climate services for the Kiel Bay INNOVA innovation hub is intended to support management of the beach wrack. The work in INNOVA aims to understand the underlying relationship between beach wrack and climatic factors. Many scientific activities and initiatives are on-going (see Video episode #5). In this video researchers from Christian Albrecht University (CAU) in Kiel were interviewed. Scientists from CAU are analyzing beach wrack for nutrients, and the presence of microplastics and heavy metals. In Video #4, Dr. Ivo Bobsien from GEOMAR in Kiel explains the ecological functions of seagrass meadows and beach wrack habitats.

BLUE CARBON INITIATIVE

Blue carbon – a catchphrase coined in the last 10 years (Macreadie et al. 2019), describes coastal carbon-rich ecosystems, such as mangroves, saltmarshes and seagrass meadows. The coastal blue carbon ecosystem can help mitigate effects of climate change by sequestering and storing carbon dioxide (Herr et al. 2017). Globally, seagrass meadows only cover a small area of the ocean sea floor (ca 0.1 to 0.2%), but their carbon sink capacity may account for up to 18% of the total oceanic carbon burial (Rohr et al. 2016). The enormous carbon sink capacity can be explained by the carbon sequestration, meaning the capture and storage of carbon in sediments in the timescales of millennia. The Baltic has an estimated seagrass meadow cover of around 1500–2000 km². However, over the last decades and centuries, the area of seagrass meadows have declined by 67% (de los Santos et al. 2019). Apart from the storage capacity, seagrass meadows also provide other ecosystem services, including coastal protection, water quality management, food provision, and the role of seagrasses as fisheries and key habitats for marine species.

In order to emphasize the importance of blue carbon ecosystems, an ‘International Blue Carbon Initiative’ (BCI) was founded in 2011 to protect and restore coastal ecosystems for their role in reducing impacts of global climate change. For example, the initiative published a comprehensive manual for measuring, assessing, and analyzing coastal blue carbon (Howard et al. 2014). Their website also hosts an extensive library of peer-reviewed publications and reports by the Blue Carbon Initiative that can be browsed by ecosystem or geography. Additionally, a ‘Carbon Scientific Working Group’ was initiated as part of the BCI to provide the scientific foundation for the BCI by synthesizing current and emerging science on blue carbon and by providing a robust scientific basis for coastal carbon conservation, management and assessment. In September 2019, the 12th Annual Meeting of the working group was held in Copenhagen, Denmark. Focus of the working group was a Nordic perspective with the aim to design a ‘Nordic Roadmap for Blue Carbon’. More information on the results of the workshop is available on the webpage of the working group.

REPLANTING SEA GRASS MEADOWS

Human impacts such as pollution causing eutrophication, dredging and climate-change are causing 7% of global seagrass losses (by area) per year. The decline of marine landscape is a major global crisis and key ecosystems services such as commercial fisheries, coastal nutrient filtering, wave attenuation, coastal protection, biodiversity and carbon sequestration are lost for the next generation. Therefore, the need for seagrass meadow restoration is required to re-establish ecosystem services, particularly in areas such as the Danish coast, where losses are severe.

The goal of the project TRANSPLANT (large scale eelgrass transplantation), is led by the University of Southern Denmark. The aim is to conduct large scale transplantation of seagrass in bare and shallow coastal areas. Seagrass meadows have been successful restored by transplantation. This method consists in transplanting shoots (Figure 1A) to chess-like plots of 4m² but up to 0.5 ha. Seagrass transplantation requires manual planting of single shoots, which are buried 5 cm into marine sediment, and anchored with degradable material such as bamboos (V-stake anchor) and iron nails (Weighted anchor) (Figure 1B). In the Danish case, the transplantation is usually done by a 10-persons team. This method is obtaining great success in seagrass restoration. In one of their test locations, Horsens Fjord, the number of shoots increased from 17,000 to 380,000 (22-fold) in transplanted plots in one single year (Figure 2). There is also a rapid return of seagrass biomass and biodiversity of marine invertebrates, suggesting that restoration of meadows play an important role in regaining valuable ecosystem services (see selected photos of transplanted areas). More information on the project leader and research activities can be found here.

Seagrass transplantation and meadow restoration is also taking place in other coastal areas e.g. ‘Seagrass Ocean Rescue’ project in the UK, and in locations of the Chesapeake Bay area of the US (Virginia Institute of Marine Science).
Figure 1: Panel A: Morphology of *Zostera marina* (eelgrass) indicating shoots (terminal and lateral) and rhizome. Panel B: Shoots prepared for transplantation attached to iron nails.

Figure 2: Shoot density in transplanted sites in Horsens Fjord (V-stake anchor, Weighted anchor) and natural meadow.

Sea star

Pipefish
Besides the Baltic Sea, beach wrack also presents a major challenge in other parts of the world. Since 2011 large quantities of Sargassum, another species of seaweed (algae) washes up on Caribbean shores. Sargassum, a brown algae, quickly piles up on the beaches in very large quantities. In the case of Sargassum, the rotted organic material cause a foul odour which also has potential health risks and negatively influences the attractiveness of beaches for tourism. Several factors could explain the proliferation of Sargassum in recent years. Climate change (with warmer temperatures and change of sea currents) together with a surplus of nutrients from agricultural fertilizers and wastewater in the tropical Atlantic area is one possible reason for the proliferation of the algae (see Wang et al. 2019; Louime et al. 2017).

Sargassum also affects the popular shores of the small islands of Guadeloupe and Martinique. These French West Indies islands are INNOVA case studies. In October 2019, an ‘International Conference on Sargassum’ was hosted in Guadeloupe. The conference laid the groundwork for efficient and pragmatic cooperation to provide functional and operational responses to the stranding of Sargassum. The conference brought together heads of state, regional and international organizations, private sector, members of civil society, researchers and academics from the Caribbean. The conference was a first step in a broader Interreg project “SargCoop” designed to foster cooperation between Caribbean territories and to provide shared monitoring information about Sargassum strandings and shared information about the seaweed itself and ways to manage it. Région Guadeloupe and the French National Research Agency also announced and presented the 12 projects selected within their research call for projects on Sargassum.

The Conference was accompanied by a trade show on Sargassum seaweed management. SargExpo showcased products and services in the domains of Remote sensing, monitoring and forecasting of groundings; Sargassum collection; and Sargassum recycling. This first ever trade show was organized by the Région Guadeloupe, in partnership with SEM Patrimonia Guadeloupe and ADEME, the French Agency for Environment and Energy Management. Sargassum prevention and collection equipment were presented (floating barriers, boats, conveyors…) and exhibitors showed promising recycling solutions, such as composting and production of bioplastics and other material (paper, cardboard).

You can find more information on Sargassum management in the French Caribbean here and here.
In summary, beach wrack affects coastal areas around the globe, not only on the German Baltic Sea. In most of these locations, where beach wrack is common, it is often seen as nuisance for coastal communities and beach tourists. However, there is also another more positive side to this story. Beach wrack can be seen as a common and cheap natural resource that offers many opportunities for exploitation. As part of the circular economy, beach wrack can be used for several different and beneficial purposes. A shift of perception of the usefulness of beach wrack seems possible and is needed: from risk and loss to opportunity and benefit. This E-Zine presented some views on the potential benefit of the use of beach wrack. It also highlighted the uncertainties of relying on the availability of beach wrack as a resource under a changing climate. 27

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Pictures:
Page 1: Project CONTRA
Page 2: Project INNOVA
Page 4: Nico Stelljes
Page 5: Project CONTRA
Page 7: Project TRANSPLANT
Page 8: Jérôme Roch