



Research Portfolio

Assignments September 2015 – February 2016

DELTA ACADEMY APPLIED RESEARCH CENTRE
MAY 2015

TABLE OF CONTENTS

DELTA ACADEMY APPLIED RESEARCH CENTRE	0
RESEARCH GROUP AQUACULTURE IN DELTA AREAS	1
LIVE FEED FOR FISH LARVAE: COPEPODS	1
EFFECT OF LIGHT ON THE GROWTH AND BIOCHEMICAL COMPOSITION OF <i>ISOCHRYSIS GALBANA</i>	1
EFFECT OF DIFFERENT CULTURE MEDIUMS ON THE GROWTH AND BIOCHEMICAL COMPOSITION OF ALGAE	2
EFFECT OF DIFFERENT HARVEST REGIMES ON THE PRODUCTION OF ALGAE	2
Production and overwintering of red seaweeds	3
Grow-out and intermediate harvesting of red seaweeds	3
Detecting stress levels in MUSSELS in relation to CULTURE practices	4
SHELLFISH PRODUCTION PARAMETERS IN OFF-BOTTOM AND IN-BOTTOM CULTURES IN THE DUTCH DELTA	4
Modelling shellfish production	5
OFF-BOTTOM OYSTER CULTURE: A NEW METHOD FOR THE NETHERLANDS TO CULTURE OYSTERS, DOES IT IMPROVE OYSTER QUALITY AND WHAT ARE THE ENVIRONMENTAL IMPACTS?	5
TRANSPORT COSTS FOR MUSSELS: ADAPTATIONS AFTER SUDDEN CHANGES IN FOOD QUALITY	6
Miscellaneous	6
BUILDING WITH NATURE	7
Effect of water dynamics on the clearance rate of oysters and mussels	7
Battle for the Reefs: Exotic vs native species on artificial oyster reefs	8
ARTIFICIAL OYSTER REEFS ON THE OESTERDAM SAFETY BUFFER PROJECT LOCATION	8
EARLY BENTHIC PHASE EUROPEAN LOBSTERS (<i>HOMARUS GAMMARUS</i>), WHERE ARE YOU?	8
biodiversity assessments on rich revetments	9
Tidal inlet dynamics at perkpolder	9
Biodiversity on the dikes with mastic asphalt of Zeeland	10
BUILDING WITH NATURE: INTERNSHIPS AND GRADUATION PROJECT OUTSIDE HZ	13
IDENTIFYING THE RELATION BETWEEN THE TRAITS OF INTERTIDAL-ORGANISM AND THE ECOSYSTEM SERVICES THEY PROVIDE: CARBON STORAGE, COASTAL PROTECTION AND BIODIVERSITY	13
DEVELOPING KNOWLEDGE TO PRESERVE AND RESTORE VALUABLE COASTAL ECOSYSTEMS: A GLOBAL STUDY ON SEAGRASSES, MANGROVES AND SALT MARSHES	13
BIOGEOMORPHIC LANDSCAPE FORMATION BY ECOSYSTEM ENGINEERS: GENERALIZING ACROSS SPECIES BY UNDERSTANDING THE ROLE OF ORGANISM TRAITS (PLANTS, ALGAE AND BENTHOS)	14
PROVIDING A MECHANISTIC UNDERSTANDING HOW TO MAXIMIZE COMBINED NATURE AND COASTAL PROTECTION GOALS	14
WATER TECHNOLOGY	15
Reuse of greenhouse wastewater	15
Enhancing the biodegradability of cooling tower blowdown using advanced oxidation processes	15
Reuse of process water and water contents from Food industry	15
Haalbaarheidsstudie naar vetzuurproductie in anaerobe reactoren (Dutch only)	16
Removal of pesticides from agricultural feedwater	16
prevention of legionella from wastewater prior to reuse	16
plug & play pilot for multipurpose recycling of industrial wastewater	17
WATER SAFETY & SPATIAL PLANNING	18

Professionals and Self-reliant Citizens	18
Hydro-Social Deltas	18
Water Sensitive Area Development in the Waterpoort region	19
Recreational opportunity map of the West-Brabantse Kreken	20
Spatial and leisure opportunities of a mild desalination wetland	20



Reservoir near DOW



Oesterdam Safety Buffer Project



Oyster cultivation in SEA Lab

DELTA ACADEMY APPLIED RESEARCH CENTRE

Delta Academy

The Delta Academy, as part of HZ University of Applied Sciences, offers unique study programmes and an applied research centre in the field of delta technology. The academy is based in the southwestern delta of the Netherlands.

The study programmes are designed to develop a broad range of skills in delta technology, which will give students a foundation in knowledge for water, land and life in delta areas. The three specialised Bachelor's programmes Civil Engineering, Water Management and Delta Management focus on infrastructure, ecology, water supply, policy and governance in delta areas.

Applied research in delta technology

Furthermore, the Delta Academy includes an applied research centre. Lecturers, researchers and students work together to conduct applied research in delta technology in four main fields: Building with Nature, Aquaculture in Delta Areas, Water Technology and Water Safety & Spatial Planning.

The applied research is carried out in close collaboration with various partners in professional practice, like small and medium-size businesses and public institutes, sometimes in international consortia. The applied research provides knowledge and new insights that will lead to practical solutions and products to professional practice.

Education and applied research are strongly interconnected in the Delta Academy. Mostly through courses, fieldwork and experiments in the laboratory facility SEA Lab. Students participating in applied research come in contact with professional practice through internships, minors and research-assignments, which give them the opportunity to build a professional network during their studies.

Are you interested?

Students have the possibility to participate in applied research. This research portfolio is an overview of all projects the Delta Academy Applied Research Centre has to offer. Students that are interested in an internship or final thesis can apply by sending a motivation letter. Motivation letters are to be sent preferably before February 2015. Please send your letter to the contact person for the research group of your interest:

- Aquaculture in Delta Areas: Jouke Heringa – jouke.heringa@hz.nl
- Building with Nature: Carla Pesch – cpesch@hz.nl
- Water Technology: Hans Cappon – hans.cappon@hz.nl
- Water safety and Spatial Planning: Jean-Marie Buijs – jm.buijs@hz.nl

More information

Find more information about the research groups on [the Delta Academy website](#). Or follow us on Twitter ([@DeltaAcademy](#)) and Facebook ([Delta Academy](#)).

AQUACULTURE IN DELTA AREAS

Research group Aquaculture in Delta Areas of the Delta Academy has its focus on sustainable saline aquaculture in and outside the region Zeeland. Aquaculture is the controlled production of saline crops, algae, seaweed, ragworms, shellfish and fish. Cultivation of these organisms can take place in several (intensive and extensive) ways. The research group Aquaculture has built up an extensive network of Small and Medium Enterprises (SME), consultancies and knowledge institutes involved in aquaculture in and outside the Netherlands. The main research topics are; Integrated Multi Trophic Aquaculture (IMTA), new species to the Dutch situation (such as lobster and abalone), improvement of cultivation environments, groundwater suitability, quality aspects in shellfish cultivation and algae cultivation.

The research group Aquaculture uses a full-fledged research facility SEA Lab, in which many applied research (experiments) are carried out.

More information about research possibilities of this group: Jouke Heringa: jouke.heringa@hz.nl
Please send your application and motivation letters for internships and final thesis to Jouke Heringa. Motivation letters are to be handed in preferably before July 17, 2015.

LIVE FEED FOR FISH LARVAE: COPEPODS

In many cases live feeds are used in the first feeding phase of fish larvae. Research showed that the use of copepods has several advantages over the use of Artemia or rotifers: 1. Early life stages of copepods are smaller than Artemia or rotifers and therefore more suitable for small fish larvae; 2 The swimming motions of copepods seem to be more attractive to fish larvae; 3 the nutritional value of copepods is higher than for the other live feed sources. Because of these reasons copepod eggs have a huge market potential and could be exported worldwide. However besides producing copepod eggs and ensuring good quality of the eggs. The eggs still have to be stored and transported in order to make shipping possible. Questions remain on the processing steps and their relation with the quality and shelf life of the eggs.

Research type: literature study, experiments (HZ, Vlissingen)

Research level: minor / internship / final thesis (BSc./MSc. level)

Prerequisite: good understanding of biology/chemistry; good analytical skills; communicative

Partners: Fry Marine

Researcher involved: research group aquaculture (Pim van Dalen and Jasper van Houcke)

Period: 1st semester 2015-2016

EFFECT OF LIGHT ON THE GROWTH AND BIOCHEMICAL COMPOSITION OF *ISOCHRYSIS GALBANA*

In June 2015 the RAAK PRO project "Robust Algae culture for AQUAculture" (RAAQUA) has been granted. This project involves a 4 year study to gain new knowledge about the relation between environmental factors, control variables and eventually yield of cultured marine algae for land based aquaculture. The project will be carried out in close cooperation with Wageningen UR, aquaculture companies, other institutions and the Province of Zeeland. The main focus is the effect of 5 control variables (light, temperature, medium, harvest regime and mixing) on the quality, quantity and cost price of three alga species (*Rhodomonas baltica*, *Skeletonema costatum* and *Isochrysis galbana*) cultured in three different systems (photo bioreactor, Seacaps and open ponds).

Previous studies on the effect of different light sources on the growth and biochemical composition of *Rhodomonas baltica* showed good results considering maximum density and production. The same study needs to be carried out for the algae *Isochrysis galbana*. Three different light sources (tL, LED

white and LED purple) will be used. Growth will be measured with algae counts and the biochemical composition (lipids, proteins, carbohydrates and fatty acids) will be determined in the lab.

Research type: literature study, experiments (HZ, Vlissingen)

Research level: minor / internship / final thesis (BSc./MSc. level)

Prerequisite: good understanding of biology/chemistry; good analytical skills; communicative

Partners: Wageningen UR, several Small and Medium (Aquaculture) Enterprises, national and international knowledge partners, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Pim van Dalen, Wessel Bakhuizen and Jasper van Houcke)

Period: 1st semester 2015-2016

EFFECT OF DIFFERENT CULTURE MEDIUMS ON THE GROWTH AND BIOCHEMICAL COMPOSITION OF ALGAE

This study will also be part of the RAAK PRO project RAAQUA. Many different culture mediums (Walne, F/2, Bold's basal etc.) are available for the culture of algae. All with different nitrogen or phosphorus sources, different concentrations and different N-P ratios. Other differences between the mediums are the concentrations of micronutrients and vitamins.

During this study the effect of different mediums on the growth and biochemical composition (lipids, proteins and carbohydrates) of several algae will be examined.

Research type: literature study, experiments (HZ, Vlissingen)

Research level: minor / internship / final thesis (BSc./MSc. level)

Prerequisite: good understanding of biology/chemistry; good analytical skills; communicative

Partners: Wageningen UR, several Small and Medium (Aquaculture) Enterprises, national and international knowledge partners, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Pim van Dalen, Wessel Bakhuizen and Jasper van Houcke)

Period: 1st semester 2015-2016

EFFECT OF DIFFERENT HARVEST REGIMES ON THE PRODUCTION OF ALGAE

Harvest regimes can have a big influence on the production of algae. Timing of harvest (mid exponential, late exponential etc.) and amount of harvest volume seem to have relations with algal production. In this study a semi-continuous algae culture will be started and it is up to you to get the highest production based on the harvest regime. Of course other influencing parameters should remain stable throughout the experimental period. This study will be part of the RAAK PRO project RAAQUA. The algae production will take place in the SEA Lab in Vlissingen. The culture will be done either in Seacaps systems or in raceways, depending on the species ((*Rhodomonas baltica*, *Skeletonema costatum* and *Isochrysis galbana*). You will need to closely monitor the cultures and test different harvest regimes for the different systems and algae species.

Research type: literature study, experiments (HZ, Vlissingen)

Research level: minor / internship / final thesis (BSc./MSc. level)

Prerequisite: good understanding of biology/chemistry; good analytical skills; communicative

Partners: Wageningen UR, several Small and Medium (Aquaculture) Enterprises, national and international knowledge partners, Centre of Expertise Delta Technology, Centre of Expertise Biobased Economy

Researcher involved: research group aquaculture (Pim van Dalen, Wessel Bakhuizen and Jasper van Houcke)

Period: 1st semester 2015-2016

PRODUCTION AND OVERWINTERING OF RED SEAWEEDS

The company Seaweed Harvest Holland is in the startup phase to farm seaweed for human consumption. At the moment they grow seaweed on a pilot scale level and intend to rapidly scale up their production facilities. For two species of red seaweed (*Gracilaria gracilis* and *Chondrus crispus*) the HZ performed research about reproduction. The next step is to focus on production of these seaweeds. Different cultivations systems like bubbling columns and tanks need to be tested and compared in the SEA-Lab.

In the Dutch delta, *Gracilaria* grows from late spring till the end of fall. To maximize the cultivation period of this species, it can be interesting to keep the seaweed over the winter. Methods to keep the seaweed in good condition need to be explored.

As part of this research a literature study needs to be performed about productions systems and achievable production quantities.

The aim of this research is to obtain practical knowledge about production and over-wintering of red seaweed.

Research type: lab experiments and literature study (HZ, Vlissingen)

Research level: minor/ internship (both BSc. and MSc. level)

Prerequisite: good understanding of biology; good analytical skills; good literature research skills; good practical skills; communicative

Partners: Seaweed Harvest Holland, Hortimare, Centre of Expertise Delta Technology, Centre of Expertise Biobased Economy

Researcher involved: research group aquaculture (Jorik Creemers)

Period: 1st semester 2015-2016

GROW-OUT AND INTERMEDIATE HARVESTING OF RED SEAWEEDS

To produce large quantities of seaweed with low running costs, Seaweed Harvest Holland wants to cultivate seaweeds at rafts in the Eastern Scheldt. The purpose of this research is to test this cultivation method for *Gracilaria* and *Chondrus* in practice, thereby focusing on growth rate, epiphytes and predation. The cultivation methods that are tested, are placing the seaweed on lines and in bags.

There is a demand for seaweed year round, therefore Seaweed Harvest Holland wants to be able to deliver these red seaweeds over the whole cultivation period. The effect of intermediate harvesting (harvesting parts of the plants and leaving stems to grow out) is not known. As part of this research, the effect of intermediate harvesting on the production will be tested.

Placing starting material (seaweed stems) on lines can be labor intensive, a different method would be to let the seaweeds sporulate and let the spores settle on lines. To obtain more knowledge about this, literature research needs to be performed about sporulation and the biological background of reproduction of red seaweed.

The aim of this research is to obtain practical knowledge about grow-out and intermediate harvesting of red seaweed.

Research type: field experiments and literature study (HZ, Vlissingen)

Research level: minor/ internship (both BSc. and MSc. level)

Prerequisite: good understanding of biology; good analytical skills; good literature research skills; good practical skills; communicative

Partners: Seaweed Harvest Holland, Hortimare, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Jorik Creemers)

Period: 1st semester 2015-2016

DETECTING STRESS LEVELS IN MUSSELS IN RELATION TO CULTURE PRACTICES

In on-bottom mussel culture mussels are seeded on culture plots, where they grow out from small mussels to consumption size. Seeding upon transplantation of mussels is common practice in mussel bottom culture. Previous work showed that mussels on culture plots experience large loss rates after seeding. Meanwhile, seed performance is critical for culture success. Culture practices can cause stress in mussels, with adverse effects on mussel condition, while survival of mussels is determined by their physiological condition and quality upon seeding. The question is when does this occur in mussel culture and how can this be avoided.

We like you to determine methods to detect stress levels in mussels and test this by sampling and examine stress levels, that have been exposed to different stressors. In advance experiments can be carried under controlled conditions where we can test different effects of different stressors.

Research type: desk study, sampling & experiments (HZ, Vlissingen)

Research level: internship (BSc. level)

Perquisite: preferably affinity with biology and chemistry, precise, dedicated, analytical skills

Partners: Several major Mussel farmers, Imares, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Eva Hartog & Jacob Capelle)

Period: 1st semester 2015-2016

EFFICIENCY OF FISHING GEAR IN EXTENSIVE MUSSEL CULTURE

Dredging is the only method available for harvesting mussels in extensive bottom culture. A study on dredge efficiency in oyster fishery showed that dredge efficiency is low. In mussel culture dredges are adjusted according to the circumstances. An increase in dredge efficiency will reduce the numbers of tows required to catch the harvest limit, reduce costs, and reduce localized biological and ecological effects. Dredge designs to increase efficiency need to be able to cope with a range substrate compositions and topography, different types and volumes of bycatch, a range of current speeds and sea conditions. We want you to quantify and visualize mussel dredge performance, by means of underwater video cameras. This will result in recommendations, on how to improve dredging efficiency. When improvements are likely and if time allows, new designs can be tested. Furthermore, similar questions apply to other types of gear used in mussel culture e.g. dredges to remove starfish from mussel plots.

Research type: field work (on mussel vessels), video analysis, technical improvements on dredges

Research level: minor/internship (BSc. level)

Perquisite: technical skills, dedicated, creative

Partners: Several Mussel Farmers, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Jacob Capelle)

Period: 1st semester 2015-2016

SHELLFISH PRODUCTION PARAMETERS IN OFF-BOTTOM AND IN-BOTTOM CULTURES IN THE DUTCH DELTA

We are looking for a student who is willing to participate in a project (Saline Production), in which optimization of shellfish production by different innovative methods in the Dutch delta is investigated. Production is determined by growth and survival of starting material, which are often juvenile shellfish. Culture systems and species under research include: longline mussel culture, oysters (*Crassostrea gigas* and *Ostrea edulis*) in baskets, bags and flupsies, carpet shells and cockles in-bottom on culture plots. The

student will have to take and process samples from the different culture systems and analyze results on growth, mortality and quality (meat weight, shell shape and fouling) as function of different treatments.

Research type: combination of field work and lab work

Research level: internship (BSc.level)

Prerequisite: understanding of basic ecological principles, driving license

Partners: Cooperation of three major Shellfish farmers, Imares

Researcher involved: research group aquaculture (Jouke Heringa and Jacob Capelle)

Period: 1st semester 2015-2016

MODELLING SHELLFISH PRODUCTION

In September 2013 the RAAK PRO project 'Saline production' has been granted. This project involves a 4 year study in optimizing various near shore shellfish culture in Lake Grevelingen, Lake Veere and Oosterschelde in the South West Delta Region. Focus of the project is off bottom (in cages) oyster farming, bottom culture of manila clams and cockles, and rope culture of mussels, all in close cooperation with local producers, companies and research institutes (a.o. IMARES). Main goal of the project is to increase on site (farm-scale) shellfish production, based on local (farm-scale) conditions. One of the activities of this project is the development of a mathematical production model that can be used as a decision support tool for farmers. In a previous phase of this project, a 0-D farm model has been developed in R. The model is based on an generic growth model (the Dynamic Energy Budget model) and a model describing the population dynamics. The input to the model are the starting conditions (species, amount and size) and the environmental conditions (temperature and food). The output of the model is the development and production of the shellfish. By varying input, users can run different scenarios and evaluate the effect of management options. In a previous phase, simulations were made with data on temperature and food availability from fixed monitoring locations of RWS. Since July 2014, on-site data on food availability (chlorophyll-a) and temperature from the actual farms is available. With the model, the student(s) will perform model simulations in order to get insight on density dependent food uptake and describe the relations for the different shellfish species (mussels, oysters, clams and cockles) between stocking density and food uptake, and between food transport/flow rate and food availability/uptake. The challenge is to preprocess the measured data on temperature and food availability and analyze the model output using different input. The student will learn to work with dynamic models using the open source software R. Student(s) will work closely together with researchers from IMARES and research group Aquaculture in Delta Areas.

Research type: literature/desk study

Research level: minor/internship

Prerequisite: good understanding of ecology, biology of shellfish and hydrology; good analytical and mathematical skills; good planning skills

Partners: local producers, companies and research institutes

Researcher involved: research group aquaculture (Tony van der Hiele) and IMARES

Period: 1st semester 2015-2016

OFF-BOTTOM OYSTER CULTURE: A NEW METHOD FOR THE NETHERLANDS TO CULTURE OYSTERS, DOES IT IMPROVE OYSTER QUALITY AND WHAT ARE THE ENVIRONMENTAL IMPACTS?

Market demands for high quality oysters is higher current production in the Dutch delta. A group of oyster growers are starting with a new initiative to culture oysters off-bottom, in baskets and bags (on tables). Whether this method is successful and allows up-scaling, is dependent on the growth and

quality of the oyster from these production methods and the cost-price per oyster. Growth and quality should be better than for oysters from bottom plots, which is the traditional oyster culture in The Netherlands and at least comparable to oysters imported from France. Differences in oyster quality for the different oysters will be tested. Furthermore, structure of culture systems and activities around them will have an impact on the local environment. This impact needs to be quantified. Impacts will be estimated by effects on bird disturbance, by quantifying effects of culture activities on foraging bird species.

Research type: combination of field work and lab work

Research level: minor/internship (BSc. level)

Prerequisite: driving license, exactitude, bird identification skills are advantageous

Partners: Cooperation of three major Shellfish farmers

Researcher involved: research group aquaculture (Jacob Capelle & Jouke Heringa)

Period: 1st semester 2015-2016

TRANSPORT COSTS FOR MUSSELS: ADAPTATIONS AFTER SUDDEN CHANGES IN FOOD QUALITY

Mussels are cultured on a large scale culture in The Netherlands, it involves about 80 companies and is carried out on about 100 km² of culture plots in the Oosterschelde and Dutch Wadden Sea. Each company owns several culture plots and during the culture cycle mussels are regularly transplanted between plots. Environmental conditions on culture plots differ, for example the Wadden Sea is much more turbid than the Oosterschelde. Mussels are filter feeders and will adapt themselves to prevailing conditions. However, when the difference between conditions is large, mussels struggle to adapt or may not cope at all. There are indications that this reduces mussel production potential. We are investigating this effect within the framework of a project on improving mussel productivity (PROFMOS). We focus on adaptations in the feeding apparatus of mussels (gills and palps and their ratio), we monitor these quantities from culture plots and carry out additional experiments. Focus is on the relation between adaptation and condition.

Research type: lab work/experiment

Research level: minor/internship/final thesis (BSc. level)

Prerequisite: good dissection skills, exactitude, interest in biology/ecology,

Partners: Several major Mussel farmers, Centre of Expertise Delta Technology

Researcher involved: research group aquaculture (Jacob Capelle & Jouke Heringa)

Period: 1st semester 2015-2016

MISCELLANEOUS

The Applied Research Group Aquaculture in Delta Areas is closely involved with aquaculture initiatives from stakeholders in the region. Regularly, research questions and topics pop up during the semester. These researches are different level and can be different types. It is worthwhile to contact the coordinator Jouke Heringa (jouke.heringa@hz.nl) for further research possibilities.

BUILDING WITH NATURE

As a result of changes in societal demand and technical developments, water management and engineering are moving from hard traditional structures like dikes and dams, to designs in which natural structures and processes are incorporated. One of the underlying factors in this development is the increasing awareness of the impacts of climate change and its effect on water levels and extreme events. Furthermore, water managers are expected to create more safety, opportunities for recreation, and other benefits, with increasingly smaller budgets. This requires infrastructure that combines multiple functions. In our research group we work on application of the Building with Nature concept. 'Building with Nature' focusses on solutions that use abiotic forces of nature (e.g. wind and currents that transport sand) and ecosystem services delivered by organisms (e.g. reefs and vegetation that catch and stabilize sand). The research group also focusses on Building for Nature: creating additional nature values in and on monofunctional structures such as dikes.

Current research themes include:

- 1) Optimizing the design of Building with Living Nature structures such as oyster reefs or salt marshes, used for coastal protection and nature development
- 2) Sediment dynamics on sand nourishment locations
- 3) Rich revetments: Building for Nature on dikes
- 4) Tidal restoration projects
- 5) Transfer of knowledge by means of an expertise management

More information on research possibilities of this group: Carla Pesch cpesch@hz.nl

Please send application and motivation letters for assignments within the HZ to Carla Pesch. Motivation letters are to be handed in preferably before July 17, 2015..

EFFECT OF WATER DYNAMICS ON THE CLEARANCE RATE OF OYSTERS AND MUSSELS

As part of the Building with Nature project investigating the possibility of farming shellfish on the dykes, it is important to know how the oysters will grow in these high dynamic environments where the movement of water can be intense.

The growth of shellfish is highly dependent on how much an individual eats i.e. the available algae in the water, which can be measured by the rate at which the oyster filters the algae out of the water (clearance rate). To better understand how oysters and mussels fare in dynamic environments with high water dynamics you will work in Yerseke at NIOZ measuring the clearance rate of small oysters and mussels in three different levels of water movement intensity and their growth over three months. From this you can extrapolate the effect of hydrodynamics on the feeding behaviour and growth of oysters if they were to be farmed on the dykes.

Research type: lab research, desk research.

Research level: minor

Prerequisite: interest in ecology

Partners: Rijkswaterstaat Zee en Delta, NIOZ

Client: Anneke van den Brink

Period: semester 1, 2015-16

BATTLE FOR THE REEFS: EXOTIC VS NATIVE SPECIES ON ARTIFICIAL OYSTER REEFS

The Oosterschelde has a high number of exotic species that arrived (among others) via the shellfish aquaculture industry. The introduction of new hard substrates in the form of dykes and oyster reefs at the Oesterdam is intended to help the developing ecosystem by providing new habitats to colonise. As these new habitats begin completely empty, they also provide an equal starting line for both exotic and native species. It is likely that the exotic and native species will compete for the new habitat and for food. Who will win?

In this project you will conduct a monitoring investigation of the four artificial oyster reefs around the Oesterdam as well as the natural oyster reefs to determine the ratio of exotic and native species of similar ecological niches, thereby creating an indication of how the ecosystem is developing and of what species are likely to benefit from the further addition of artificial oyster reefs to the Oosterschelde. Furthermore you will gather, measure and compare the ratios of the crab community from both artificial and natural oyster reefs with focus on the native crab *Carcinus maenas* and the exotic *Hemigrapsus takanoi* as indicator species. You will use this data and that of previous students project to draw conclusions about the competition for habitat between the two species.

Research type: field research, desk research.

Research level: minor

Prerequisite: Driver's licence, interest in ecology, no fear of handling crabs

Partners: Rijkswaterstaat Zee en Delta, NIOZ

Client: Anneke van den Brink

Period: semester 1, 2015-16

ARTIFICIAL OYSTER REEFS ON THE OESTERDAM SAFETY BUFFER PROJECT LOCATION

An Oyster is an ecosystem engineer which is able to change waves, currents and sedimentation patterns in their vicinity. Nowadays we want to use these abilities in our advantage by building artificial oyster reefs. This innovative solution can be used not only to protect dikes against wave action but also stabilize sand on sand banks.

Recently 4 new oyster reefs were constructed at the "Oesterdam safety-buffer project" and it is going to be your task to monitor not only the reef development but also their effects in the morphology of their surroundings. For that you will evaluate the existing data and be responsible to collect new data. You will also compare your results with similar researches. As the oyster reef Technology is still in the beginning your results/work can be very important for improving the design of artificial oyster reefs.

Research type: field research, desk analysis with GIS or Matlab

Research level: Water management students and/or Civil engineering students; minor, internship or graduation bachelor thesis project.

Prerequisite: Driver's License, interest in ecology, morphology, and fluid dynamics

Partners: Rijkswaterstaat Zee en Delta, Deltares

Client: Matthijs Boersema and João Paiva

Period: semester 1, 2015-2016

EARLY BENTHIC PHASE EUROPEAN LOBSTERS (HOMARUS GAMMARUS), WHERE ARE YOU?

The Eastern Scheldt has an extensive lobster fishery for the European lobster (*Homarus gammarus*). There is some knowledge about the distribution of adult lobsters based on catch data and observations by recreational divers. However, the early benthic phase (EBP) lobsters have never been observed in the field. Laboratory experiments have shown that they hide in gravel but also are able to dig tubes in mud. To gain more insight into the possible whereabouts of these tiny lobsters, additional experiments are performed to study their substrate preference. You will perform choice experiments to test the

preference for gravel or mud. Several size fractions of gravel will be tested. Next to the experiments, a literature study will be carried out to seek information on the possible hiding places of the EBP lobsters in natural waters. The outcome of the experiments maybe used for the future design of foreshores of dikes in the Eastern Scheldt, to create a suitable substrate for juvenile lobsters.

Research type: Desk and laboratory research

Research level: Internship

Prerequisite: Interest in aquatic ecology

Client: Tim van Oijen

Period: semester 1, 2015-2016

BIODIVERSITY ASSESSMENTS ON RICH REVETMENTS

Currently, dikes and foreshores are primarily designed from a civil engineering perspective. The main focus is on flood protection and water management. The Building for Nature approach aims at innovating the design of coastal protection structures in order to increase their nature values. Dikes with this type of design are called rich dikes, or rich revetments. These revetments can be of more interest for other use such as diving, fishing or aquaculture.

In Spring and Autumn 2014, and Spring 2015, concrete blocks with different sizes of pits (holes) on the surface were designed and placed at three field locations in the intertidal in the Eastern Scheldt. In this research you will compare the changes in biodiversity on these blocks and you will assess which one performs better and why. Based on your analysis you provide advice on the design of new revetments.

Research type: Desk and field research

Research level: AET students and/or Civil engineering students; minor or internship.

Prerequisite: interest in design and aquatic ecology; experience with Autocad is an asset

Customer: Tim van Oijen, João Paiva

Period: semester 1, 2014-2015

SALT MARSH DEVELOPMENT IN THE RAMMEGORS POLDER

In December 2014, the polder at Rammegors was opened to the Eastern Scheldt. This will create major changes for the previously freshwater area. In this tidal restoration project, the initial development of the salt marsh vegetation will be studied, to develop generic knowledge for future tidal restoration projects. Your assignment is a collaboration between the Research Group Building with Nature and NIOZ, and will consist of an extensive literature research on salt marshes and/or tidal restoration projects, with and a field research on the availability and distribution of seed materials and/or other processes that are of importance for salt marsh development. The results of your literature research will also be used as input for the DeltaExpertise-site, i.e. a wiki environment for knowledge and expertise relating to delta's.

Research type: field research, lab analyses, literature research

Research level: bachelor internship, minor research

Prerequisite: interest in vegetation and ecology, driver's licence

Client: Tjeerd Bouma, Carla Pesch

Period: semester 1, 2015-16

TIDAL INLET DYNAMICS AT PERKPOLDER

Since the termination of the ferry service between Perkpolder (Zeeuws Vlaanderen) and Kruiningen in 2003 the area needed a new destination. In close cooperation with stakeholders a new plan was developed which combines, housing, recreation and the development of a salt march

(www.perkpolder.nl). For the development of this salt march a freshwater agricultural area will be connected to the Western Scheldt in July 2015. The salt water from the Western Scheldt will flow through an opening in the dyke.

The morphological dynamics of this inlet (or breach in the dyke) will depend on the flow velocity, size of the salt march, tidal range and the present type of material (sand and clay). In this study you will monitor the development of the inlet, which will give Rijkswaterstaat important information concerning the stability of the dyke. Furthermore you will try to develop a model which predicts the flow velocity in the inlet and the discharge during ebb and flood.

Research type: field research, modeling (GIS, MATLAB, Excel)

Research level: bachelor internship, minor research

Prerequisite: interest in morphology and fluid dynamics

Partners: Rijkswaterstaat Zee en Delta, Deltares

Client: Matthijs Boersema, Joao Salvador de Paiva

Period: semester 1, 2015-2016

BIODIVERSITY ON THE DIKES WITH MASTIC ASPHALT OF ZEELAND

The Netherlands have been using dikes to protect their country from flooding events for a long time. Although the province of Zeeland is currently protected from flooding due to the dikes that have been constructed along its estuaries, these dikes are still being enforced with hard structures such as asphalt. Often, mastic asphalt is being applied on the lower parts of the dike to enforce the foreshores of the dike. Asphalt has a bad reputation when it comes to facilitating ecology of the foreshore, in part due to its structure and temperature. The foreshores of the dikes of Zeeland often border Natura 2000 areas and can have interesting ecology with for example with different weeds and shellfish. Since asphalt is being applied regularly in the field, it is important to improve the design of asphalt for ecology purposes while maintaining safety. In order to find the driving factors behind organisms growing on this type of asphalt current ecology on these substrates need to be monitored along with its environmental conditions.

During the internship you will do field work along different (predetermined) dike areas in Zeeland, and offshore frames installed with asphalt tiles at the NIOZ site. You will do an inventory of the ecological communities growing on the asphalt enforced areas of the lower dike based on community descriptions, and take pictures of these communities. Also the physical aspects of the different dikes and the mastic asphalt have to be described to build up a database in a Geographical Information System.

You also will analyze your findings along with the environmental conditions that you have measured. The results could be useful for improving the design of mastic asphalt on dikes for both safety and ecology.

Research type: Ecological and Physical field work and data analysis (Zeeland, HZ)

Research level: Free elective (BSc. or MSc.)

Prerequisite: Interest in aquatic ecology and dikes

Partners: Deltares, HZ, Stichting Anemoon

Client: Sophie Vergouwen sophie.vergouwen@deltares.nl, Tjark van Heuvel (HZ)

Period: semester 1, 2015-2016

PBZ-WIKI

Projectbureau Zeeweringen (PBZ) heeft in de ruim 15 jaar dat het actief is een enorme efficiënte manier van werken opgebouwd in het verbeteren van de dijkttrajecten in Zeeland. In ruim honderd verschillende projecten is in die jaren meer dan 300 km dijk verbeterd. Alle expertise van het projectbureau is vastgelegd op de DeltaExpertise-site waarvan de HZ de oprichter en de beheerder is. De kennis die is vastgelegd op de site komt onder andere beschikbaar voor het onderwijs. De wijze waarop de expertise

van PBZ in de site is opgenomen is nog niet optimaal. Vooral de beschrijving van de werkprocessen zijn nog niet volledig in de site beschreven. We zijn hiervoor op zoek naar een enthousiaste student die gevoel heeft voor het schematiseren van processen, het werken in een digitale omgeving en veel eigen initiatief toont. Je wordt opgeleid tot wiki-redacteur en de werkzaamheden zullen onder andere inhouden dat je door middel van interviews 'best en bad practices' zult gaan achterhalen bij de medewerkers van PBZ.

Zie hier voor een zogenaamde 'guided tour' door de Zeeweringenwiki:
http://195.93.238.49/wiki/deltaexpertise/wiki/index.php/GT_PBZ_VN

Research type: interviews, modellering

Research level: internship (stage)

Prerequisite: redactionele vaardigheden, Nederlands

Partners: Projectbureau Zeeweringen

Researcher involved: Paul Vader

Period: 1st semester 2015-2016

RWS ECOLOGIE

In opdracht van Rijkswaterstaat wordt de kennis van een van hun medewerkers die recent met pensioen is gegaan, vastgelegd op de DeltaExpertise-site. Het gaat om ecologische kennis die is opgenomen in allerlei losse documenten. Het werken volgens de expertise-managementmethode (EMM) verbindt deze kennis en legt verbanden waardoor de voorheen losse documenten in een logisch kennissysteem komen te staan. We hebben nog plaats voor een stagiaire die zich graag in de wereld van de wiki wil verdiepen, geïnteresseerd is in de theorie achter EMM en een zwak heeft voor ecologie. Je wordt opgeleid tot wiki-redacteur en je krijgt een eigen deelonderwerp die je gaat uitwerken in schema's en bijbehorende wiki-pagina's. Om een idee te krijgen van het product dat we van je vragen, zie bijvoorbeeld de ecologie van zeegras: http://195.93.238.49/wiki/deltaexpertise/wiki/index.php/Zeegras_Ecologie_van_zeegras_VN

Research type: modellering, literatuurstudie

Research level: internship (stage)

Prerequisite: redactionele vaardigheden, Nederlands

Partners: Rijkswaterstaat

Researcher involved: Paul Vader

Period: 1st semester 2015-2016

HOW TO USE MUSSELS FOR GENERATING MULTI-ECOSYSTEM SERVICES?

Meerwaarde met Mosselen; van concept naar toepassing

Within a collaboration with commercial mussel growers, nature conservation groups, the government and scientists of NIOZ, IMARES and Deltares, the HZ University of Applied Sciences explores the opportunity to create and maintain intertidal musselbanks by active management. The research aims to develop methods to combine a number of seemingly contradictory goals:

- create new, commercial relevant production locations for mussel growers;
- develop new, environmental friendly methods to diminish erosion of tidal flats
- to enhance the environmental quality to fulfil Natura-2000 goals.

By means of experimental and comparative experiments, we will test a number of factors that may be used to improve the chances of establishing intertidal musselbanks, and that may be used to enhance their ecological plus economical value and their effect on sediment stability. Understanding the role of active long-term management in achieving these goals is essential. The project aims to yield applicable knowledge, based on in depth understanding.

Within this context, we offer interested students to participate within the research. The first studies will be aimed at understanding those factors that affect the establishment and survival of young, establishing mussels. The first tests will be done in flumes (stroomgoot) and wave-mesocosms, where after the research will be validated by field experiments. The exact topic that can be done will be based on the period you are interested in.

For more information, please contact: Tjeerd Bouma - tjeerd.bouma@nioz.nl

BUILDING WITH NATURE: INTERNSHIPS AND GRADUATION PROJECT OUTSIDE HZ

NIOZ ASSIGNMENTS: NIOZ prefers graduation over internships

IDENTIFYING THE RELATION BETWEEN THE TRAITS OF INTERTIDAL-ORGANISM AND THE ECOSYSTEM SERVICES THEY PROVIDE: CARBON STORAGE, COASTAL PROTECTION AND BIODIVERSITY

Intertidal landscapes are a harsh environment for both plants and animals. These organisms have to withstand tidal flow, wind waves, anoxic soil conditions, flooding/drought-cycles, and many more stresses. Despite these harsh environmental conditions, a wide range of organisms (plants, algae and benthic animals) inhabits the tidal landscapes, each with their own specific adaptations that enable them to survive. Some of the organisms are even able to modify their physical environment via their structures or activities, which is often referred to as ecosystem engineering. Although the importance of ecosystem engineering for providing ecosystem services is well recognized, the underlying mechanisms explaining how it works are still poorly understood, as it requires an interdisciplinary approach.

We aim to understand which organism traits are most important for *i)* the ecosystem resilience and long-term survival, *ii)* their ecosystem engineering effect on the intertidal landscape development and *iii)* ultimately the ecosystem services they provide (carbon storage, coastal protection and biodiversity).

To answer this question, we combine field and laboratory studies, using state of the art techniques including (wave) flumes, instruments to manipulate and measure mechanical properties of the organisms, various chemical analyses, and many other techniques

Within this research theme we offer several topics, each with the opportunity to tune it towards your specific interest. The possible topics will however strongly depend on the timing of the research. Within this research area, there will be several opportunities to collaborate with the Research Group Building with Nature Building of the HZ Univ. Applied Sciences.

Contact person: Tjeerd Bouma (tjeerd.bouma@nioz.nl)

DEVELOPING KNOWLEDGE TO PRESERVE AND RESTORE VALUABLE COASTAL ECOSYSTEMS: A GLOBAL STUDY ON SEAGRASSES, MANGROVES AND SALT MARSHES

Coastal waters with healthy seagrass meadows, mangrove forests and salt marshes belong to the most productive ecosystems in the world, and also have a high economical value. They provide food and shelter for various organisms, including young life stages of various commercially important fish species. They contribute to coastal protection and store considerable amounts of carbon. At this moment, seagrasses, mangroves and salt marshes are rapidly disappearing on a global scale. Proper management requires a mixture of measures aimed at maintaining existing ecosystems, restoring lost ecosystems and mitigation measures for threatened ecosystems. Experience has learned that such management measures will only be successful when based on fundamental insight in the processes affecting these ecosystems. We want to contribute to preserving seagrasses, mangroves and salt marshes, by dedicated research around the globe (i.e., the Netherlands, Mediterranean, and tropical regions). We specifically aim at understanding basic mechanisms affecting the establishment, growth and disappearance of these vegetation types, and to derive indicators and critical threshold values that can be translated in management objectives.

The research is done by a combination of techniques, including field studies in exotic places, as well as studies in the flume where we can control all environmental conditions, including current and flow.

Within this research theme we offer several topics, each with the opportunity to tune it towards your specific interest. The possible topics will however strongly depend on the timing of the research. Within

this research area, there will be several opportunities to collaborate with the Research Group Building with Nature Building of the HZ Univ. Applied Sciences.

Contact person: Tjeerd Bouma (tjeerd.bouma@nioz.nl)

BIOGEOGRAPHIC LANDSCAPE FORMATION BY ECOSYSTEM ENGINEERS: GENERALIZING ACROSS SPECIES BY UNDERSTANDING THE ROLE OF ORGANISM TRAITS (PLANTS, ALGAE AND BENTHOS)

Interactions between organisms and hydrodynamic forces from waves and currents determine where sediment will erode, and where sediment will accumulate. Hence, these bio-physical interactions are a main determinant of landscape formation (i.e., geomorphology) at intertidal areas.

Especially large (vascular) plants and macro algae have striking effects on intertidal geomorphology. In the intertidal zones, a broad range of different types of plant and algae co-occur, that strongly differ in their appearance (i.e., morphology) Such differences will affect how plants affect the currents and waves, and thereby thus the sediment transport.

Besides plants, there is also a large group of benthic animals (i.e., macro benthos) that affect the landscape formation. Some are highly visible in that they create large reefs, such as oysters and mussels (i.e., epi-benthos). Others are invisible, as they are 'hidden' in the sediment (i.e., endo-benthos). Although hidden, these organisms also have major impact on the sediment dynamics and grain-size distribution by affecting both the critical threshold for erosion to occur and mixing different depth layers.

We are working on developing a general understanding how traits of individual organisms affect processes at the level of populations and thereby affect the large-scale long-term intertidal landscape development.

Within this research theme we offer several topics, each with the opportunity to tune it towards your specific interest. The possible topics will however strongly depend on the timing of the research. Within this research area, there will be several opportunities to collaborate with the Research Group Building with Nature Building of the HZ Univ. Applied Sciences.

Contact person: Tjeerd Bouma (tjeerd.bouma@nioz.nl)

PROVIDING A MECHANISTIC UNDERSTANDING HOW TO MAXIMIZE COMBINED NATURE AND COASTAL PROTECTION GOALS

Ongoing accelerated sea-level rise, increased storm frequency and altered sediment dynamics, threaten coastlines and estuarine ecosystems around the globe, imposing the need for new, cost effective defense schemes. At the same time, many coastal ecosystems are currently threatened and declining, imposing the need for nature conservation and restoration of coastal ecosystems. Restoration or creation of coastal ecosystems offers promising opportunities for building cost-effective coastal defense schemes that enhance nature goals. It is however unclear to which extent nature and defense goals are compatible or opposing.

We aim to unravel *i)* how to use intertidal ecosystems for coastal defense schemes, *ii)* how to maximize nature goals and *iii)* how to integrate both aspects. We study this for coastal vegetation as well tidal flats with benthic communities. Our studies integrate different scales, by combining both the local-scale (i.e., within an ecosystem) and the landscape-scale (i.e., the connectivity between ecosystems and ecosystem compartments). We aim at developing fundamental insights in the physical and biological drivers and interactions that can be widely applied.

Within this research theme we offer several topics, each with the opportunity to tune it towards your specific interest. The possible topics will however strongly depend on the timing of the research. Within this research area, there will be several opportunities to collaborate with the Research Group Building with Nature Building of the HZ Univ. Applied Sciences.

Contact person: Tjeerd Bouma (tjeerd.bouma@nioz.nl)

WATER TECHNOLOGY

The research group water technology aims at development of applicable technologies for sustainable water (re)use in a combined fresh/saline delta.

Current research themes include:

- 1) Recycling of surface and process water for industry, agriculture and aquaculture. Examples are reuse of cooling tower blowdown, rainwater runoff and industrial wastewater.
- 2) Recovery of valuable content in waste water, like nutrients.
- 3) Monitoring and control. Examples are monitoring and control of water filtration systems and control of biofouling in water systems with ultrasound.

Please contact Hans Cappon (hans.cappon@hz.nl) for more information. Motivation letters are to be handed in preferably before July 17, 2015

REUSE OF GREENHOUSE WASTEWATER

Greenhouses have a high water recycling rate, which incorporates disinfection of recycled water in order to remove viruses, fungi and diseases (pathogens). A pilot installation based on ultraviolet/ultrasound (UV/US) will be employed on the spot to disinfect the water. Several microbiological analysis methods will be used to detect pathogen removal and optimize dosages of UV and US. Monitoring and improvement of the operational settings is what this assignment is about. (This assignment is dependent on the availability of the pilot setup.)

Research type: literature study and experiments

Research level: internship

Prerequisite: interest in physics, chemistry and microbiology

Partners: Centre of Expertise Delta Technology, Lans Tomatoes

Contacts: Peter Vollaard, Niels Groot

Period: semester 1, 2015-2016

ENHANCING THE BIODEGRADABILITY OF COOLING TOWER BLOWDOWN USING ADVANCED OXIDATION PROCESSES

Reuse of industrial water is becoming increasingly important in order to reduce the water footprint. Cooling tower blowdown is a tough, but interesting source of water, because it is widely available from process industry and power companies. Blowdown contains various persistent, yet organic substances, which can hardly be treated with biological wastewater processes. The aim is to study a combination of advanced oxidation processes (ozone, UV ultrasound) and biological treatment before reuse.

Research type: experiments

Research level: minor / internship

Prerequisite: interest in chemistry and (micro)biology

Partners: Centre of Expertise Delta Technology, Dow Benelux, AWWWS

Contacts: Peter Vollaard, Niels Groot

Period: semester 1, 2015-2016

REUSE OF PROCESS WATER AND WATER CONTENTS FROM FOOD INDUSTRY

During food processing various wastewater streams (rinsing, blanching, cooling) have possibilities for reuse. The first step is an inventory of the various streams and their quality within the food company.

The next step in this process is the investigation of reuse possibilities and possible treatment steps needed.

Research type: in-company inventory of quantity and quality (experiments)

Research level: internship / graduation

Prerequisite: good understanding of chemistry and interest in biology

Partners: Foodport Zeeland, Centre of Expertise Delta Technology

Contact: Hans Cappon

Period: semester 1, 2015-2016

HAALBAARHEIDSTUDIE NAAR VETZUURPRODUCTIE IN ANAEROBE REACTOREN (DUTCH ONLY)

De productielocatie van Lamb-Weston/Meijer in Kruiningen heeft drie anaerobe reactoren, waarin biogas wordt geproduceerd. In dit project worden de omstandigheden van een full-scale reactor zodanig aangepast, dat de productie van vetzuren wordt bevorderd t.o.v. methaan/waterstof. Het project is gefaseerd in een deskstudie om de massabalans en variabiliteit in samenstelling van het te behandelen afvalwater vast te stellen en de daaraan gekoppelde theoretische vetzuurproductie. Aan de hand daarvan worden de meest optimale procescondities bepaald voor het maximaliseren van vetzuurproductie. Op een van de reactoren zullen vervolgens deze condities worden getest en gevalideerd met massa & componentbalansen van de reactieproducten.

Research type: graduation / internship

Prerequisite: analytical chemistry / chemical engineering

Partners: Centre of Expertise Biobased Economy, Lamb-Weston/Meijer Kruiningen

Contact: Hans Cappon

Period: semester 1, 2015-2016

REMOVAL OF PESTICIDES FROM AGRICULTURAL FEEDWATER

In the first semester a start was made with detection of pesticides in recirculation water from greenhouses (tomato). We wish to extend these detection methods to other components and to surface water in which disturbing constituents might influence the measurements. A comparison between blanks, known pesticide pollution and real water samples should be made, determining the practical use of the methods developed.

Research type: minor

Prerequisite: analytical chemistry

Partners: Waterhouderij Walcheren

Contact: Niels Groot

Period: semester 1, 2015-2016

PREVENTION OF LEGIONELLA FROM WASTEWATER PRIOR TO REUSE

Dow Benelux reuses wastewater for cooling tower makeup. Since Legionella might develop during the recycling process, adequate measures for prevention are being taken through the installation of a full-scale UV/US system before supplying the water to the cooling towers (and other users). The task is to monitor the water quality of this new system and make possible suggestions for improving the operation.

Research type: internship

Prerequisite: interest in microbiology and process engineering

Partners: HZ, Dow, Evides

Contact: Niels Groot

Period: semester 1, 2015-2016

PLUG & PLAY PILOT FOR MULTIPURPOSE RECYCLING OF INDUSTRIAL WASTEWATER

This cross-border collaborative project IMPROVED involves a multi-functional plug 'n play pilot installation for recycling industrial wastewater. Various purification techniques will be incorporated in the pilot, which can be switched on or off depending on the wastewater characteristics and the required water quality. A first step in the design process is the analysis of various wastewater streams of the collaborating companies (Dow, BASF, Eastmann), an inventory of product water quality requirements, and the selection of the best solutions to be integrated in the pilot. (This assignment is subject to change, since the program is not yet final.)

Research type: minor / internship

Prerequisite: interest in process engineering / water analysis

Partners: IMPROVED Interreg V partners

Contact: Hans Cappon

Period: semester 1, 2015-2016

WATER SAFETY & SPATIAL PLANNING

The research group Water Safety and Spatial Planning is aimed at the multiannual programme Resilient Deltas. In this programme we explore the nature of resilience in relation with multiple interrelated systems in delta areas, design instruments to longitudinal monitor community resilience and its effects, and develop smart solutions to limit the vulnerability and increase the adaptive capacity of communities in delta areas.

Water safety and spatial planning are core elements in our approach, but our research also includes elements of critical infrastructure, social capital, economic development, and governance. By understanding the interrelations of these systems we aim – in collaboration with a diversity of organizations - to develop knowledge and create capabilities to enhance the resilience of delta societies. One of the specific applications is the ‘water sensitive area development approach’.

The research programme offers several opportunities for students with interest in above topics. An overview of the assignments for next semester are published below. We are also open to students with relevant ideas in relation to above themes.

- 1) Professionals and Self-reliant Citizens
- 2) Hydro-Social Deltas
- 3) Water sensitive area development in the Waterpoort region
- 4) Recreational opportunity map of the West-Brabantse Kreken
- 5) Spatial and leisure opportunities of a mild desalination wetland

Application + motivation for the projects are requested to be handed in preferably before the summer break. Please send your application and motivation letters to Jean-Marie Buijs: jm.buijs@hz.nl. Motivation letters are to be handed in preferably before July 17, 2015

PROFESSIONALS AND SELF-RELIANT CITIZENS

The CoE project ‘Professionals and self-reliant citizens’ is aimed at development of practical knowledge about co-creating safety and to apply this within communities in the south-west delta. This is established by learning safety professionals to deal with self-reliance, by improving alignment between professionals, citizens and other societal actors, and by developing instruments to enhance and monitor community resilience. In this study flood risks are used as a main scenario.

For this project, it is essential to have insight in the basic perception and action strategies of citizens, businesses, professionals and governments in relation to flood risks. The student is asked to contribute to surveys about self-reliance within the municipality of Veere, the organization of design studio meetings and the development of community resilience instruments.

Assignments: research minor / internship / final thesis

Education programmes: Students of Delta Management, Water Management, Social Work,

Research type: different types of research possible,

Prerequisite: interest in water safety and society; interest in surveys is a pre; Dutch language;

Partners: Research group, Safety Region Zeeland, Municipality of Veere

Contact: Jean Marie Buijs (jm.buijs@hz.nl)

HYDRO-SOCIAL DELTAS

In this assignment, the student is asked to contribute to the NWO Urbanising Deltas of the World research project 'Hydro-Social Deltas'. An academic interdisciplinary research that aims to understand flows of water and flows of people and their interrelations. The project has the objective to improve policies and strategies for disaster risk reduction and sustainable development in both the Netherlands and Bangladesh. By using models of resilience, the interplay between hydrological (flooding, riverbank erosion, water logging) and social processes (demographic shifts, urbanization processes, governance) are studied in the urbanizing delta of Bangladesh and the southwest delta of the Netherlands. The project provides opportunities for research minor students and final thesis projects to do case studies in the Southwest Delta, and to contribute exploration with Bangladesh about hydro-social deltas. A first case study is the 'Vlissing Model', considered as a best practices for the Delta programme Spatial Adaptation. The 'Vlissing Model' describes a civil construction principle to construct on the primary storm flood barrier, wherein the construction takes into account that increase of the flood barrier should be possible without having to demolish buildings. And moreover, to make these buildings adaptable and consequently provide opportunities for area development. The student is asked to report to the research group and Unesco-IHE, and to provide recommendations about the case in relation to the models about hydro-social deltas.

Assignments: research minor / internship / graduate internship

Student: Delta Management, Water Management, Civil engineering.

Research type: literature and desk research, case study, field research (interviews, observations)

Prerequisite: good analytical and writing skills; specific interest in water safety, disaster management and demography

Partner: Research group Water Safety and Spatial Planning, UNESCO IHE, Wageningen University, Uppsala University and HIS (Erasmus University Rotterdam)

Contact: Jean Marie Buijs (jm.buijs@hz.nl)

WATER SENSITIVE AREA DEVELOPMENT IN THE WATERPOORT REGION

The HZ Delta Academy participates together with 3 provinces, 9 municipalities, 2 other Universities of Applied Sciences and several other organizations in Waterpoort. Waterpoort is an area development process initiated by the province of Brabant to create new opportunities in the mainly rural area around the Volkerak-Zoom lake. In this area redevelopment process, involved governments, businesses, ngo's and citizens try to find new roles in water related area development. The involved organizations try to stimulate and facilitate citizens and local businesses to innovate, to restore connectivity with the water and to co-create an identity and future of the area.

In this project you will build on previous research. With input from participating students we created an overview of the different user groups in Waterpoort and their relation with the water, as well as an overview of the main historical drivers for in transitions in the area. Last semester students conducted 4 cases studies, which will accomplish the previous results in an overall document, called the 'Atlas of the Waterpoort'. In this assignment you will contribute to this project by linking the case studies and previous research to the overarching theme of water sensitive area development. You will contribute to writing a cross sectional overview of the project, with final recommendations, visions, conclusions and perspectives for region. Resulting in a publication which will be made together with the competent researcher of the research group.

Assignments: research minor

Student: Delta Management, Aquatic Ecotechnology,

Research type: literature and desk research, qualitative analysis and reporting

Prerequisite: good analytical and Dutch writing skills ; basic knowledge of GIS and Adobe software is a

pre,

Partner: Research group, Waterpoort Partners (Province Noord-Brabant)

Contact: Lukas Papenberg (lr.papenberg@hz.nl) or Jean-Marie Buijs (jm.buijs@hz.nl)

RECREATIONAL OPPORTUNITY MAP OF THE WEST-BRABANTSE KREKEN

In extension of the 'the Atlas of Waterpoort' project, shows the municipality of Steenberg interest in an opportunities-map of recreation facilities in the inter-municipal area of the West-Brabantse Kreken.

An unique heritage landscape that has to be developed for tourism and leisure purposes across the municipal policy borders. An inter-municipal opportunity map, that has to be explored by the water sensitive area development approach in the format of an Atlas with guiding textual explanations.

Within this assignment, the student is asked to conduct research into economical, spatial and landscape values of the West-Brabantse Kreken area, by acquiring research data for developing the 'Leisure Atlas of the West-Brabantse Kreken'. This can be done by interviewing stakeholders after exploring desk research, mapping the Atlas by GIS-software and subsequently publishing the Atlas in a representative format for publication.

Assignments: research minor

Student: Delta Management, Aquatic Ecotechnology, Vitality and Tourism Management

Research type: literature and desk research, field research (interviews, observations)

Prerequisite: basic knowledge of GIS and Adobe software, interest in landscapes

Partner: Research group, Waterpoort Partners (Waterboard, Municipality of Steenberg, Province N-Brabant)

Contact: Lukas Papenberg (lr.papenberg@hz.nl) or Jean-Marie Buijs (jm.buijs@hz.nl)

SPATIAL AND LEISURE OPPORTUNITIES OF A MILD DESALINATION WETLAND

Fresh water supply is a crucial infrastructure for communities, ecosystems and industries. In Zeeuws Vlaanderen the HZ Delta Academy studies together with involved industries (Dow Chemical), governments and other stakeholders, opportunities to increase the quantity of high quality fresh water for industry and possibly other stakeholders. Possibilities are examined to desalinate brackish water via a mild desalination installation, in order to be less dependent from other water sources. This project is focused at the options for a constructive wetland to pretreat the brackish water flows.

For this assignment the student is asked to conduct in prolongation of a running project about the spatial and leisure opportunities in relation the construction of a wetland. By making use of GIS-mapping techniques, desk research and interviews the student will acquire knowledge to give advice to the client by producing the second part of the 'Atlas of the Lovenpolder'. An atlas of leisure and scenic link opportunities for the wetland, including a proposal of an ecological landscape design.

Assignments: research minor

Student: Delta Management, Aquatic Ecotechnology

Research type: literature and desk research, field research (interviews, observations)

Prerequisite: basic knowledge of GIS and Adobe software, specific interest in ecology and spatial planning

Partner: Research group, Research group Water Technology, Grontmij and other partners

Contact: Lukas Papenberg (lr.papenberg@hz.nl) or Jean-Marie Buijs (jm.buijs@hz.nl)