



Ministry of Rural Development,
Environment and Agriculture



Agricultural research in the state of Brandenburg

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Agricultural research in the state of Brandenburg

Prologue

Brandenburg as a centre for successful agricultural research facilities in the German federal states

As a result of the unification of Germany, several institutions have been set up in the agricultural sector in Brandenburg since 1992, the budgets of which are essentially borne by several federal states. By doing so, the participating states are making important contributions through the options that they have open to them, especially in relation to practical research topics in the area of agricultural sciences. For more than three decades now, these multi-state institutions have proved to be an important complement and partner to universities and colleges and federally funded research institutions.

These institutions are unique in the new federal states and their professional competence gives them a strong national and international appeal. The spectrum ranges from bee economies, inland fisheries, animal breeding, animal husbandry, dairy farming and the food industry to environmentally sound mining restoration.

Through the infrastructure and project-related support of these institutions, Brandenburg as the home state has a special responsibility for contributing to the co-financing federal states being able to benefit from the research sites.

It is in no way a coincidence that companies from the region frequently offer their services as partners in practice for innovative solutions from the institutions. Model projects can be used to create solutions that then radiate nationwide. Training, further training and continued training in the agricultural sector also benefit from the knowledge transfer.

One desirable effect is also to use science to keep highly educated and dedicated professionals in Germany. With a view to the new and up-and-coming generation in agricultural sciences, young researchers need to be offered attractive research projects and good professional conditions in order to maintain the acknowledged high level of agricultural research in the coming years. Investments in the research sites form the basis for innovations. It remains our responsibility to safeguard this with every new budget.

We can all be proud of the fact that we are not only preserving multi-state institutions, but also preparing ourselves to face the challenges of the 21st century head-on. The breadth of the projects that they work on and the high level of scientific knowledge attained is impressive, as the following pages of this newly edited brochure quite clearly show.

Contents

Research institute for post-mining landscapes.....	8
Educational and experimental centre for animal breeding and husbandry Ruhlsdorf/Groß Kreutz.....	12
Institute of food and environmental research	18
Dairy educational institute Oranienburg	24
Institute for Bee Research Hohen Neuendorf.....	28
Institute for the propagation of farm animals Schönnow	36
Institute for inland fisheries Potsdam-Sacrow	42
Teaching and research institute for horticulture and arboristics	50

Research institute for post-mining landscapes

Application-related research for sustainable solutions

Founded in 1992, the Forschungsinstitut für Bergbaufolgelandschaften e.V. (FIB) in Finsterwalde addresses landscapes damaged by raw material extraction, especially in the lignite mining region in Lusatia. 30 staff are employed there who work on re-mediation solutions with a focus on agricultural and forestry re-cultivation, aquatic ecology, landscape development and nature conservation. Adaptation strategies for other habitats or ecosystems impaired in their function are also being developed. This applies, for example, to energy crop cultivation optimised for poor soils or the effects of climate change on water, soil and plants.

In doing so, the FIB e.V. is not just concerned with achieving a deeper understanding of processes and ecosystems or modelling the complex landscape structure, as the development of mainly bio-based process solutions, along with their technological implementation, is becoming increasingly important. Political decisions should be supported here, which can lead to the creation of planning procedures, guidelines and recommendations for action. This is the reason why the researchers in Finsterwalde cooperate closely with state authorities and enterprises, other scientific institutions, non-profit trade associations, local authorities and business enterprises.

By way of example, two research projects in the field of land and water management that are particularly important for the state of Brandenburg and are financed by public funds support this claim.

The „Brown Spree“ phenomenon and new strategies for water body restoration Pilot project Ruhlmühle

Time and time again, the daily newspapers in Brandenburg can be seen to report on the conspicuous clogging of the Spree and other waters with iron (iron ochre precipitation). The alarm bells are now ringing among farmers and ecologists, but especially among water managers and tourism operators in the region, and also in nearby Berlin. The brown coloration of the Spree and numerous other smaller rivers results from dissolved iron, which, following its precipitation, threatens the habitat for fish, insect larvae and underwater plants. Aided by their knowledge, the researchers from Finsterwalde have become involved in solving this complex problem that can be traced back to the widespread lowering of the groundwater level in the lignite mining area in Lusatia. This process aerates the subsurface and disintegrates the iron sulphide minerals, such as pyrite and marcasite (FeS_2). In order to prevent the derived iron and sulfate products from entering the Spree, FIB e.V. operated a pilot plant in Neustadt (Spree) in the district of Bautzen from December 2014 to June 2017 on behalf of Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH (LMBV). This caused the mineral weathering in the subsurface to be reversed biologically, even before the groundwater reached the surface waters. To achieve this, the existing, but not very active, sulphate-reducing bacteria were supplied with an easily soluble carbon source (glycerol). As a result, the „hungry“ microorganisms did a great job and the trial for this method was very successful. The iron and sulfate concentrations of almost 500 mg/l and 1,200 mg/l respectively were reduced by more than 90 percent. The remediation process has no negative consequences and can be operated for many years without obstructing the flow of groundwater or endangering the environment.

Climate Change Region Brandenburg and Irrigation Agriculture Project Precision Irrigation (EIP)

With its 3,000 lakes and about 30,000 kilometres of flowing waters, Brandenburg is one of the most water-rich regions in Europe. On the other hand, however, much of the land used for agricultural purposes fails to adequately store the increasingly scarce amount of rainfall, which is typical for the blotting sand in the March region. A testament to this is farmers having to fear for their harvest in dry summer years. The use of modern large-scale irrigation machines promises to remediate this, but they are cost-intensive and require the use of valuable groundwater reserves. Scientists are looking for practical ways to improve demand-based irrigation. Precision irrigation is now the buzzword and means that each crop receives just as much water as it needs to develop optimally. The information required for this needs to be obtained in real time on-site and automatically translated into irrigation volumes.

One possible solution is to measure the surface temperature of the plants, since this increases when the water stress increases. A methodology applicable to local conditions for how to translate these thermal images into pinpoint irrigation recommendations is still lacking, however. The plant technology also needs to be retrofitted for subarea-specific water distribution. The development work required for this is being performed by the FIB e.V. together with partners from agriculture and industry and the Fachverband Bewässerungslandbau Mitteldeutschland e.V. (FBM). The project is being funded by the European Agricultural Fund for Rural Development (EAFRD) and the state of Brandenburg.

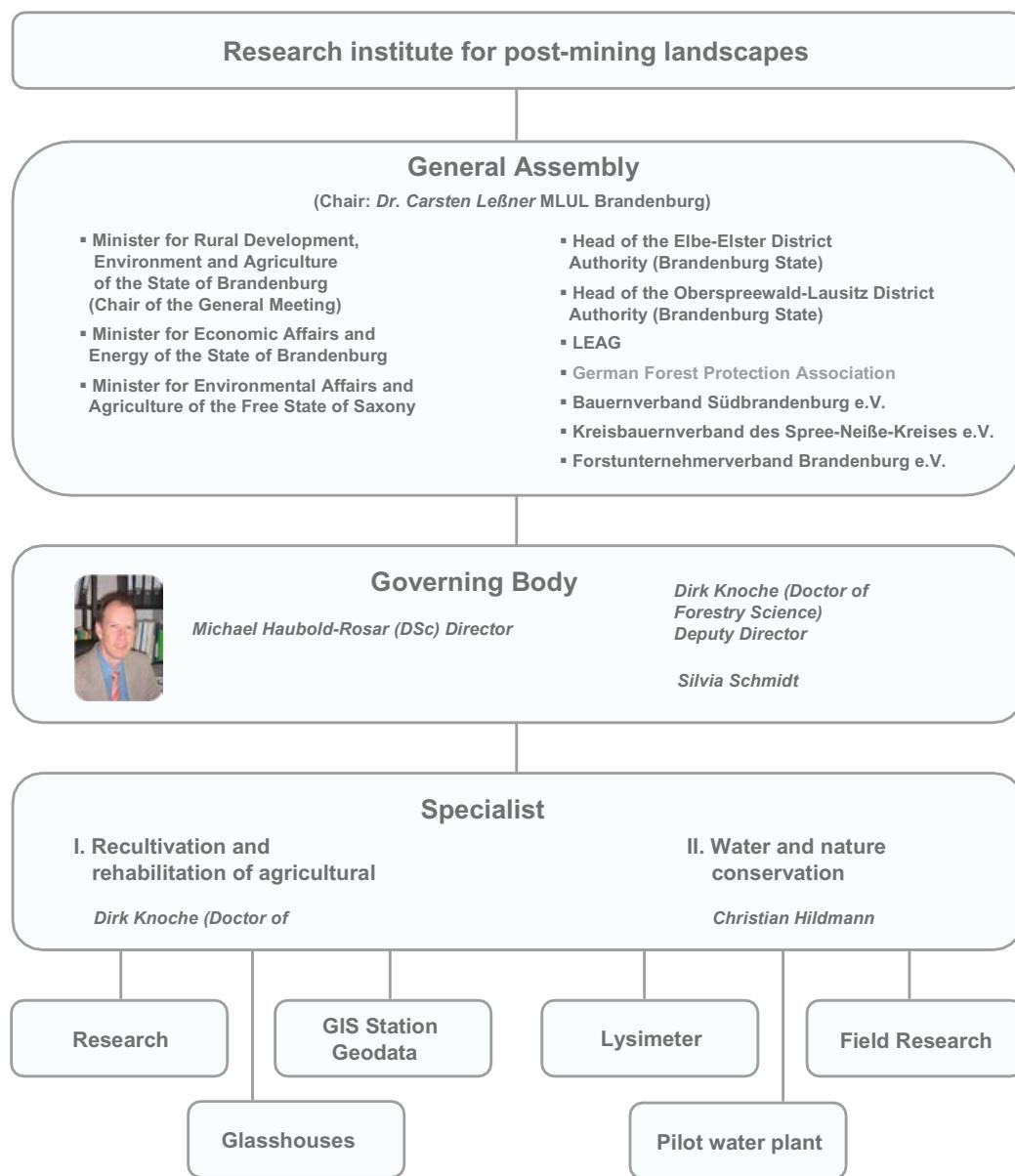


Top left: The river Spree has turned brown from iron and sulphate pollution

Top right: Pilot system for groundwater treatment at Ruhlmühle near Neustadt/Spree

Right: The costly, latest-generation centre-pivot sprinkler irrigation system in use

Organisational Chart



Research institute for post-mining landscapes

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Educational and experimental centre for animal breeding and husbandry Ruhlsdorf/Groß Kreutz

From practice, for practice – Educational and experimental centre for animal breeding and husbandry Ruhls- dorf/Groß Kreutz

The work performed by the 40 staff at the Lehr- und Versuchsanstalt für Tierzucht und Tierhaltung e.V. Ruhlsdorf/Groß Kreutz (LVAT) involves studies of agricultural production processes and demonstrations of practically applicable results from animal husbandry. In connection with this, the LVAT undertakes public relations work as well as a considered and proper education of the consumer and provides support to trade visitors on questions of modern and environmentally-friendly cattle, pig and sheep farming.

One of the most important tasks of the LVAT is training and hence organising and holding courses and training events and other events, partly in cooperation with the State Office for Rural Development, Agriculture and Land Consolidation (LELF). For example, veterinary and biology students can gain practical experience in the field of animal husbandry. The intensive further training of farmers and agricultural advisers is also an essential goal of the LVAT. These receive valuable and practical tips in line with the philosophy of the LVAT, „from practice, for practice“. In addition to topics addressing animal husbandry, the institute also serves to provide interested visitors with information on the use of renewable energies.

At the end of 2016, the state government commissioned the LVAT to develop the Brandenburg Animal Welfare Plan together with the Leibniz-Institut für Agrartechnik und Bioökonomie e.V. (ATB).

Sustainability in Brandenburg animal husbandry

By means of the LVAT project „Sustainability in the Brandenburg livestock industry“, the scientists involved want to provide practitioners with recommendations for action in order to direct their operations according to sustainable criteria. The issue of sustainability in livestock farming is increasingly gaining in importance, especially with a view to improve public acceptance. In principle, a sustainable mode of production in agriculture is based on the three pillars of ecology, economy and social affairs (Fig. 2), which need to be taken into consideration when

Ökologie	Ökonomie	Soziales
Naturschutz	Wirtschaftlichkeit	Arbeitsplatz
Land-schafts-pflege		Familie
Biodiversität		Weiterbildung
Erhalt der Kultur-landschaft		Tradition
Schutz von Wasser, Luft, Boden		gesellschaftliches Engagement
		Regionale Akzeptanz
		Ländliche Räume
		Investitionen

Fig. 2: The three pillars of sustainability and examples of building blocks (according to the DLG, as of 2013)

addressing the questions within the framework of the project. In the area of animal husbandry, the pillar comprising animal welfare or animal health also needs to be included.

In order to be able to assess the business practices of a farm with regard to sustainability issues, various rating systems have been developed in the past. Primarily, the LVAT has set itself the goal of evaluating the systems and programmes for assessing the sustainability of dairies, and secondly, its objective is to set up and develop an indicator system.

Furthermore, an in-house assessment of the sustainability of material flows and processes is taking place, followed by their evaluation. Further questions and investigations in the context of the project are dedicated to, for instance, monitoring feedstuffs in dairy cattle husbandry, developing measures to improve calf health, analysing the amount of working time required in suckler cow husbandry and communicating good agricultural practice on social media.

Innovative breeding methods and health values

The aim of the project addressing „Innovative breeding and health values“ is the further development and evaluation of a system of performance testing and genetic evaluation in dairy cattle using new methods of genome analysis and genomic selection, and the incorporation of additional features of overall fitness, health and fertility. Overall, the project seeks to improve genetics in terms of fitness and health parameters. The goal is to reduce miscarriage rates, extend useful life and hence increase the performance of dairy cows during their lifetime in order to achieve cost reductions. Improving the health characteristics of the breed meets the demands of consumers by reducing the amount of antibiotics used and increasing the level of animal welfare. The project will enhance the test herd system to record additional traits (e.g. birth patterns and calf weights, central nervous system disorders and miscarriages, classification according to exterior and condition) and validate genomic breeding values. As a result of the quarterly evaluations of the data they produce and their management reports, participating operations (test herds) can implement measures for improvement, thereby increasing the competitiveness of breeding and production facilities in Brandenburg.

Preventing tail biting

One of the key issues in pig keeping is the prevention of tail biting. In order to avoid injury to the animals, farmers dock tails, which is becoming less and less popular among many consumers but also among farmers themselves. Various projects have been launched throughout Germany to solve this problem. The most diverse questions concerning how to move forward without docking pigs' tails have also been addressed in Ruhlsdorf since 2012:

- Influence of occupancy density in the mast (comparison between a comfort and standard bay)
- Influence of feed additives, such as animal protein and individual amino acids (tryptophan)
- Effect of roughage and other structural feedstuffs
- Comparison between a different form of water presentation and recording consumption
- Influence of litter and social structure
- Development of a technical employment material
- Testing a housing system without re-housing (wean-to-finish).

Currently, a retrofit solution for conventional rearing compartments is being tested and has delivered promising results. Climate zones, solid areas, long troughs and the use of structural feedstuffs form the focus of attention.

Performance Test

The performance test for cattle, pigs and sheep is carried out at the LVAT in cooperation with the LELF. The performance test for pigs takes place at the Ruhlsdorf site, which has its own EU-certified slaughterhouse. Performance testing on sheep and progeny, origin and suitability performance testing for male offspring of beef cattle breeds takes place at the Groß Kreutz site (Fig. 3). The LVAT thus has three test stations overall. The benefits of station testing lie in the uniformity of the testing environment, through which the genetic differences in performance



Fig. 3: LVAT site in Groß Kreutz

can be assessed more clearly. There are three methods of performance testing for cattle: The aim of the progeny test is to determine the breeding value of breeding bulls from the fattening and slaughtering achievements of the offspring under intensive fattening conditions. To this end, at least ten males were subjected to a test.

This was performed on the pure-bred male offspring of meat breeds from suckler cow husbandry.

The examination of suckler cow herd groups serves to establish the fattening and slaughtering performance of beef cattle from different breeds and cross-bred varieties. The evaluation takes place according to operational and genotypic origin. This provides operations with information on the future performance of their weaning calves under intensive fattening conditions. Furthermore, recommendations can be derived



Fig. 4: Testing the performance of beef cattle at the Groß Kreutz site

concerning which paternal breeds should be adapted to the existing maternal basis in order to improve the quality of the marketable product. The in-house performance test for future beef cattle breeding bulls helps to evaluate the meat performance of the animals based on daytime increases and muscling determined on the day of testing.

EIP project „COW Added VALUE Navigator“:

The LVAT is also the lead partner in the EIP project „COW Added VALUE Navigator“. This project is designed to identify, weight and economically evaluate the mechanisms of action of individual components and risk factors in dairy cattle farms. The goal is to develop a software-based decision-making tool. By doing so, problem areas should be identified; sound decisions made at cow and at farm level, changes to risk factors detected promptly and cows and farms compared.

This approach will improve animal welfare and health by improving animal welfare rates and dairy cow productivity. The project will run for 5 years.

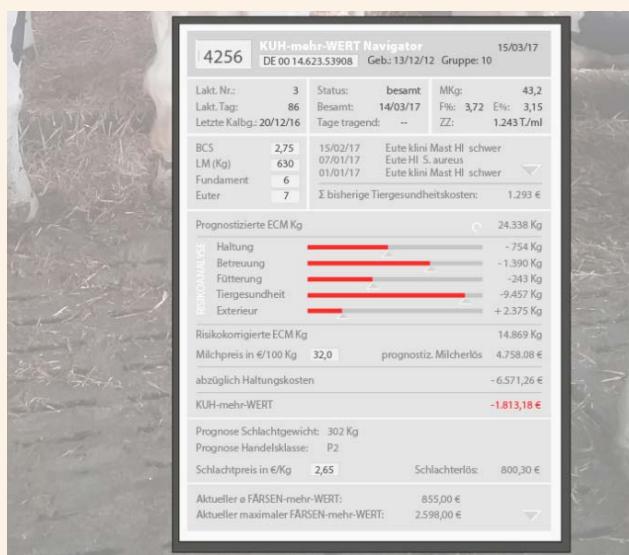
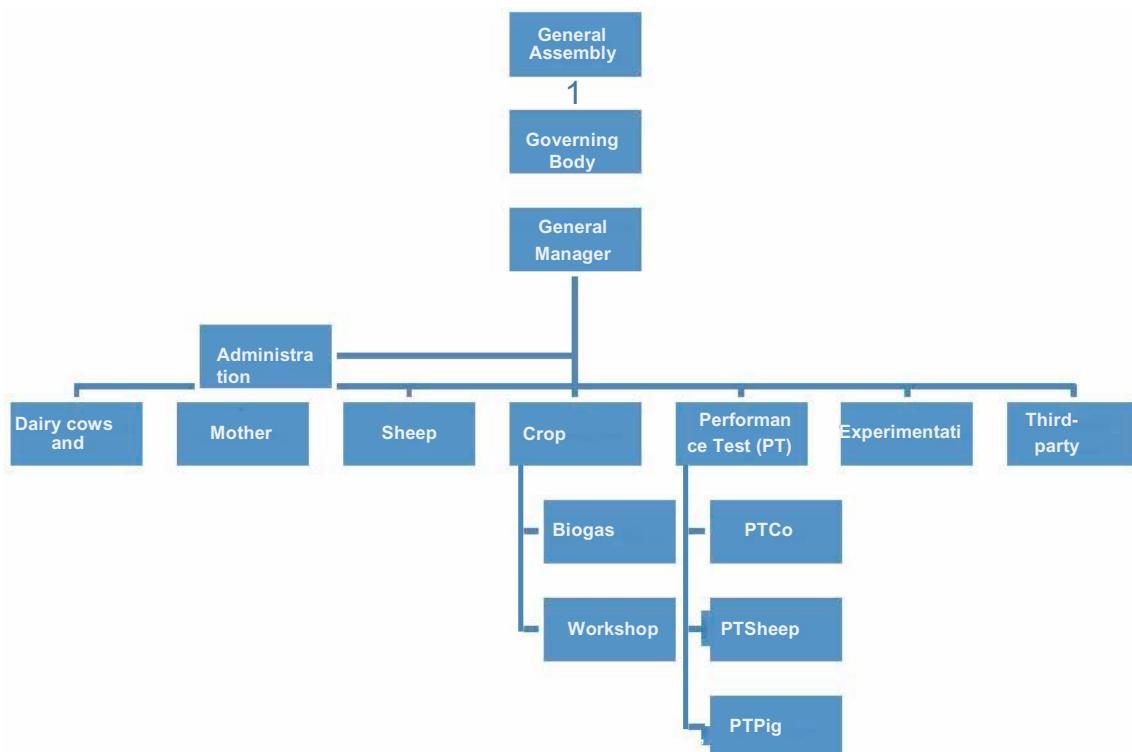


Fig. 5: Screenshot: COW Added VALUE Navigator

Networked

The LVAT cooperates closely with other scientific institutions, such as universities, polytechnics and institutes, as well as breeding associations. The LVAT is a member of the „Organic pig husbandry“ research networks in the European innovation partnership. Since 2012, a training network has existed in the Potsdam-Mittelmark and Teltow-Fläming districts to improve vocational training through joint instruction taught in agricultural operations. The LVAT is a member of the training network in the Potsdam-Mittelmark district farmer's association and actively participates by undertaking instructional teaching and participating on the association's advisory board. The LVAT is also a member of the „Success factor family“ network.

Organisational Chart



Educational and experimental centre for animal breeding and husbandry Ruhlsdorf/Groß Kreutz

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Institute of food and environmental research

Research for a healthy diet and a healthy environment

The Institut für Lebensmittel- und Umweltforschung e.V. (ILU) was founded in 1991. The association pursues charitable aims exclusively and directly.

The task of the ILU is scientific and technological application-oriented research in the food industry with a focus on the environment.

At the Institut für Lebensmittel- und Umweltforschung e.V., scientists and technicians are employed who combine the expertise of food technologists, chemists and food chemists, biologists, microbiologists and biochemists. Additional specialised scientists are recruited for limited periods for development projects.



Microbial raw materials as protein, EPA and DHA sources for use in aquaculture feed

About half of the global seafood consumed is produced by the aquaculture industry. It is assumed that this figure will grow even further in the future. The limited amount of seafood for a diet containing proteins, EPA and DHA makes a sustainable feed industry necessary for aquaculture.

This project will evaluate the potential of two groups of microorganisms as a sustainable source of feed for aquaculture containing high levels of omega-3 fatty acids. MICRO-feed focuses on two groups of microorganisms: The heterotrophic thraustochytrides, capable of accumulating high levels of DHA-rich lipids, and phototrophic microalgae rich in EPA and DHA. Both groups can be cultured using sustainable sources of carbon dioxide and energy (light, carbon dioxide and organic waste) and have a high protein content. Both the EPA and DHA levels, as well as their production rates, will be increased by optimising the culture conditions and applying selection pressure to generate particularly productive strains. As part of the project, several up-scaling steps are to be carried out for the cultivation. The efficacy of microbial biomass will be tested in feeding experiments with salmonids, European sea bass and cichlid. The focus will be placed on growth and digestibility. The optimisation experiments carried out so far at the ILU e.V. show great success in the enrichment of the lipid contents. In comparison to conventional cultivation, the lipid levels in individual microalgae species could be multiplied on a laboratory scale. The transfer of the results from the laboratory to mass cultivation in outdoor facilities has already started.

The partners in the collaborative project are from Norway (NTNU, SINTEF fisheries and aquaculture, SINTEF materials and chemistry), Germany (ILU), Turkey (Ege University and MEDFRI) and Iceland (MATIS).

Monitoring of cyanobacteria and cyanotoxins in surface waters of rural areas.

Cyanotoxins occur in virtually all of the world's surface waters. They are formed by various cyanobacteria and are increasingly being observed in waters that are rich in plant nutrients. They can also occur elsewhere, such as in animal feeders during summertime. Contact with or ingestion by the human body can result in skin irritation, earache, allergic reactions, nausea and vomiting. Acute liver damage from cyanotoxins has widely been described in domestic and farm animals, as well as wild animals, including fish and birds. This research project will perform long-term sampling of model surface waters in the state of Brandenburg and analyse the samples in a variety of ways. One particular aim of the project is to create an inventory of organisms, potential toxins and environmental conditions at the specific time of sampling. The feasibility of rapid methods will be tested to improve cyanobacteria detection. Characteristics of the microorganisms found will also be examined with regard to the dependency on various environmental factors. A predictive model for the excessive occurrence of cyanobacteria will be developed based on this data. The overall goal of the project is to deepen the understanding between changing environmental parameters in surface waters in the state of Brandenburg and the emergence of dangerous cyanobacteria populations. The methods developed here will find their way into modern water monitoring measures.

The development of biofunctional algae-active ingredient complexes to protect the skin from light-induced skin ageing

Delaying ageing has been a challenge for the cosmetics industry for centuries. There is also a growing demand for high-performance active anti-ageing ingredients, in particular to protect the skin from UV damage and photo-induced skin ageing. The aim is to gain biofunctional active substance extracts from microalgae and plants and examine whether a protective effect against UV-induced cell damage and photoageing of the skin can be achieved. By preparing and combining hydrophilic and lipophilic metabolites from algae and plants, bespoke bioactive substance complexes with new mechanisms of action and innovative application forms should be created. The aim is to arrive at a principle for the complex processing of sustainably produced algae biomass. The project is pursuing a new approach to combat the visible signs of skin ageing. The innovation is comprised of the development of a new generation of anti-ageing agents that modulate the skin's own metabolic processes and thus prevent light-induced skin ageing at the molecular-biological level.

As part of extensive laboratory screening, 18 microalgae strains were evaluated and investigated for their growth properties and potential for synthesising bioactive metabolites. The microalgae species selected are comprised of algae that have not yet been distributed on the market and whose economic exploitation is still pending. The bioactive effectiveness of the extracts was investigated both in the cell culture assay with UV-irradiated skin cells and in a broad-based biological cell platform. The results confirm the excellent biological radical scavenging properties of the algae and plant extracts versus the cell-damaging effect of UV-induced reactive oxygen species (ROS). In the biological study model, human skin cells showed that the expression of genes associated with oxidative stress and inflammation is inhibited by algae extracts. In addition, the gene expression of specific key proteins of the skin, which are responsible for stabilising the skin barrier and improved skin homeostasis, is stimulated by algae extracts. The algae extracts investigated show a variety of skin-improving and anti-ageing effects, such as stimulation of the skin's own collagen biosynthesis, anti-inflammatory and regenerating activities and strong cellular antioxidant activity. By applying a new encapsulation technology, lipophilic and hydrophilic algal metabolites have been successfully included in an innovative dermal carrier system and offered as an innovative application form.

Development of sustainable legume-based farming systems, feed and food chains in the EU Legvalue

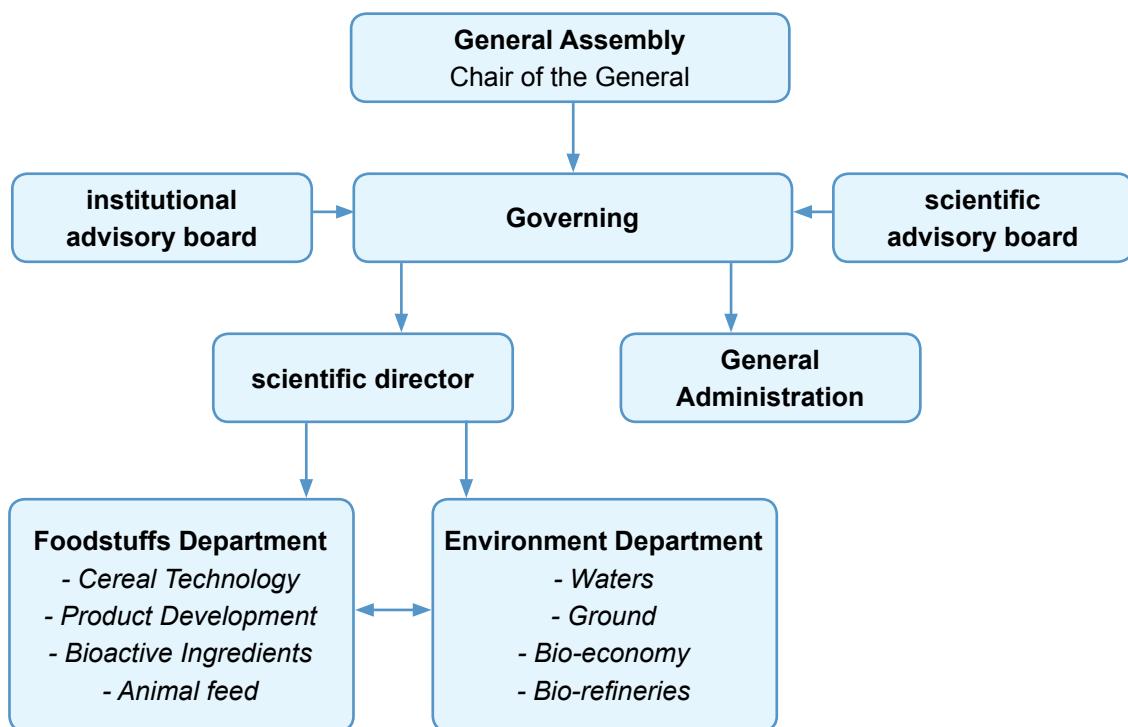
Crop rotation in Germany and Europe by adding other crops, and, in particular, legumes, represents an important component of more sustainable agriculture. Based on the Leguan national research project, in which the ILU e.V. has investigated the efficient and market-driven production of innovative foods and ingredients (semi-finished products) based on native legume species, such as peas (grain-feed peas and vegetable peas) and field beans, these experiences and research results are also being introduced on an international scale. Partners from ten European countries are collaborating on the Legvalue project to consolidate the cultivation and use of legumes in the EU. The aim is to develop sustainable and competitive cultivation systems and value chains in the feed and food sectors. With the help of 20 existing value chains and networks that reflect the diversity of European legume cultivation, LegValue aims to demonstrate the value that legumes could have for each stakeholder.

One of the outcomes of the project will be an easy-to-use tool to list leguminous crops that are suitable for each specific crop for their specific situation, under the prevailing conditions. The aim is also to achieve greater market transparency for the trade in and use of legumes. Together with national and international partners, the ILU participated in an inventory of the processing and innovation types in the legume sector currently being instituted by companies. The analyses focused on the transfer of innovations in the food, animal feed and non-food sectors.

Networked

The association works in a multidisciplinary manner with other scientific institutions, especially universities and technical colleges. The ILU e.V. is a member of the Association of Innovative Enterprises Zuse CommunityBrandenburg Food Industry Cluster, Nutriact Competence NetworkFederal Gene Group Food Industry Research Group.

Organisational Chart



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Dairy educational institute Oranienburg

The history of dairy farming in Oranienburg dates back to the 17th Century, when Louise Henriette of Orange, wife of the Great Elector of Brandenburg, had a dairy built in the town in 1653. This served for the training of dairy hands in the Dutch style. The beginnings of quality control for milk in the Oranienburg area also date back to the days of the Electress.

With the foundation of the Milchwirtschaftliche Lehr- und Untersuchungsanstalt Oranienburg e.V. (MLUA) on 1 July 1992, the service activities performed by the Dairy Institute, which was originally established in Oranienburg in 1923, were continued in the areas of analysis, training and research, with the aim of maintaining and improving the standard of performance in the dairy industry. This tripartite activity profile, which offers many synergy effects, gives the institute a unique character in the newly-formed German states.

Analysis of milk and dairy products

The MLUA functions as a contact point for all parties involved in the transportation of milk and dairy products. An important field of work is the analysis of the raw material itself and the products made from it. Here, analytical services are provided to public authorities, companies and other institutions nationwide. Offering accreditation for around 410 analysis procedures/parameters, the MLUA delivers a wide range of services for this purpose, which also represents a fixed financial cornerstone of its work. Among other things, the services offered include the recording of microbiological food safety criteria, the investigation of harmful germs and spoilage organisms, the material nature of individual milk parameters, such as fat, protein, carbohydrates, and dry matter, and individual markers, such as additives, vitamins and heat indicators, as well as sensory testing for appearance, odour, taste, texture and, finally, declaration control. This range of services offered is constantly

being updated. About 80,000 items of analytical data are collected each year. All these investigations serve to determine quality and provide proof of food safety and hence promote marketability and foster image-building for dairy products. They also make an important contribution to healthcare and consumer protection at the same time.

In the state of Brandenburg, the MLUA supervises around 30 dairy-processing companies within the framework of the monthly GQA on the basis of national federal and state regulations. Since the number of large dairies to be served has declined over recent years due to structural changes in the dairy industry, the number of direct marketers has steadily increased and now represents an expanding field of activity. Some 1,100 samples are examined individually each year as a part of official food controls outside the area of activity of the MLUA. The MLUA also performs a monthly quality inspection on around 3,000 samples a year, supplemented by production-related controls in the organisation's own laboratories.

The research activities undertaken by the MLUA serve to record and evaluate the quality of milk and dairy products as well as promote performance standards in the dairy industry in Brandenburg and Berlin.

Training and further training

Another focus of activity is training and further training. For the catchment area that makes up Brandenburg, Berlin, Saxony, Saxony-Anhalt, Mecklenburg-Western Pomerania and Thuringia, the MLUA functions as the central, inter-company training centre for the recognised occupations of dairy technologist and dairy technician. With more than 250 trainees in Oranienburg, some 20 per cent of young trainees in the dairy industry in Germany are trained on an inter-company basis. A boarding school offers accommodation for 40 young people in the town. The provision

of additional training modules in the subject of dairy technology supports training companies that cannot meet all their training requirements. These include training modules covering milk powder, mixed milk products, cheese and special process techniques. The MLUA also offers preparatory courses for the examination to become Dairy Master and Laboratory Supervisor on a part-time basis. Each year, this training course is taken by 500 qualified people, ranging from milk truck drivers to milk processors and food monitoring staff. All students taking the qualification courses have access to the MLUA Student Library, which places textbooks, monographs, the latest journals and annual reports at their disposal. Professional events, such as the Milk Information Day for veterinary medicine and food technology students, dairy farmers' days for farmers and milk producers, and student project days round off the educational offering from the MLUA.

Application-oriented research

Through experimental work, the MLUA mainly conducts application-related research aimed at optimising product quality and improving analytical quality assurance. In the work they perform, the scientists at the MLUA are guided by the requirements of the market, food law and consumer healthcare. The focus is placed on the development, standardisation and validation of chemical, microbiological and sensory test procedures on a national and international level.

One area of focus is the collection of data, e.g. to distinguish between conventionally and organically produced milk. Determining the nutritional data of milk from exotics, such as goats, sheep and buffalo is becoming more and more widespread.

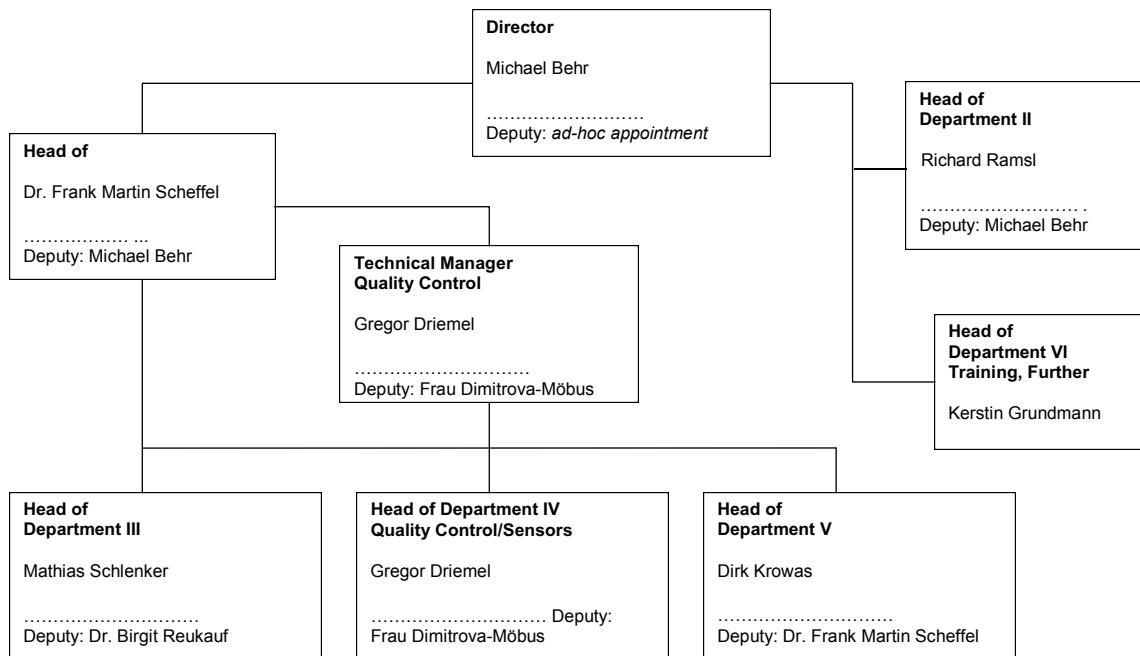
The aim of the research is to optimise product quality and improve analytical quality assurance. For this purpose, technical-technological questions are examined and microbiological, chemical-physical and sensory tasks are undertaken.

Networked

Joint project: Frankenförder Forschungsgesellschaft mbH (Potsdamer Straße 18a, 14943 Luckenwalde); MLUA as analytics and consulting partner, project: Development of techniques and procedures for the energy-efficient, cost-effective and mobile spray-drying of liquid media at the place of extraction, using goat whey as an example

Joint project: NutriAct (German Institute of Human Nutrition, Potsdam-Rehbrücke, Arthur-Scheunert-Allee 114-116, D-14558 Nuthetal); MLUA as a technological partner for the production of newly developed samples in the training dairy, possibly with accompanying analytics and consulting

Organisational Chart



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Institute for Bee Research Hohen Neuendorf

The smallest of farm animals represent an enormous challenge

The Länderinstitut für Bienekunde Hohen Neuendorf (LIB) is a research institute that receives joint support from the five federal states of Brandenburg, Saxony-Anhalt, Saxony, Thuringia and Berlin. The LIB's mission is to conduct hands-on research on various aspects of bee biology. When the institute was newly founded, the following research priorities were established from recommendations made by the Science Council:

- Breeding and behaviour
- Molecular microbiology and bee diseases
- Honey analysis and pollination.



Institute for Bee Research Hohen Neuendorf

There are sixteen employees at the state bee keeping institute, including six scientists. Visiting scientists, PhD students and Master's/Bachelor's students work on various research projects financed by third-party funds. The institute also fulfils further tasks in the areas of training and further training for bee keepers and the interested public as well as practical bee keeping.

Breeding and behaviour

The main areas of research in the Breeding and Behaviour Department are:

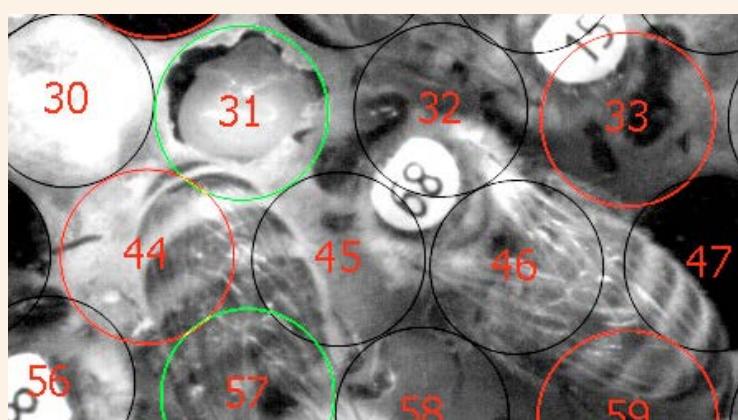
- Genetic evaluation and estimation of genetic parameters in the honey bee,
- Breeding a Varroa-resistant honey bee line,
- The molecular-genetic basis of disease resistance,
- Behaviour in social organisations,
- Strategies to conserve honey bee biodiversity,
- The reaction of bee colonies to stressors.

Project SMARTBEEES

The diversity of bee breeds in Europe was created through a process of natural selection in adaptation to climate, vegetation, parasites and pathogens. There were, of course, many different bee breeds in Europe originally. Meanwhile, this situation has changed significantly. Primarily, the Varroa mite (*Varroa destructor*), which originates from Asia and which the local honey bee (*Apis cerana*) copes with well, has caused high losses among European bee colonies (*Apis mellifera*) for many years. Also taking place is a systematic displacement of many European bees by two breeds that have been bred for some time now for their performance, quiet demeanour and disease resistance. Both causes dramatically reduce the genetic diversity of honey bees in Europe and endanger sustainable, regionally adapted bee keeping. Funded with 6 million euros by the European Commission, Project SMARTBEEES cooperated with geneticists, molecular biologists, parasitologists, virologists, immunologists, communication scientists, mathematicians and bee specialists from 11 countries until the autumn of 2018. Coordinated by the LIB, the project re-surveyed the current status of honey bee diversity in Europe based on samples from thousands of bee colonies. In order to enable bee keepers in different regions of the continent to improve their local bees through breeding, a network of breeder groups has been established that will continue beyond the end of the project. The involvement of the LIB made it possible to directly subject the performance data generated by these groups to a modern genetic evaluation.

The main cause for the loss of bee colonies in Europe is the parasitic Varroa mite. Within SMARTBEEES, the LIB, in collaboration with Danish partners, has developed genetic markers that will make it possible to easily and inexpensively determine the disposition for future resistance to the mite. A better understanding of the important factors in the interaction between the bee, the parasite and the viruses transmitted by the virus was also achieved. The project came to an end in 2018. However, the findings, training materials and networks are sure to have a lasting effect.

(Financed by the European Commission, FP7 KBBE Funding Programme 2013.1.3-02; Grant Agreement No. 613960)



*Project SMARTBEEES:
In order to find out which
genes play a role in the
resistance to breeding
parasites, marked bees
were observed individu-
ally at the LIB during the
removal of the infested
brood (cell „31“ is cur-
rently being opened by
a bee). Their DNA was
later analysed the Danish
project partners.*

Project Genomic Selection in the honey bee (GeSeBi)

In combination with various viruses, the Varroa destructor mite is threatening honey bees worldwide. The high winter losses that can be identified in some years are mainly attributable to these parasites. With the support of the Federal Ministry of Agriculture (BMEL), a new breeding method for the honey bee is being established in the three-year GeSeBi research project, which will significantly improve the breeding of resistant bee colonies against this deadly threat. The project is to be realised at the Länderinstitut für Bienekunde Hohen Neuendorf e.V. with the help of a modern DNA chip. In the future, this technology will detect the smallest differences in the bees' genome (totality of all genes) and hence recognise the possible causes of the different forms of resistance, efficiency and gentleness in bees. In order to shorten the generation interval and hence increase breeding progress, the pupa skin discarded when the queen hatches is to be used for non-lethal DNA extraction in the future. However, special attention is also being paid to improving honey bees' resistance to the Varroa mite. In addition, the procedure proposed will also allow detailed insights into the genetic diversity of the native honey bee, which is an essential basis for sustainable breeding concepts. The project lives on the extraordinary interest that German bee keepers have in this forward-looking technology and their close cooperation. The DNA chip is being developed in close cooperation with Eurofins Medigenomix GmbH in Ebersberg.

(Financed by the BMEL through the Rentenbank 742397/BLE 28-RZ-3-72.043)



Project GeSeBi:

Newly hatched queen from breed A m. carnica. Non-lethal DNA removal from the valuable breeding queens represented a central problem for the project. Success was achieved in obtaining DNA of comparably good quality and quantity from the pupa skin remaining in the queen's cells. Final tests with the SNP chip are still pending.

Establishment of a gene bank for honey bees

Due to the endangerment of the genetic diversity of the honey bee, the Federal Ministry of Agriculture has commissioned the LIB to produce an initial collection of freeze-preserved drone sperm from Germany and neighbouring countries. We are collaborating with the Bee Institute in Kirchhain/Hessen for this purpose. Frozen storage techniques are

being used, which were developed during previous projects, including ones at the LIB. In the current project, which will continue until 2022, samples from around 300 colonies will be taken in total. These are stored in the recently established National Genebank for Agricultural Livestock in Mariensee.

Molecular microbiology and bee diseases

The scientific interest taken by the Department of Molecular Microbiology and Bee Diseases at the LIB applies to bee diseases. The goal of the research being carried out there is to continually develop new disease control strategies by developing a better understanding of infectious diseases in honey bees and minimising colony losses during the season and in winter. In addition to developing molecular methods for diagnosing infectious diseases in honey bees, the researchers are also focusing on three bee pathogens: the Deformed Wing Virus (DWV) RNA virus, the gram-positive pollen bacteria *Paenibacillus larvae* and the microsporidia *Nosema apis* and *Nosema ceranae*, which

are types of fungi. All three pathogens are economically important since they cause significant losses in the Western honey bee *Apis mellifera*, the third to fourth most important form of livestock in Germany. DWV causes the death of infected pupa or the hatching of crippled bees that are unable to survive, especially when it is transmitted by the *Varroa destructor* mite. *P. larvae* causes American Faulblough (AFB), which does not just kill a single larva but can also cause the death of entire colonies. *Nosema apis* and *Nosema ceranae* infest adult bees as intestinal parasites and cause diarrhoea and the weakening of afflicted colonies.

Project ATLAS

Within the scope of an experimental development project funded by the Landwirtschaftliche Rentenbank (project agency: Federal Agency for Agriculture and Development, BLE), a textbook on bee diseases in the form of a pathology atlas was created in cooperation with Project Director, Dr. Heike Aupperle (Laboklin GmbH Kissingen). The experience and results of a decade of research on bee diseases at the LIB have been incorporated into this specialist book. The basis for the creation of the pathology atlas was the analysis and visualisation of healthy, infected and diseased bees (larvae, pupae, adult bees) and bee parasites. To visualise the normal findings, healthy bee material was used, especially that from the bee colonies at the LIB. The preserved normal findings for healthy queens, workers and drones at all stages of development can be found in the first part of the pathology atlas in Chapter 1 „General Structure“ and Chapter 2 „The Organ Systems“. In order to present disease-specific pathological changes in larvae or adult bees, controlled infection experiments were carried out in the laboratory. The findings address all key diseases in bee larvae and adult bees caused by viruses, bacteria, fungi and parasites. Pathogens and the corresponding pathological findings are illustrated in the second part of the pathology atlas in Chapter 3 „Bee Diseases“ and its Subchapters 3.1 „Controlled infection experiments“ and 3.10 „The small hive beetle and the Tropilaelaps mite“ using macroscopic, microscopic and electron microscopic images. The methods and techniques for microscopically diagnosing bees newly developed for the atlas are briefly presented in the second part in Chapter 4 „Microscopic diagnostics in bees“. The keys and texts were written in German and English to facilitate the widest possible circulation of this innovative book. Published in the summer of 2016 following four years of development work, the Diagnostic Colour Atlas of Bee Pathology is the first of its kind. It provides the essential foundations for understanding the functional

anatomy of the honey bee and the pathogenesis of bee diseases. Boasting more than 350 coloured illustrations, it takes the form of an informative and illustrative reference work for diagnosing bee diseases for pathologists, scientists and students, as well as interested bee keepers. The pathology atlas was published in June 2016 in a first edition of 1,000 copies under the title „Diagnostischer Farbatlas der Bienenpathologie/Diagnostic Color Atlas of Bee Pathology“ (ISBN 978-3-00-052781-4) and can be purchased for 49 euros. (Financed by the BMEL through the Rentenbank 755057/BLE 28LR30-012



The Diagnostic Color Atlas of Bee Pathology is the first of its kind (bilingual German/English). It teaches the essential foundations for understanding the functional anatomy of the honey bee and the pathogenesis of bee diseases. Boasting more than 350 coloured illustrations, it takes the form of an informative and illustrative reference work for diagnosing bee diseases for pathologists, scientists and students, as well as interested bee keepers.

Honey and pollination

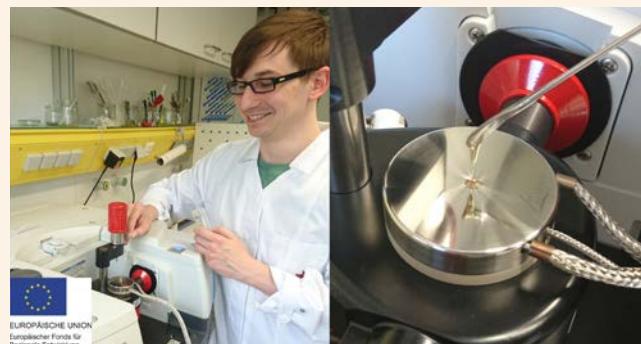
Unlike many other foods, honey is a natural product containing a variety of constituents. Its composition and quality are determined decisively by the nectar input from an infinite variety of plants in various combinations. However, external factors such as weather conditions, soil quality and bee keeping measures also need to be taken into account. The study of honey quality has been a focus of research at the LIB for many years. Not only has special emphasis been placed on the development of new analytical methods in order to be able to offer low-cost honey analysis to regionally

based bee keepers in particular, but also to investigate honey constituents. The pollen image of a honey strain can also show which plants the bee has visited for its production. The various honey strains from a region therefore provide a mirror image of the bee pasture actually used and hence important information on how the bees are supplied. New insights in this area can be used to help bee keepers improve their honey quality or break new ground in marketing.

Project on the use of alternative methods in honey analysis: Examining honey using infrared spectroscopy

Infrared spectroscopy is an analytical method that allows substances of any consistency to be reliably examined. It is used, among other things, in food control. For the first time in 2002, infrared spectroscopy (IR) was also successfully used on honey in the Honey Analysis department at the LIB in Germany, and established as a routine method at the institute. This method is used to measure key constituents in a faster and more environmentally friendly manner, but still as reliably as with standardised methods. For sugar analysis alone, the amount of time needed to measure a sample can be reduced from 40 to about two minutes. IR can also be used to determine several analysis parameters simultaneously. Within the scope of this project, the technology previously used is being converted to new, modern IR device technology. Whereas diluted samples were previously used to take measurements, the new IR spectrometer with attenuated total reflection (FTIR-ATR) requires no more than a single undiluted drop of honey. This also makes it possible to determine the honey constituents in lower concentrations along with the water content. The device first needs to be calibrated to be able to investigate the various quality parameters of honey and make measuring the honey constituents altogether possible. The variety of the honey also needs to be taken into account, since, unlike other foods, its composition varies greatly depending on many factors, such as yield and weather. One of our primary goals is to translate the benefits of this modern technological process into practical honey quality testing so that bee keepers can benefit as well. The investigation of beeswax for adulteration by means of FTIR-ATR was also established in another project.

(Co-financed by the European Union ((EC) Regulation No. 1308/2013)



Just one drop of honey is enough to determine the key quality parameters of honey by means of infrared spectroscopy.

Training and further training

Training has always been part of the institute's work. In order to be better able to cope with the strong growth in demand, however, a separate work area was set up at

the end of 2007 with the goal of encouraging and supporting the personal initiative of bee keeper(s) (associations). The aim is to achieve a high level of effectiveness with sustainable benefits using comparably little effort. The focus here is on the development and



A bee observation box can be set up in the classroom like an aquarium, significantly enriching learning processes (not only) in science subjects.

testing of teaching material and the training and further training of (Co-financed by the European Union ((EC) Regulation No. 1308/2013)

Services and profile of the services provided

The services the institute offers include breeding value estimation for the whole of Germany, disease diagnostics for bees, honey and wax quality analyses, performance tests on bee colonies, artificial insemination of queen bees, delivery of queen bees, training and advisory for 12,000 bee keepers and for the interested public, teaching at universities, the supervision of degree dissertations and doctoral theses and practical placements for pupils and students. The bee school, which is located at the institute, offers excursions and lessons on the ecological use of bees and the value of their products. The LIB has an open house on the first Sunday in September every year, which everyone is invited to attend.

In the network

The LIB is exceptionally well networked throughout Germany, Europe and internationally and cooperates with institutions in the

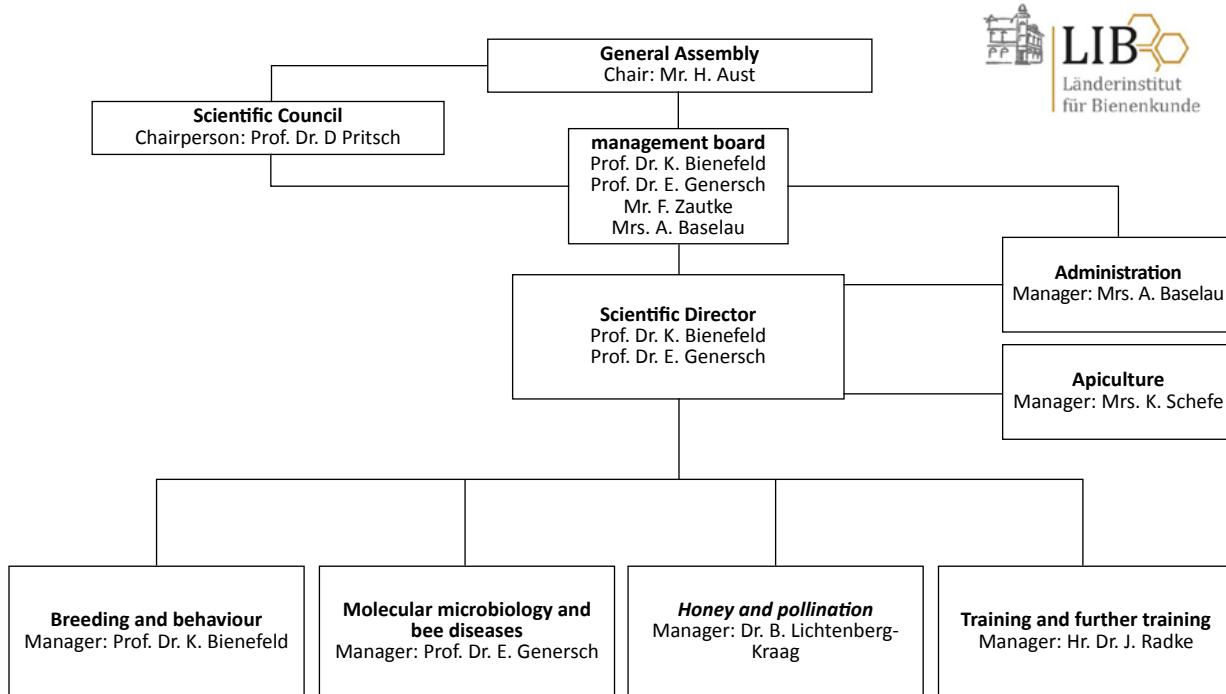
Berlin/Brandenburg area, as well as nationally and internationally. The scientists from the LIB hold lectures at the Faculty of Life Sciences at the Humboldt University of Berlin and the Department of Veterinary Medicine at the Free University of Berlin, which guarantees the transfer of knowledge to the next generation of scientists and also ensures the qualified and future-oriented continuation of scientific research. Networking the LIB in this manner at the interface between university education, practice-oriented research and users (bee keepers) ensures that a constant dialogue takes place between science and practice that regularly generates new impulses for innovative developments. The services offered by the LIB are in high demand, particularly in Germany. The breeding value estimation of the honey bee also attracts a great deal of attention internationally and is now being performed for several European countries including Austria, Italy, Sweden, France, Belgium, Norway, the Netherlands and Switzerland.

The LIB is also a member of the working group at the Institute für Bienenforschung e.V. and the scientists from the LIB are members of national and international associations and societies such as the International Bee Research Association, the European Bee Breeding Group, the German Society for Breeding, the German Veterinary Society, the Association of General and Applied Microbiologists, the Society for Invertebrate Pathology, the International Honey Commission, the Farm Animal Breeding and Reproduction Technology Platform – FABRE_TP and in the Biopatenting working group. Research projects, which are often performed in collaboration with national cooperation partners, are managed by the ministries responsible for the respective agricultural policies from the federal states of Brandenburg, Berlin, Saxony, Saxony-Anhalt and Thuringia. The LIB coordinated the „Sustainable Management of Resilient Bee Populations“ project, which

was approved as part of the EU's Seventh Framework Programme for Research (FP7) and included the participation of 16 different European partner institutions until 2018. In cooperation with university and non-academic institutes, the LIB has been involved

since 2004 in several graduate programmes funded by the German Research Foundation (DFG), hence strengthening its research network in the Berlin/Brandenburg area.

Organisational Chart



Last Updated: 07/2019

Institute for Bee Research Hohen Neuendorf

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Institute for the propagation of farm animals Schönow

Practical research with knowledge transfer

The Institut für Fortpflanzung landwirtschaftlicher Nutztiere Schönow e.V. (IFN) is an innovative animal breeding facility that embodies the transfer between research, training and further training and practice. The development and enhancement of biotechnology in animal breeding, the preservation of biodiversity, the sustainable design of agricultural production and antimicrobial aminisation in agriculture represent the primary goals of the institute's application-oriented and practice-oriented research.



The IFN:

- Is an institute where practical agricultural research is performed, from which important impulses and innovative ideas for breeding animals and the biotechnology of reproduction emanate
- Carries out training courses in its role as a state-approved training centre under the German animal breeding act (Tierzuchtgesetz)
- Facilitates the implementation of innovative approaches by start-up companies and hence the transfer of technology between science and industry
- Organises modern training events for farmers and veterinarians
- Creates channels that enable knowledge transfer between the different levels in agriculture and visualise various facets

The use of genetic diagnostic methods is currently also of high priority in innovative agriculture. These are applied with the aid of the latest technologies from IFN Schönow GmbH, which forms the competence centre at the IFN together with the IFN e.V.

The establishment of the Schönow Competence Centre in the regional and national association

- ensures that the requisite professional breadth and transdisciplinary orientation of the IFN is provided in agricultural research
- Facilitates the intensification of international cooperation through the establishment of international research projects
- Creates interdisciplinary infrastructures with numerous universities and technical colleges and also supervises doctoral theses and bachelor's and master's dissertations as well as PhD students, hence ensuring the subject-specific qualification of young scientists

Key mechanisms of female and male fertility

A decade-long selection process has left molecular signatures in the genome of fertility mouse lines, which are referred to as ‚signatures of selection‘ and can be detected today using genome sequencing and the latest bioinformatics methods. This helps to identify the genes and signalling pathways underlying increased fertility. In order to clarify whether the signatures observed are actually important to fertility, genomic selection of the gene variants detected is performed in a previously unselected control line. Furthermore, many genes that regulate female reproductive processes, such as egg development, also play a role in male reproduction processes. For this reason, additional comparative studies on farm animals and wild animals should clarify the consequences of selecting a primary female fertility trait for male fertility. The project is being undertaken by the Leibniz Institute for Farm Animal Biology (FBN Dummerstorf) in cooperation with its partners from science and industry, the IFN, the Leibniz Institute for Zoo and Wildlife Research (IZW) Berlin, the Institute of Clinical Molecular Biology (IKMB) Kiel, the Geolifes veterinary service and the Federal Hybrid Breeding Programme (BHZP).

SOS FERTIL, SFN: SAW-2016-FBN-1, Leibniz Cooperative Excellence.

Innovative antimicrobial concepts in pig insemination

The aim of this project is to develop an innovative concept for minimising antibiotic use and by doing so prevent the development of multi-resistant germs in pig insemination and establish it in practice. This project will make an active contribution to the German government’s antibiotic resistance strategy (DART). In the comprehensive project approach taken, comprised of science, insemination organisation, industry and agriculture, a novel method for the low-temperature preservation of boar semen is being tested using a prototype preservative medium. The project represents a measure to minimise the growth of germs while largely avoiding classical antibiotics, especially those referred to as reserve antibiotics. The key technology here is low-temperature preservation. In this manner, the proposed project will be able to both increase productivity in agricultural practice and reduce the use of antibiotics in animal husbandry. It also significantly reduces the danger of the emergence of multidrug-resistant germs. In addition, the insemination centres organised within the Association for Bioeconomy Research (FBF), together with the reference laboratories from the scientific partners at the University of Veterinary Medicine Hanover and the IFN, have established a strict hygiene control programme with spermatological standards, which is an integral part of the German Livestock Association (BRS) and already led to a significant decline in the number of contaminated ejaculates.

AMIKOS, SFN: 28-RZ-3.053, Federal Office for Agriculture and Food, Landwirtschaftliche Rentenbank.

Influence of antibiotic-free sperm preservation on fertility

In this project, the method used for preserving boar semen in an antibiotic-free carrier medium mentioned in the aforementioned research project (AMIKOS) is put into practice. The aim of the German-Brazilian DAAD cooperation project is to test the low-temperature preservation concept with an antibiotic-free thinner in field trials in Brazil. Since the management of operations and insemination varies widely, field trials under different conditions are also required. Brazil has large operations where tests of this type can be carried out under well-defined conditions. Collaboration between Brazilian and German researchers, in particular the involvement of young scientists in both groups, will enable the exchange of in-vitro and in-vivo tools for the future improvement of sperm conservation concepts worldwide.

SFN: PPP Brasilia PROBAL, German Academic Exchange Service (DAAD).

Bacteriocinated diluents for preserving boar semen

The goal of this project is to develop and produce a bacteriocin-based diluent for preserving boar semen, which should enable a significant reduction in antibiotics of at least 60% in order to reduce both the bacterial burden and the tendency to develop resistance. Bacteriocins are toxins that are secreted by bacteria and can inhibit the growth of other bacteria. A special diluting medium needs to be developed to ensure the efficacy and simultaneous sperm compatibility of the bacteriocins in the sperm diluent. It can be assumed that the parallel use of antibiotics and bacteriocins enhances the antimicrobial effect of both substances and that a reduced amount of antibiotics can be used for this reason. Individualised bacteriocin cocktails are also to be produced, which can be adapted to the specific germ environment of the insemination stations. This would result in significant economic, logistical and medical benefits for the stations. Project partners are Miniübeg GmbH and the Institute of Food Safety and Food Hygiene at the Free University of Berlin. *BoarZin, FKZ: ZF4276702SK6, Central Innovation Programme for Small and Medium-Sized Enterprises (ZIM), Federal Ministry for Economic Affairs and Energy.*

Flow cytometric investigation methods in spermatology

Fertility predictability of semen quality is indispensable in order to ensure the production performance of inseminators and bulls. Flow cytometric investigations after staining the sperm with fluorescent stains make it possible to visualise physiological parameters. For example, based on this analysis, a statement can be made about the proportion of sperm with active mitochondria. By investing in new technology, the extension of the diagnostic spectrum in the field of research and service for spermatology in boars and bulls is made possible as part of an infrastructure for the project funded by research, development and innovation (Infra-FEI). Following an adjustment and validation phase, the expansion of the range of methods is now being placed in the foreground. The four lasers the new device is equipped with makes the parallel detection of different dyes possible in what is referred to as a multicolour fluorescence analysis. Simultaneously analysing different dyes not only saves time and sample material compared to individual measurements, but also allows for the simultaneous analysis of multiple sperm defects.

SpermFlow, Ministry of Rural Development, Environment and Agriculture.

Lactic acid bacteria for fertility on the dairy farm

The fertility of its dairy cows represents an important pillar for the profitability of a dairy farm. In cooperation with the Institute of Veterinary Biochemistry at the Free University of Berlin, the IFN is therefore focusing on the development of a practicable, economical and at the same time hormone- and antibiotic-free strategy to improve the uterine health and hence fertility of dairy cows. A first joint study has already shown that administration of a probiotic strain of lactic acid bacteria (*Lactobacillus buchneri*) in the uterus of dairy cows has a positive effect on their uterine health and fertility. The successful use of such a probiotic would lead to a significant reduction of hormones and antibiotics and increase the acceptance of dairy cattle by consumers. In order to be able to confirm these promising initial results, a further study is currently being conducted on the practicable use of *Lactobacillus buchneri* to improve fertility on the dairy farm.

Ministry of Rural Development, Environment and Agriculture Brandenburg and the Saxony State Office for Environment, Agriculture and Geology.

Further development of microscopic diagnostics in cows

One of the main causes of reduced fertility in dairy cows is the inflammation of the uterine lining (endometritis). Triggers are predominantly pathogenic bacteria, which the mother is particularly vulnerable to during and in the days after calving. In the case of clinically indistinguishable symptoms, such as purulent discharge, what is known as subclinical endometritis may be present. This cannot be detected with practical and conventional diagnostic methods, since the proportion of specific immune cells in endometrium smears needs to be determined. These diagnostics are associated with a complex and costly analysis in the laboratory and for these reasons have not been established in practice. Most cases of subclinical endometritis therefore remain undiagnosed. Ocoolze GmbH, a spin-off from the Technical University of Applied Sciences Wildau, develops and builds smartphone microscopes equipped with integrated and automated image analysis, enabling microscopic images to be evaluated anywhere and within seconds. Under the technical assistance and advice of the IFN, this system will now be enhanced and validated in order to be able to offer a practicable alternative for diagnosing subclinical endometritis.

Monitoring cow health and fertility by employing rumen bolus

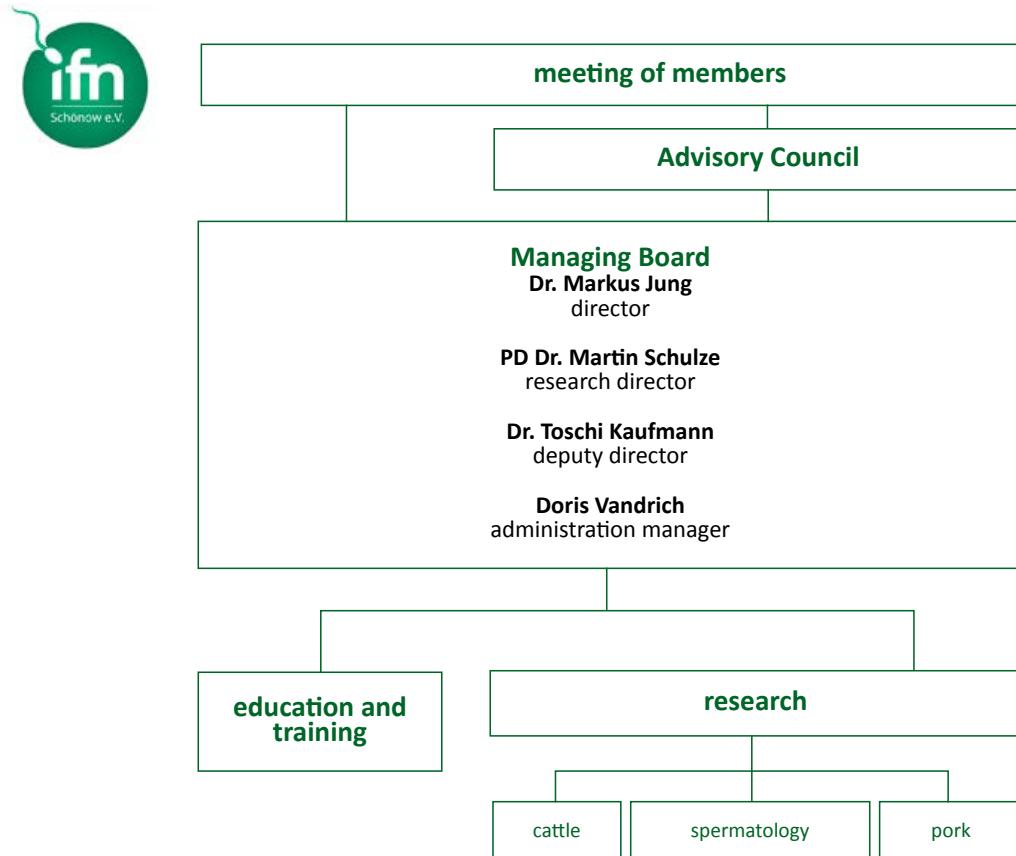
Good animal monitoring forms the basis for optimal health management on dairy farms. For this reason, Dropnostix has set itself the goal of developing a ruminal bolus that provides comprehensive data on the activity and health of the individual animal in a dairy herd. This technology facilitates oestrus monitoring and thus simplifies insemination at the optimum time point. It also gives the farmer the opportunity to initiate targeted measures at the first sign of an animal's illness. The IFN is supporting the Potsdam-based start-up company in developing this rumen bolus and matching the technology to the requirements in the cowshed. The institute is also facilitating the first practical testing of the new bolus on the institute's proprietary livestock, as well as further trials on dairy cattle farms in Brandenburg.

Dropnostix GmbH. Current application from the Deutsche Innovationspartnerschaft Agrar (DIP).

In the network

- Member of the ZUSE research community
- Animal reproduction network
- Lower Saxony virtual centre for reproduction

Organisational Chart



Institut für Fortpflanzung landwirtschaftlicher Nutztiere Schönow e.V. (IFN)

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<https://www.linkedin.com/company/ifn-kompetenzzentrum-schönow>

Institute for inland fisheries Potsdam-Sacrow

Partner for fishermen and anglers

The Institut für Binnenfischerei e.V. (IfB) is a scientific institution dedicated to applied fishery and fish ecology research in inland waters. As a result of the work it performs, it sees itself as a bridge and link between basic research and practice. The main goal of the institute's work is to create, by means of research geared to practical issues, scientific foundations and ready-to-use insights for viable and successful fishing and angling, including aquaculture, as well as technically substantiated fisheries policy decisions. The principle of „fisheries research from practice for practice“ that was forged at the time the institute was founded continues to characterise the manner in which the institute works today.

The intention behind the institute's work is to serve the fishing industry, policy-makers, fish consumers and the environment. In addition, the institute supports polytechnic and university education on fisheries and informs the public about current developments in the areas of fish, fisheries and inland waterways.

Current discussions on the future touch upon the management of fish stocks and the resulting interactions with the aquatic environment. For example, the sustainable use of regional fishery resources makes an important contribution to the provision of safe, high-quality food in a manner that is close to nature and environmentally friendly. The institute in Sacrow wants to contribute to the future availability of captive and farmed fish from local inland waters in sufficient quantities under certain conditions. At the same time, issues concerning water, environment and animal welfare are also being raised in relevant social discussions. Keywords such as low-emission methods, preservation of the genetic diversity and fish health and species-appropriate husbandry outline this area. The climate changes

predicted will also have a significant impact on fish fauna and its use and management.

The staff at the IfB are convinced that technically sound, application-oriented fisheries research will continue to play an important role in this context in the future.

The IfB currently employs around 30 staff, including 12 scientists. Trainees and interns are also employed. The financial basis of the institute's work after 1992 initially was to implement research projects from the ministries responsible for fisheries in the states of Brandenburg, Saxony-Anhalt, Schleswig-Holstein and Thuringia. In the past 20 years, the volume of tasks and projects that receive financial support through funding programmes from other federal states, the Federal Government, the European Union and third parties such as foundations has steadily increased. The same applies to the commissioning of investigations and professional services by a wide variety of public and private customers.

The institute's work covers a wide range of topics. These can be grouped into fishing and angling, fish and water ecology and aquaculture and fish farming.

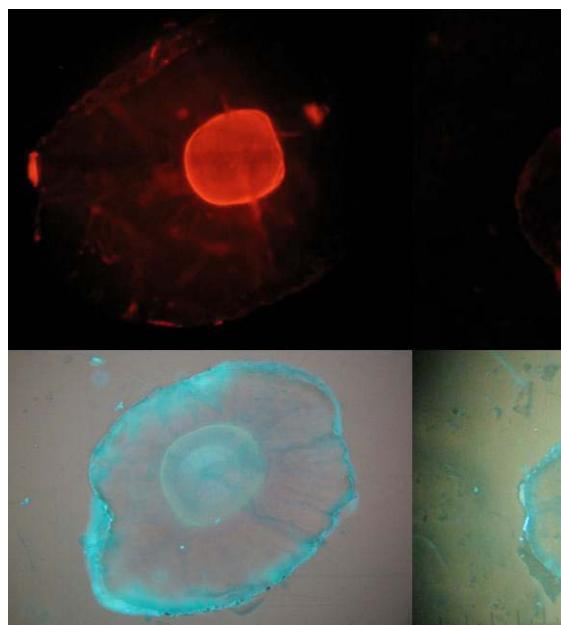
Sustainable management of eel stocks

One of the thematic research focuses involves studies addressing the sustainable management of stocks of various fish species in lakes and streams in Brandenburg. The dynamics of eel stocks is of interest in particular, because this species forms the economic basis of the fishing industry in Brandenburg and is also an important species favoured by anglers. At the same time, a European regulation is calling for the establishment of eel management plans. In the course of our investigations, the natural immigration of eels from the North and Baltic Seas to Brandenburg inland waters was quantified, the survival rates of young eels until they reach adulthood age was modelled and their migration into the sea was analysed in terms of triggering factors and speed.

With regard to the efforts to stabilise the eel population by increasing the number of mature eels, the studies showed that the required outcomes can only be achieved in the short and medium term by extensively exposing young eels in Brandenburg lakes and rivers. Natural occurrence is currently not enough. Other management measures, such as an increase in the minimum catch size for anglers, are only complementary and not effective enough in themselves. Studies on the behaviour of migrating, fully mature eels showed pronounced phases of activity in the months of April-May and September-November. The majority of the eels swam through the Havel to the delta in the Elbe in just a few weeks. Some eels needed several months, though, and a few even more than a year, owing to interruptions in the activity phases. Overall, the singleness of purpose of migration appears to be increasing in a downstream direction. The analysis of the migratory velocities leads to the conclusion that migrating silver eels predominantly drift passively with the current and do not swim actively downstream. The phases of highest activity are during the twilight and night hours.



Top: Specially designed weir for quantifying the migration of young eels in use on the lower Havel



Right: Earstone with and without colour marking for the identification of previous eel occupancy

Salmon in Brandenburg

The successes achieved in repatriating salmon and sea trout to the secondary waters of the Elbe are also closely linked to studies performed at the Institute of Inland Fisheries. On the initiative of the Landesanglerverband Brandenburg eV. (LAVB) and the Department of Inland Fisheries (IFB), the resettlement project for salmon and sea trout in the River Stepenitz, funded by the fishery levy, was started in 1998 and later extended to the Schwarze Elster/Pulsnitz river basin. On the one hand, the quality of the water improved significantly in these historic salmon rivers after 1989 and, on the other, the natural structural diversity was also preserved there. This provided good chances for the successful re-population of both species.

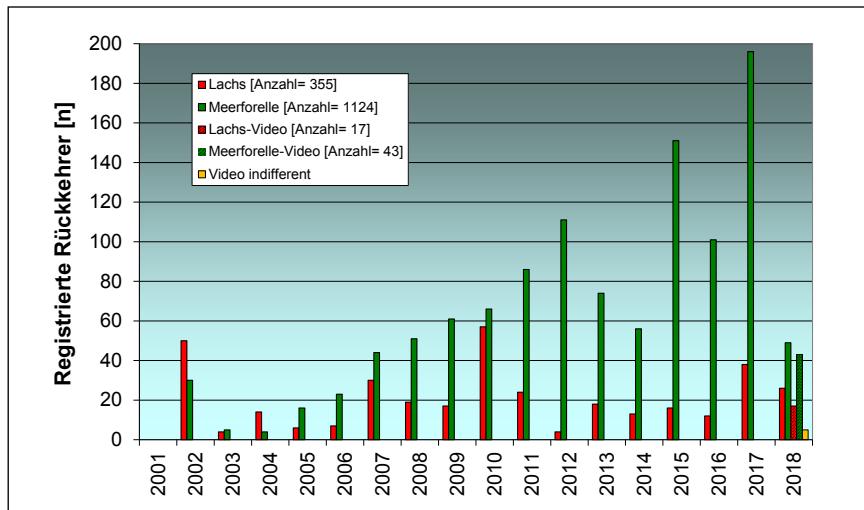
Since the first occupation in 1999 until today, one million salmon and sea trout broodlings and juveniles have been exposed in the Stepenitz area. At the age of one to two, these fish swim out of their nurseries with the aid of the current and finally reach the North Sea and Atlantic via the River Elbe. They commence their return journey to their home waters once their sexual maturity approaches. Our investigations have shown that the returnees to the Stepenitz system reproduce naturally and lay the foundations for the independent development of subsequent generations.

In close cooperation with the state angling association in Brandenburg, the State Office for the Environment and the various water and soil organisations, 17 weirs have been redesigned on the Stepenitz since the project began, so that they no longer represent an hindrance to fish as they migrate in the river system. This means that salmon, sea trout and other species can reach around 60 percent of the river basin again today even without stocking. Besides salmon and sea trout, other endangered species, such as the river lamprey, can be seen to be spreading again.

Positive developments in stock have led to the ban on sea trout fishing in the Stepenitz having since been lifted. Even though the ban still persists for salmon, all stakeholders have already come a great deal closer to the project goal of developing self-sustaining stocks that can be used for fishing. The local fish fauna in Brandenburg, comprising about 60 species, has two of its most striking representatives.



Salmon Portrait



Proof of salmon and sea trout caught in the Stepenitz system from 2002-2018



*Zellwolle Wittenberge
Weir (Stepenitz) –
prior to conversion*



*Zellwolle Wittenberge
Weir (Stepenitz) –
after conversion*

Use of network-based systems in lignite mines to solve the young carp fry problem in the pond economy

Another thematic focal point is the optimisation of techniques and technologies in aquaculture. The reliable and economical production of juvenile carp fry in ponds is still problematic or impossible, especially due to the influence of fish-eating birds on many fish farms in Brandenburg. The concentrated and shielded rearing of fish in warm water systems at lignite power plants and in ponds systems in the ponds themselves provides a way out of this problem. Several related projects have been carried out in recent years. In a pilot project in cooperation with a fishing operation in the Lusatia and Brandenburg University of Technology Cottbus-Senftenber, an alternative method for rearing young carp fry in net enclosures in lignite mine lakes was tested. The project was financed by the European Fisheries Fund, including co-financing from the state of Brandenburg.

The fishing operation built two systems, each comprised of two six-aisle enclosures with a total holding volume of 672 cubic meters set up and operated on a 26-hectare lake. The lake was created by flooding a former open-face brown coal mine and is characterised by low pH values and pronounced nutrient depletion. Rearing the carp fry took place in a net enclosure fitted with special equipment for recording and balancing the emission loads of the fish. The water quality was monitored at the same time.

During the four-year rearing period, the most important technological parameters, such as losses, feed conversion and harvest weight, produced better results.

The advantage of net enclosures lies in the fact that, compared to other methods, electrical energy and oxygen are not needed and the investment costs are comparatively low. The lossless wintering possibilities for the carp fry with little loss of condition also represents another advantage.

Examinations of the health of the fish documented very good health and nutritional status over all the years. It is very probable that the very nutrient-poor and stable water quality of the water and the low population density in the net enclosures contribute to a low pathogen pressure and therefore to the good health of the fish. In combination with optimised fish food, this results in good breeding outcomes.

Monitoring the quality of the water showed that there was no permanent deterioration of the water quality in the lake caused by the fish breeding. In the lower summer-cold body of water, a significant load was temporarily detectable, but this did not affect the entire body of water. The lake remained unchanged compared to its very nutrient-poor (oligotrophic) reference state. Of great importance is the much higher phosphorus binding capacity of the body of water compared to naturally occurring waters, formed as a result of lignite mining.

Development and testing of a compact module for eliminating phosphorus from the run-off water in recirculation systems

The cultivation of aquatic organisms in special systems containing recirculating water has the potential to sustainably increase aquaculture production in Germany and is attracting increasing interest. Phosphorus accumulates in the treatment water in circulation systems, which, in contrast to nitrogen compounds, cannot be sufficiently decomposed through the internal water treatment plant. Along with this, the run-off water from recirculation systems can contain phosphorus concentrations that lie above the legal limits. This problem contributes to the fact that fish farming in recirculation systems has been of secondary importance in Germany to date. The aim of the research project was to develop and test a practicable process for eliminating phosphorus from the discharge water in recirculation systems. The principle of the process for phosphorus precipitation was adapted to the conditions prevailing in recirculation systems. The aim was to develop an easy-to-use, compact system module that can be easily integrated into existing recirculation systems. The work initially included laboratory tests to check the efficiency of various precipitants and flocculants in run-off water from recirculating systems. Six precipitants were tested individually and in combination. Based on this, the development, implementation and testing of a phosphorus elimination module were carried out in a typical recirculation system. The combination of iron (III) chloride and calcium hydroxide as precipitate and flocculant was found to be optimal in laboratory tests for elimination performance and environmental impact. The compact, automatically operating P-module developed on this basis is equipped with a 500-litre reaction tank. Almost 90 percent of the phosphorus can be precipitated after just half an hour of sedimentation.

Following optimisation of the operating parameters (precipitation and flocculant dosing, mixing, sedimentation time), the compact module succeeded in reducing phosphorus emissions from the run-off water in a recirculating system by 95 percent for an annual fish production of around 25 tonnes. The passage of the P-module mostly further reduced the concentrations of nitrogen compounds and organic matter.

The module thus developed can hence contribute to resource-conserving and low-emission aquaculture in Germany.



Precipitation/flocculation and sedimentation experiments in the IfB laboratory



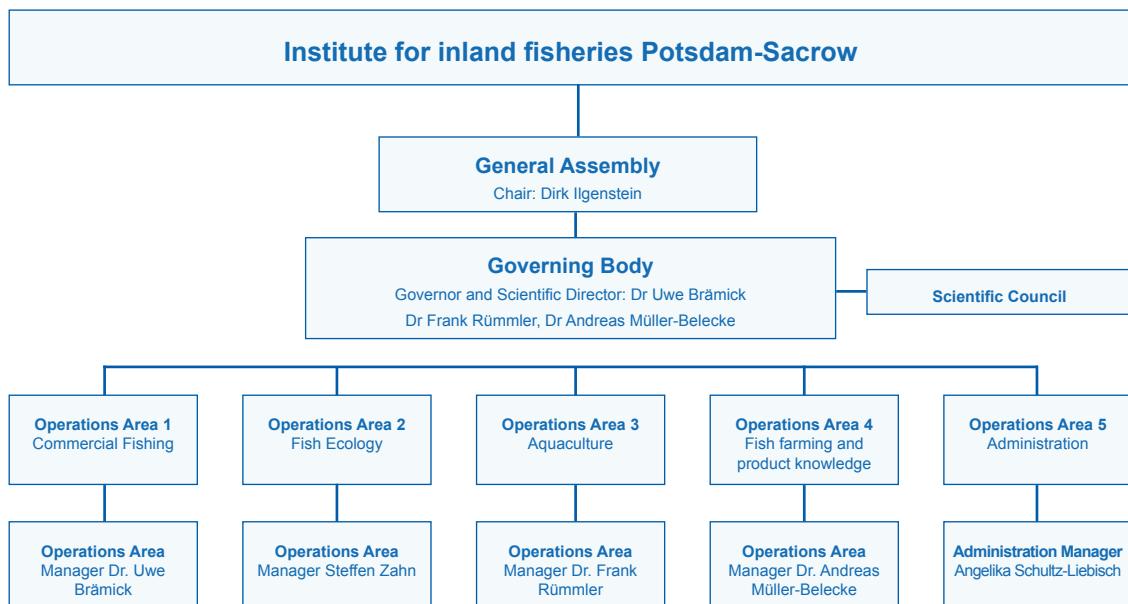
Phosphorus elimination module, 500 litre reactor and an approximately 50-litre sedimentation funnel volume

In the network

The specialists from the institute in Sacrow are active on numerous regional, national and international specialist committees and advisory boards. These include, for example, the Scientific Advisory Council of the Deutsche Fischerei-Verband e.V., the Verband deutscher Fischereiverwaltungsbeamter und -wissenschaftler and the fisheries councils of the states of Brandenburg and Saxony-Anhalt, as well as various districts. Furthermore, scientists from the institute are represented in the Fisheries Advisory Council of the Saxony State Office for the Environment, Agriculture and Geology, LMBV Fishery Association in Saxony-Anhalt and the DWA-Landesbeirat Nordost (Saxony-Anhalt, Brandenburg, Berlin, Mecklenburg-Western Pomerania). Further cooperations exist with the ICES/EIFAAC Working Group on Eels, the steering group aquacul-

ture of the German Agricultural Research Alliance (DAFA), the DLG Committee for Fish Breeding and Fish Farming, the Fisheries and Water Rights Commission of the German Fisheries Association, the DWA Working Group on Water Treatment and Wastewater Treatment in Fish Farming, the Technical Committee on Aquatic Genetic Resources of the BLE, the Working Committee for Water Protection of the German Fisheries Association and the DWA Working Group Functional Control of Systems for the Production of Continuity. The research and results of the work undertaken by the institute are distributed in national and regional media, such as the magazine „Märkischer Fischer“ published by the Brandenburg state angling association and at specialist events. Each year, several scientific papers are also published in selected international journals. The institute also publishes its own series of publications.

Organigramm



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Teaching and research institute for horticulture and arboristics

In the service of blooming landscapes

The Lehr- und Versuchsanstalt für Gartenbau und Arboristik e.V. (LVGA) was founded in 1993 as the Lehranstalt für Gartenbau und Floristik Großbeeren e.V. (LAGF). The institute is facility for the training, further training and continued training of gardeners of all disciplines, as well as anyone interested in horticulture and tree care/arboristics. On being renamed in 2019, the institute will also be active in future in research-based experimentation and will also take up activities in Müncheberg, in addition to its headquarters in Grossbeeren.

Members and sponsors are the Fachverband Garten-, Landschafts- und Sportplatzbau Berlin und Brandenburg e.V. (FGL), the Gartenbauverband Berlin-Brandenburg e.V. (GVBB), the Fachverband Deutscher Floristen Landesverband Berlin-Brandenburg e.V. (FDF), the industrial union, Bauen-Agrar-Umwelt Region Berlin-Brandenburg (IG BAU),

the working group deutscher Junggärtner e.V. (AdJ), the Bund Deutscher Landschaftsarchitekten Landesgruppe Berlin/Brandenburg e.V. (bdla), Beuth University of Applied Sciences Berlin, Humboldt University of Berlin, the Leibniz-Institut für Gemüse- und Zierpflanzenbau Großbeeren/Erfurt e.V. (IGZ), the Lenné-Akademie für Gartenbau und Gartenkultur e.V., the Deutsche Gesellschaft für Gartenkunst und Landschaftskultur Landesverband Berlin-Brandenburg e.V. (DGGL), Grün Berlin GmbH, Pomologenverein Brandenburg/Berlin, the State of Brandenburg, represented by the Ministry of Rural Development, Environment and Agriculture (MLUL), the State of Berlin, represented by the Senate Administration for Integration, Employment and Social Affairs(SIAS).

Inter-company training

The LVGA offers inter-company training in gardening and landscaping, ornamental plants, cemetery gardening, vegetable gardening,



visitors at LVGA



fruit growing, nursery gardening and perennial gardening. In order to achieve as uniform and high a level of education as possible, a coordinated concept is implemented in a triad of training company, vocational school and inter-company training centres that meets the needs of practice. During inter-company training, trainees remain in close contact with the companies that dispatch them.

Further Training

One of the main areas of responsibility involves further training in gardening and landscaping, horticultural production, and arboristics, as well as interdisciplinary training for managers. The course syllabus is constantly revised and adapted to the current demands of the green industry. The professional image of the gardener is not only characterised by a fascination for plants, but also by a strong technological focus. Both in production and service horticulture, new technologies will come into use over the next few years that will develop the identity of the horticultural profession.

Research-based experimentation

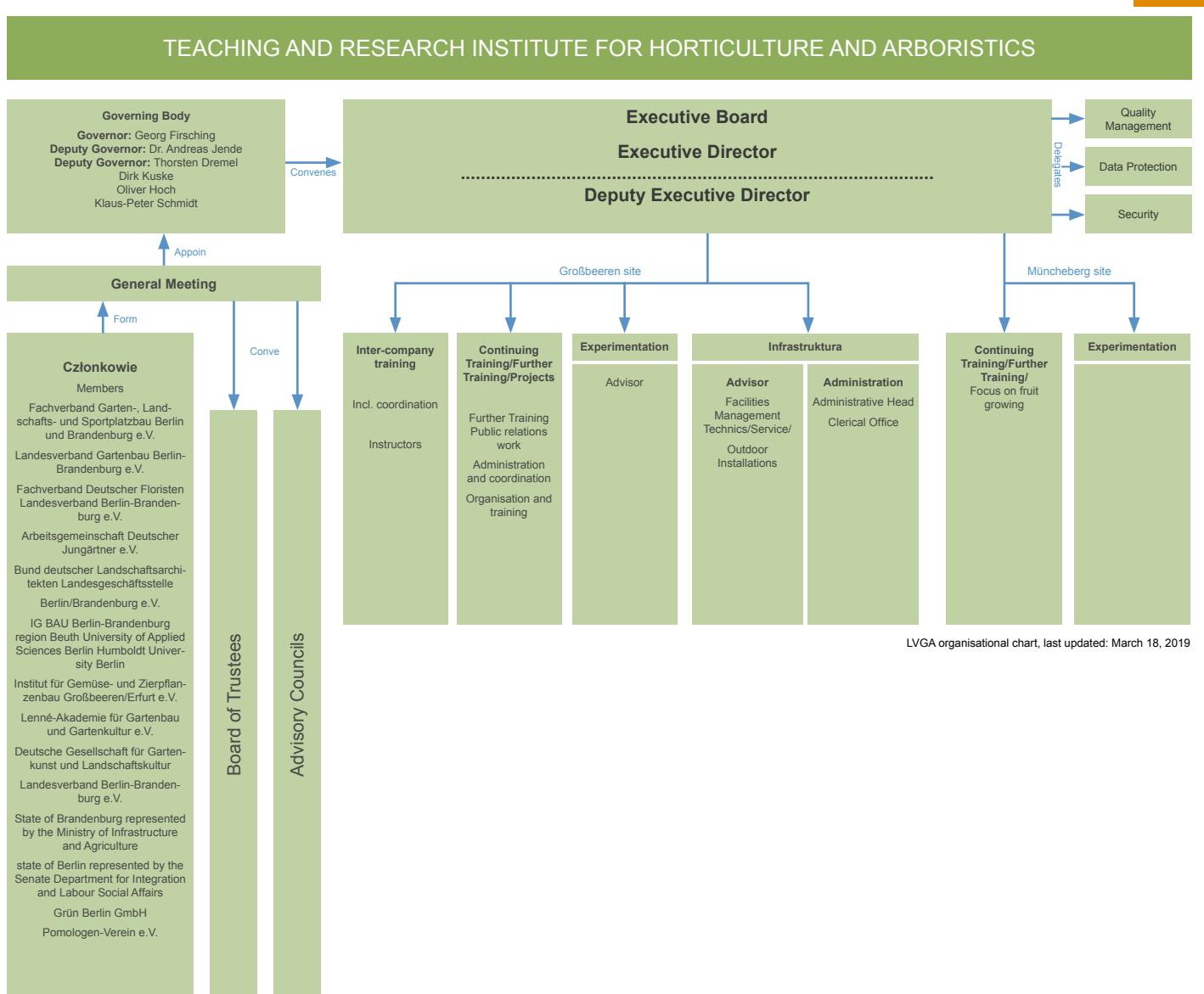
Climate change is subjecting public and private green spaces to major changes with the Berlin-Brandenburg region facing particular challenges. To address these changes and challenges, a plan has been created to set up test facilities and perform investigations and convey the findings in practice in the form of further training formats. The focus here will be placed on projects that cover all the relevant aspects of tree interaction in the green sector under the generic term of arboristics, i.e. tree care, orchards, tree nurseries and also planting and care through horticulture and landscaping.

Trial orchard station in Müncheberg (TOS)

The existing facilities at the Müncheberg site will be consolidated and expanded and the educational courses offered in orchards and arboristics will also be intensified. The experimental system will be significantly expanded in consultation with the various project partners.



Organisational Chart



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