



Icelandic Fisheries  
Laboratories



**Annual Report 2003**

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## Director General's Address



Purposeful research, development and build-up of knowledge are key factors in achieving results in increasing the value of the Icelandic marine catch in the future. IFL's mission is to increase the value and safety of marine catches through research, development, dissemination of knowledge and consultancy. Specialists working at the IFL are participants in numerous international research projects and steer many of them. IFL's knowledge and experience is a valuable "export product", and the institute also imports valuable knowledge from international scientific cooperation that enriches Icelandic fisheries and benefits consumers with more value creation in this sector, quality and safety in production. IFL works closely with the industry and universities in Iceland and thus promotes the build-up and transfer of knowledge between researchers and the industry. The collaboration entails joint projects as well as employees working partly for IFL and in part for the relevant universities.

In 2003 extensive organizational changes, involving increased emphasis on research and development, were decided that should promote increased value of marine catches both directly and indirectly. Research will be built up in the Westman Islands, Ísafjörður and Akureyri, and IFL will aim at increased collaboration with fisheries companies. At the same time IFL will decrease its competitive operations entailing service tests, such as testing for proteins, fats and microbes. IFL will discontinue service testing in the Westman Islands, Ísafjörður and Akureyri but will continue its present services in Neskaupstaður and in Reykjavík.

In 2003 IFL strategy was worked at and future goals were set for the institut. In addition, certain criteria for measuring results were decided.

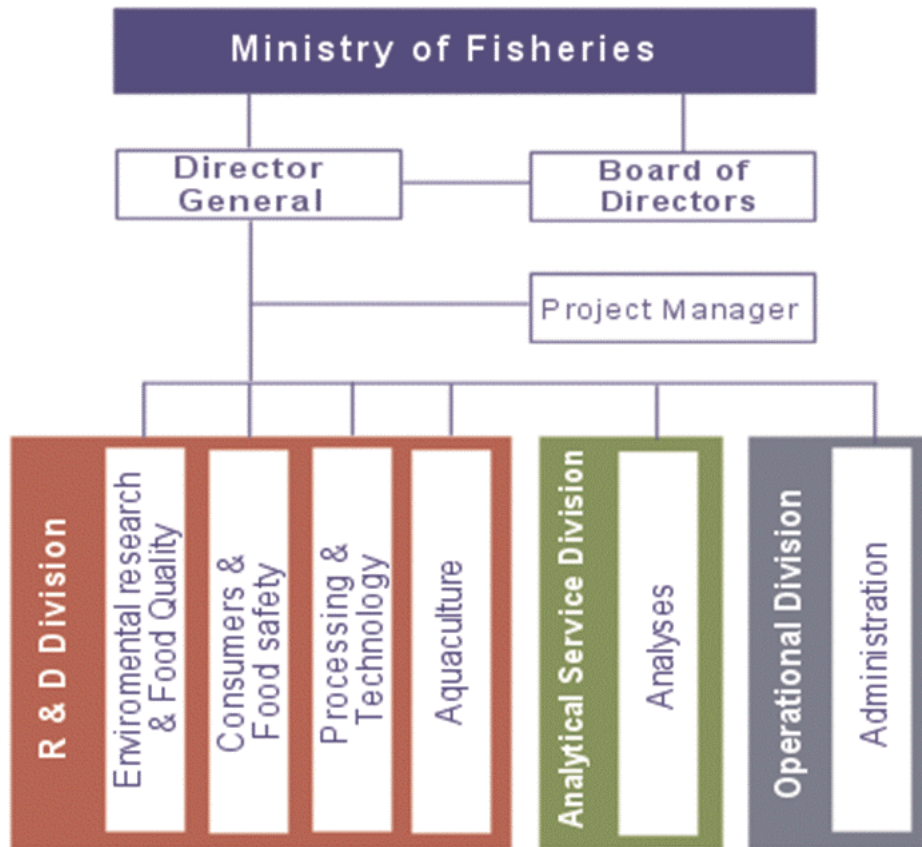
IFL's board of directors and management have set the strategy of strengthening research, development and innovation in Icelandic fisheries and other related food industries. At the same time ties with educational organizations, fisheries companies and foreign research organizations should be strengthened and increased value and safety of marine catches should be promoted. The aim is to strengthen ties with and services for IFL's customers and increase publicity for the organization's projects and results. Collaboration with research institutes and universities, both in Iceland and abroad, will be increased and various internal processes, such as project management, will be strengthened. IFL aims at increasing the number of specialists with PhDs in its group of employees and at increasing the number of students in research curricula for Master's and PhD programs in cooperation with universities in Iceland and elsewhere in the world. Regarding students working at IFL, especially those in PhD programs, emphasis will be placed on involving them in international collaboration. For example, they might engage in part of their studies abroad, or their instructors may be from overseas.

At the beginning of 2003 IFL's organizational structure was changed to make its operations more purposeful and maintain better control of activities. The R&D Division was divided into four operational units; the other divisions are the Analytical Service Division, which sees to service testing, and the Operational Division. IFL's operations were reorganized and cost control and revenue monitoring were made more efficient with each operational unit being made more responsible than before. Changes were made in accounting so that each operational unit is now more distinct and it is possible to produce information about each operational unit more efficiently. Project planning was made more purposeful and supervision increased and the activities are now used as management tools for the organization. There are now monthly settlements for the institute as a whole and for each operational unit, where actual figures are compared with plans. This generated good results regarding IFL operations in 2003 and the institute was run within the financial frame that it had.

Many challenging and exciting projects lie ahead that we who work at IFL look forward to taking on.

*Sjöfn Sigurgísladóttir*

## IFL's organisational chart



## IFL's locations



# Strategy and vision

In 2003 a new strategy was formulated for IFL, aiming at increasing the value and safety of marine catches. To place emphasis on this strategy formulation, a strategy map was presented and goals, criteria and measures were set in accordance with balanced scorecard. A balanced scorecard specifically entails being able to measure the results of activities and the strategy that is to be introduced and it is especially important for more aspects than financial gain to be taken into account and weighed. Balanced scorecard thus covers all of the goals and criteria entailed in the policy of IFL.



The strategy map was prepared in four dimensions through consideration of how **learning** and **growth perspective** support results in **internal perspective** to fulfil the needs of **customers perspective** at the same time as constraint in **financial perspective** is exercised. Scales and tasks were presented on how to achieve these criteria.

**IFL's mission** is to increase the value, quality and safety of marine catches through research, development, dissemination of knowledge and advice, and the values that IFL supports are the following:

- Cooperation
- Values of science
- Service
- Professional working procedures

## IFL's future vision is:

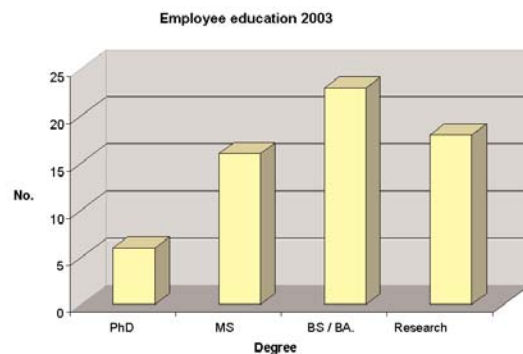
- To be a dynamic research organization and take initiative on research and development promoting increased value, quality and safety of marine catches.
- To become a leader in research, innovation and knowledge in Iceland as well as abroad.
- To become a recognized bridge of knowledge between domestic and foreign scientists, on the one hand, and representatives of the industry, on the other.

The introduction of strategy formulation at IFL began in February, 2004, and the strategy will be a living document, changing in step with IFL's emphases each time. Preparation of measurable goals has been worked on to facilitate the measurement of IFL's results. IFL's strategy to increase the value of seafood products and ensure their safety will be its guideline for acquisition of projects.

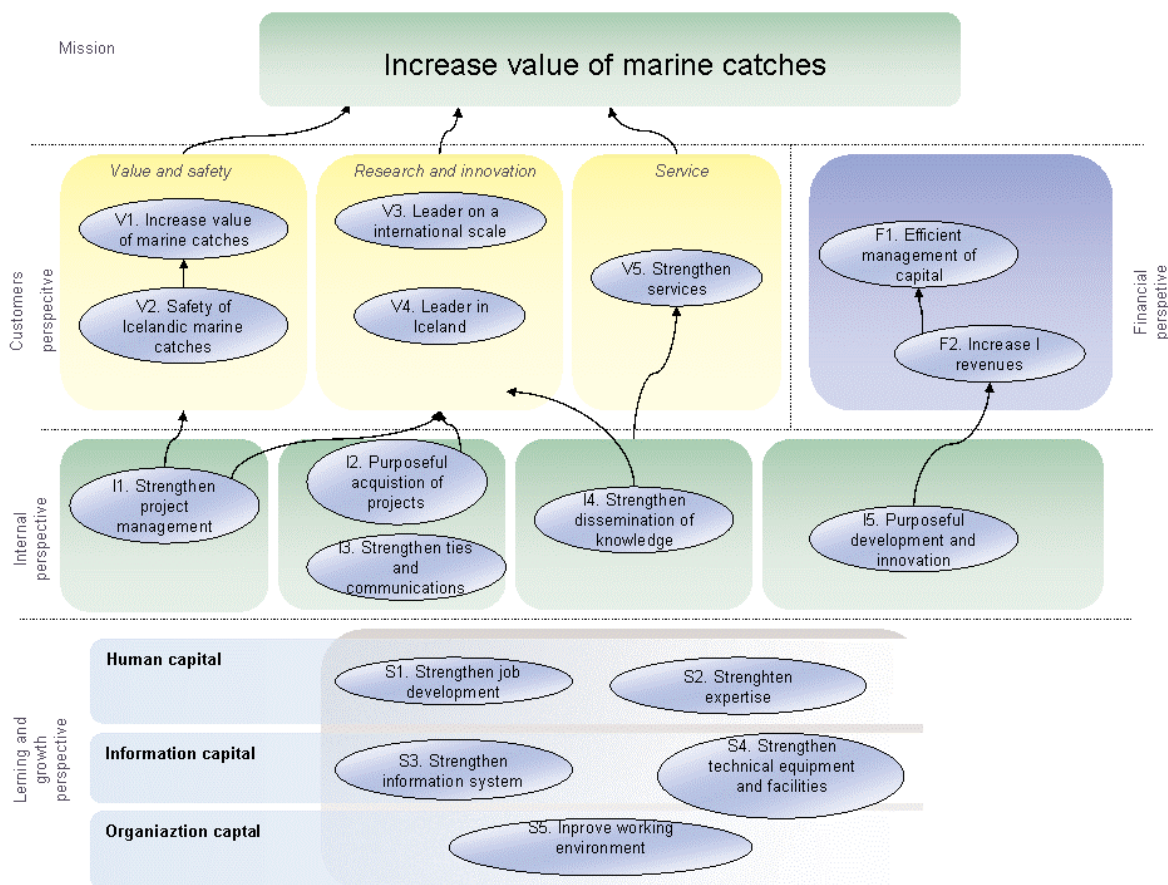
More emphasis has been placed on project management to make it easier for IFL's managers to monitor the progress of projects being carried out each time and ensure that they progress according to plan.

The tangible results of IFL studies will be purposefully checked by organized monitoring of how IFL's instructions are utilized for new production or changed products. The goal is to develop IFL's results in as many fields as possible.

To ensure IFL's continuing competitiveness in research and leadership in its field, in Iceland as well as abroad, it is important for IFL to have specialists who are at the forefront of their field. For this to materialize, IFL will encourage its specialists to pursue doctoral studies, and the goal is that new specialists hired at IFL have PhDs.



## IFL's strategy map



The aim of increased collaboration with universities is IFL's involvement in more student projects than before, where emphasis will be placed on master's and doctoral studies, and specialists will continue to be urged to publish articles in refereed scientific journals.

Collaboration with companies is important, and increased cooperation and participation in research projects on their behalf will be purposefully pursued. IFL employees will be urged to reinforce ties with companies and encourage them to collaborate on projects. IFL's chief "product" is knowledge; it is therefore important to present knowledge in as many ways as possible. It is important to have a publicity plan showing how to present IFL's knowledge. A good and well developed publicity plan increases the likelihood that research findings will be utilized.

IFL's new homepage will be followed up; the presentation of reports and findings from IFL research

projects will be increased and findings made more visible on the homepage. The goal is also to publish small pamphlets to present research project findings or to emphasize certain information available from different professional fields. Emphasis will be placed on specialists and their fields becoming visible on the homepage.

IFL's provision of information on the Internet will be renewed and strengthened to present general lore on fisheries and fish processing.

Collaboration with universities will be strengthened with increased numbers of students in master's and doctoral studies. The number of projects in collaboration with the universities will also be increased. Today there is formal collaboration with the University of Iceland, University in Akureyri, Technical University of Iceland, Hólar University and UNU (United Nations University).

## Research emphases

IFL's research emphases are on biotechnology, new processing technology, aquaculture, the processing and improved quality of chilled seafood products and the safety and wholesomeness of marine seafood.

In the fields of biotechnology and new processing technology, the goal is to utilize biotechnology in developing new products from seafood. Emphasis is placed on research on proteins and their processing from marine catches and their potential use as wholesome bio components, flavouring or other blending substances in food production, dietary supplements, herbal medicines and other medicinal products.

IFL's goal is to reinforce and strengthen aquaculture with emphasis on the effect of the environment and handling on yield and growth during the first developmental stages in marine aquaculture. Emphasis is also placed on feed and its effect on growth, quality and utilization during the whole growth period. Quality, filleting yield and the safety of farmed products are important aspects of IFL's research projects.



Regarding fresh and chilled products, IFL will work on projects promoting increased quality of catches and prolonging the shelf life of fresh and processed products. Demand for fresh products continues to increase steadily, making fresh products the category of food that is growing fastest at the moment and Iceland should and can take advantage of its proximity to major markets.

In the field of safety and wholesomeness of seafood, IFL will pursue projects to enhance the safety of Icelandic marine seafood, regarding both undesirable substances and microbes. Studies related to the wholesomeness of seafood products and their importance to human health will also be emphasized. The safety of marine catches will be of prime importance in the marketing of seafood products in the future. It is important to gather information on undesirable substances in Icelandic marine seafood and to conduct research on their wholesomeness so that the safety of

Icelandic seafood is based on scientific data. IFL will, in collaboration with the Icelandic fisheries industry and authorities, gather data that can ensure the continued access of Icelandic marine seafood to the best food markets in the world. The quality of research must meet standards of comparison and professional scrutiny and one of the most important prerequisites of this is that the IFL's specialists have professional ambition and are competitive in the international environment. We maintain that they certainly are ambitious and competitive, as experience has demonstrated!

## Collaboration with companies and organizations

In recent years IFL has established more and more links with universities in Iceland and participated in international collaborative projects in its field. Specialists at IFL are participants in numerous international research projects and steer many of them. IFL's policy is to further strengthen research, development and innovation in Icelandic fisheries and other related food industries, while at the same time reinforcing its ties with educational institutions, fisheries companies and foreign research organizations and companies in this field.

In light of how few people there are in our research groups, the key factor in this effort to achieve better results in increasing the value of fisheries is that Iceland participate in international research projects, such as SEAFOODplus. Through such cooperation it will be possible to fortify ties with foreign specialists and continue to be competitive on an international level. IFL will work purposefully on this in the coming years. Most of the projects and project ideas in which IFL is engaged today are carried out in collaboration with companies. Companies cooperating with research institutes like IFL can get assistance from specialists in developing new processing methods and products and/or improving the quality of their products. Moreover, the companies can make use of the findings from studies in which they are involved and therefore do not have to invest as much in equipment and specialists to achieve the results they aim for. Through participation in research, the companies' employees meet specialists from different professional fields which can be very useful to the companies in many ways. By participating in projects, the companies have an impact on which studies are conducted, and how they are performed. To make this possible, it is important for research funds to take into account practical values in evaluating grant applications.



Dynamic research, the gathering of knowledge and dissemination of information to the companies are some of the prerequisites for continued development of the fishing industry and its leadership on an international scale and the achievement of its goal of increased value of seafood products. IFL plays an important role in helping the industry maintaining such a position.

As is evident in IFL's policy, the institute strives to strengthen collaboration with the industry, but to achieve results in the international arena, collaboration with other institutes is important. If Iceland hopes to become a leader in certain fields, institutes and individuals must pool their energies. IFL has worked purposefully to increase collaboration with both domestic and foreign research and university institutions. Thus, collaboration agreements were made during the year with the Technical University of Iceland and Hólar University. In its collaboration with Hólar College, IFL places increased emphasis on fish farming, and the goal is to increase the number of research projects in the field of fish farming in collaboration with Hólar University and the University in Akureyri.

The cooperation with Technical University of Iceland aims at building up collaboration in the field of modelling technology, which will be utilized in evaluating risks for fisheries products. Modelling technology is also relevant to the modelling of processing, which is utilized for development and research of new processes. IFL currently has collaboration agreements with the University of Iceland, University in Akureyri, Technical University of Iceland and Hólar College. In order to strengthen international collaboration, agreements are also being prepared with foreign research institutes. The aim is thus to reinforce the knowledge bridge existing today between IFL and the international research environment and the industry.

## Research and development funds

The Icelandic Minister of Fisheries has established a new research fund, "Added Value of Seafood" (AVS) intended to promote projects which increase the value of Icelandic marine catches and can thus contribute to a stronger Icelandic economy. The AVS Research Fund will be of great importance in working toward increasing the value of seafood products over the next several years. It is nonetheless important that other governmental research funds also continue to

strengthen applied research aimed at strengthening the Icelandic economy and thus help adding value in cooperation with Icelandic companies.

Great changes occurred in the state's research funds in 2003. Unfortunately, not all which were positive for applied research. It is important for research funds to continue to emphasize the strengthening of applied research and building up of research for which it is in turn possible to apply for further grants in the European Economic Area. Many projects which have the goal of increasing viability, improving processing, promoting innovation and increasing the value of Icelandic products or increasing productivity in a specific occupation sometimes have a difficult time fulfilling the allocation rules of research funds which use scientific occupations as their main criteria for quality of research. The function of the old Technology Fund, whose goal it was to strengthen applied research, has apparently evaporated for the most part after the fund was merged with the former Science Fund that was especially intended for basic research. It also seems that the rules of the new Research Fund are primarily based on fulfilling the former function of the Science Fund, while, in the same fashion, little consideration is given to the rules and functions that were previously the purview of the Technology Fund. According to the Research Fund Act, it should nevertheless cover the functions of both the Technology Fund and the Science Fund, and projects based on increasing value creation, productivity and advantageousness should have the same possibility to receive grants as the projects falling under basic research. It is important that applied science projects be taken into consideration, and that "professional evaluation" of applications to the Research Fund embraces both basic and applied research. It is possible to continue emphasizing that professional evaluation shall be the basic focus for allocation, but basic academic evaluation may not be the only basis of a professional evaluation. Thus, strengthening of cooperation and collaboration between research organizations, universities and companies will be continued.

## IFL's new homepage

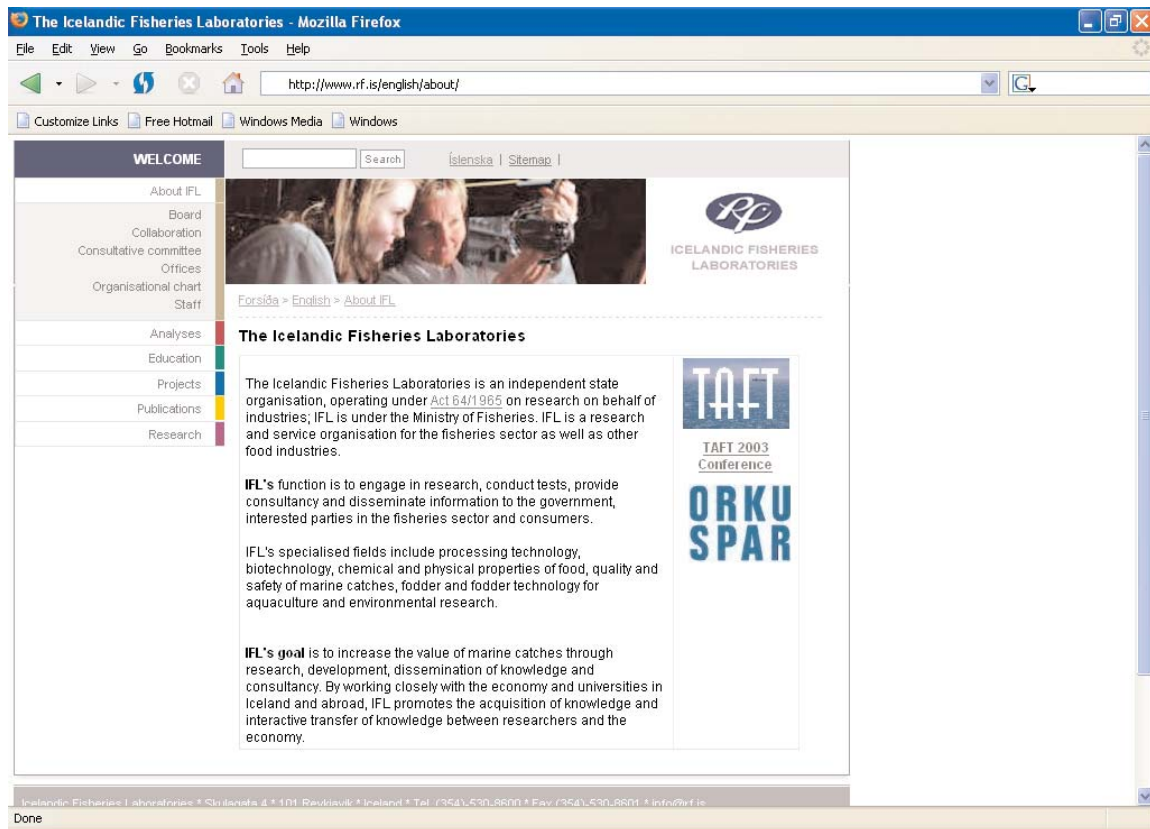
A new homepage was presented at IFL's fall meeting in November. Considerable changes have been made to the homepage, aimed at making IFL's activities more visible and making the search for information and advice as accessible as possible. For example, it is now easier than before for an outsider to find IFL's experts and expertise on the homepage since IFL's employees have been grouped by departments and fields of knowledge. It is thus possible to use search words like "biofilm", "starvation", "dioxin", "physical attributes" and find IFL employees with expertise in the relevant fields. The purpose is to facilitate direct contact with relevant IFL employees, with the goal of expediting the handling of queries and lightening the load on the IFL switchboard.

More detailed information than before can also be found on projects being done at the organization, using search words to locate them.

Furthermore, a list of published material has been updated, improved and expanded with the materials accessible free of charge in PDF-documents. In this regard, reports and monographs, peer-reviewed articles and other materials published in previous years and decades can be mentioned.

Finally, it can be mentioned that it is much easier to look up old "news", published on the IFL homepage in previous quarters, where various things are available. IFL began to put short news items on its homepage at the end of 2000, especially news about IFL's activities, but also news on domestic and foreign forums, especially news for the food industry and the general public.

The new homepage builds on the web management system Eplica, which an Icelandic company, Hugsmidjan ehf., designed and developed. It can be mentioned that the homepages of numerous companies and government organizations are now based on Eplica, including the new web site of the ministry offices.



## Analytical Service Division

The activities of the Analytical Service Division in 2003 were similar to those of the previous seven years the division has been operating. As before, emphasis was laid on quality and quick processing time, along with providing IFL customers with comprehensive service.

The Analytical Service Division performs numerous chemical and microbiological analyses of various seafood products, including analysis of chemical composition and evaluation of the most important quality characteristics. Various microbiological tests are also offered to provide information about the wholesomeness of food, hygiene during production and shelf life.

Changes in the operation of the Analytical Service Division have been pending for several years. It has proved difficult for the division's revenues to cover its costs, and in a competitive environment, the state is not allowed to subsidize such operations. With

The Analytical Service Division has had the long-term goal of providing the Icelandic fishing industry with a service where the skills and knowledge in chemistry and microbiology could be provided by an independent party at one and the same place. This involves factors like quality, wholesomeness and healthfulness, along with testing for some harmful substances.

Tests are generally performed as part of the production and sales process. If and when problems in sales and marketing come up, an impartial party has to be able to do the testing, and it is necessary to be able to obtain further interpretations to solve problems and disagreements that can even end up in court. In such instances it is necessary for tests to be performed by the same party. The Analytical Service Division's activities have therefore been primarily services for producers and exporters of Icelandic marine seafood.

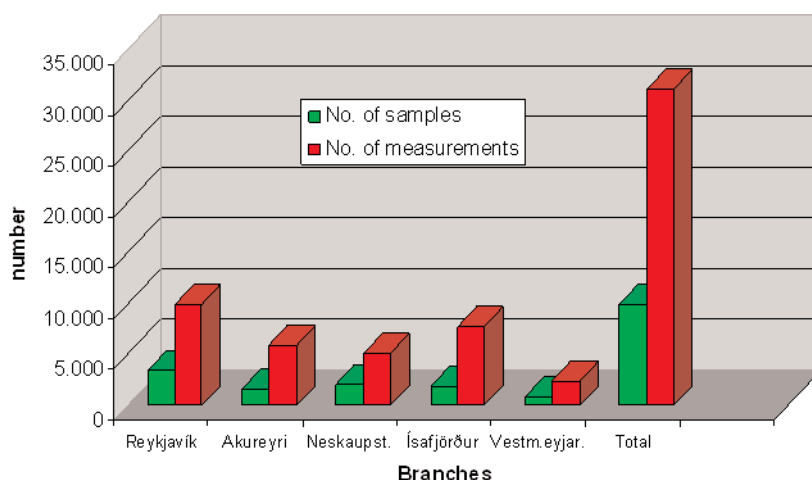
IFL certification has become well known among many customers of Icelandic companies overseas, and many buyers of Icelandic seafood products demand that a certificate from IFL accompany the product.

Exported fishmeal is tested and certified almost exclusively by IFL; also, the Directorate of Fisheries has entered into an agreement with IFL to see to certain tests since this ensures that the job is professionally done in respect of inspectors in Europe and the US.

It is IFL's policy to continue this service for Icelandic fisheries although it will be in a somewhat different form in the future.

The total number of tests performed by the Analytical Service Division in 2003 was 31,089, while the total number of samples was 9900. There was some decrease in the number of samples compared to the year before, and there are various reasons for this, including changes in the registration of samples, a poor capelin season and a smaller blue whiting catch.

**Analytical Services of the year 2003**



increased emphasis on research and innovation, IFL's goal is to reduce its competitive operations, which include service testing. In 2003 there were some indications that these ideas were about to materialise and preparations for the changes therefore began. It is important that such changes do not cause damage to IFL's clients, and that the results of the Service Division's activities will not be lost but rather utilized for the continuing build-up of services for the fisheries sector.

Since 1994, EU regulations (93/99/EEC) have required that all testing shall be done by a certified party. This provision was adopted in Icelandic regulation No. 522 in 1994. The Analytical Service Division has been certified since 1997, and 14 of the most common tests, 6 chemical tests and 8 microbial tests done by IFL have been accredited.

The traditional, annual accreditation evaluation by Swedac and the **The Governmental Agency for Accreditation, Conformity Assessment and Meterology in Iceland** was done in September



according to ISO 17025. During evaluation various aspects of the operations are checked, especially those regarding certification of tests. The accreditation parties made several comments, as could be expected. Improvements concerning these points are expected to be done within two months of the evaluation. By and large, those conducting the evaluation in 2003 were extremely satisfied with what they discovered, specifically with IFL's employees, who were adjudged to show great interest in their work and adhere closely to the quality system. One of the main points is the difficulty of showing registration of complaints, which comments were made on.

Twice a year IFL employees in the chemistry lab participate in comparative testing at the Grain and Feed Testing Association (GAFTA) in Britain. A feed sample is tested with regard to protein, fat, water and ash. Stringent standards are set for those wishing to pass the test, and if the findings are unacceptable once, the party involved is advised to review the procedure. If the findings for the same factor are still not satisfactory the next time, the laboratory is removed from the GAFTA list. If such a thing happens, it is in fact possible to apply to take the comparative test again after six months. The Analytical Service Division has been a participant in the GAFTA comparative testing since 1997 and has always had its certificate renewed.

As in previous years, students from the Fisheries Training Programme of UN University came to the IFL Chemistry and Microbiology Laboratories in Reykjavik for on-the-job training. This time there were six students, and one of them did a project dealing with the setting up of a quality system for a research laboratory in Uganda.

There were no changes in division personnel in 2003, and the total number of employees was 22 in 19.4 full-time equivalent positions. There were 10 employees in Reykjavik, 4 in Akureyri, 3 in Ísafjörður and the Westman Islands and 2 in Neskaupstaður. The price list increased by 2% at the beginning of 2003.

## R&D Division

### Changed emphases

Major changes have occurred in fisheries and fish processing in the last several years and decades. These changes have of course diverse and extensive impact, not only fishery companies, fishermen and those working in fish processing plants and other fields of the industry but also on research in this area.

When looking back over the research done at IFL in the last decades, a certain development can be discerned. The farther into the past one looks it unfolds that the main emphasis was on research having to do with processing, for example, saltfish processing, drying, etc. Then there are projects related to by-raw materials and their utilization. In the last 15-20 years one can see the emphasis in research increasingly swift to the safety of food and also to projects which have to do with aquaculture, biotechnology, software and technology. Increased emphasis on food safety bears witness to increased consumer demands in the last several years for the assurance that the food offered them be safe for consumption.

This trend in research does not occur in a vacuum but is directly linked to the contemporary developments in fisheries and fish processing in the world.

According to information from the Food and Agriculture Organization of the United Nations (FAO), most of the commercial fish stocks in the world's oceans are fully utilized, and many are in fact already overfished. It can be claimed that this development began after the nations of the world had recovered from World War Two; after that the world fish catch increased steadily until the latter part of the 1980s but has been decreasing since then. For most of this period, people seemed to assume that the earth's resources, including those of the ocean, were inexhaustible.

In the last decade of the 20th century, a substantial change also occurred in attitudes toward environmental affairs, and various parties demanded that nature should always get the benefit of a doubt. Concern for the environment, on the other hand, does not necessarily mean that absolutely nothing of the earth's bounty can be consumed; the main point is to treat nature and its resources with respect, and in this way, there will be something left to enjoy and utilize for future generations.

Respect for nature, among other things, entails the best utilization of what is taken instead of taking only the best pieces and throwing away what is left. For example, much of what Icelandic fisheries and fish processing previously threw away, such as fish heads, bones, skin and viscera are today utilized in products which are sold for millions of kronur. One sign of this development is that the word by-product is slowly being replaced in the Icelandic language by the word by-catch. Earlier research done at IFL has played a major role in this development.

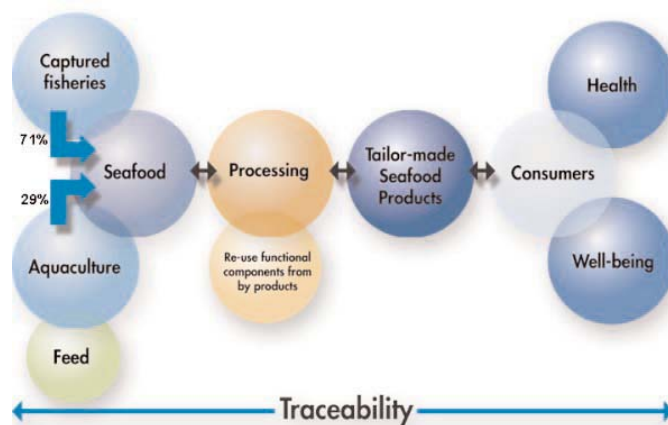
Of course various other factors have also had an impact regarding changed circumstances in the fisheries environment. Decreasing fisheries and, at the same time, increasing demands for fish, which will in all likelihood continue for years to come have laid the foundation, for example, for a major increase in world aquaculture, which is likely to expand in the coming years.

As mentioned previously, these changed circumstances are fairly well reflected in the research projects which have been going on at IFL each time.

### SEAFOODplus

Although Icelanders have achieved remarkable results in fisheries, utilization and marketing of seafood products in the past, it is IFL's belief that there is still work to do, and that it is to be done and that it is possible to create even greater value from marine catches than is already being done. Many specialists at IFL are at the forefront of research on processing and utilization of marine catches. Suffice it to say that IFL plays an important role in one of the biggest food projects that the EU has funded up to now. This is the SEAFOODplus project, which is also the most extensive

#### The ideology of SEAFOODplus



project in which IFL has participated. The main goal of SEAFOODplus is to increase fish consumption, study the effects of fish consumption on health and well being, increase the safety of seafood products and further processing of marine catches, including functional foods.

Between 60 and 70 parties from 18 countries participate in the project; SEAFOODplus is actually a collective term for 22 projects, divided into five main categories: nutrition, consumers, safety, processing and product development and aquaculture; in addition, there is emphasis on traceability, which cuts across all the projects.

In this five-year project, the effects of diet containing marine catches on the incidence of cardiovascular diseases, cancer and infections, will, i.e. be studied. Emphasis will also be placed on understanding the factors which affect the consumption of seafood and adapt seafood products to consumers demands. Although the SEAFOODplus project was not formally launched until at the beginning of 2004, preparations for several projects had already started in the fall of 2003 after it was clear that the EU would support the project.

Much of what will be focused on in the SEAFOODplus project is already being investigated at IFL. This can be seen in several projects that IFL has worked on in recent years. These include projects in IFL's main research fields at this time: fisheries, biotechnology, food safety, chilled products and product development.

## Aquaculture projects



The cost of feed in aquaculture is high and it is the biggest cost item in cod farming, which has been recently been gaining an increased deal of attention. Until now, feed for cod has been processed from high-quality fish meal and fish oil, which are expensive raw materials. Furthermore, there are some indications that the content of fish proteins and fat in feed for cod are unnecessarily high. The production cost may therefore be decreased substantially by partially substituting it with protein and fat from other sources and thereby decreasing the proportion of high-quality fishmeal and oil. The project *Feed for cod* is a Nordic collaboration project that was started in 2003. The goal of this project is to further investigate the correct composition of feed for cod.

The project *Preventive measures in aquaculture* can also be mentioned here. The project was started in 2003 with the goal of finding ways to improve environmental factors in marine aquaculture. Special emphasis is laid on the initial stages, i.e., from hatching throughout the first feeding phase, when substantial losses are experienced in marine aquaculture

*Future cod* sounds like the name of a science fiction novel, but it is actually the name of a research project that started in 2003. The goal is to design a certain quality system for the slaughter of farmed cod, whose goal is a valuable product which meets the quality requirements of the market and also to develop a standardized quality evaluation system for farmed cod (raw material, products) that can be used in continuing research, to ensure that quality comparison is always based on the same premises.

## Consumers and Food Safety

The growing emphasis on food safety in the last several years was previously mentioned. This concept does not stop here, however, for now the interest is also directed at investigating how food can directly improve people's health. Regarding marine catches, there is now interest in investigating whether Iceland can produce functional food, food supplements and bioactive components from marine catches in the future.

*Hurdletech* is a project with the goal to ensure safety and quality of processed seafood products (i.e., slightly preserved and ready-to-eat products for consumption or partial processing). Among the ways this will be done is by examining how the products are processed: tracing and minimizing pollution as much

from undesirable microbes during processing and also hindering their growth in the finished products. The possibilities of using concurrent preservation techniques (Hurdle technology) and minimal processing will also be examined.

One of the important factors in inhibiting infectious microbes from spreading to people through food is ensuring the strictest hygiene in all handling of raw material and foods. The attention has lately been focused on the design of food processing processes, for studies show that equipment and machinery which is difficult to clean and disinfect satisfactorily can foster the growth of bacteria, such as *Listeria*. In 2003 the project "*Wholesomeness of food and the design of processing equipment*" was completed; it consisted of an evaluation of this problem and publication of an instruction booklet.

Another recent IFL project in this area worth mentioning here is an evaluation of *Listeria* in herring processing and research of infectious *Vibrio* in shellfish processing.

The effect of undercooling on the quality of fish fillets is a two-year project that began in 2003; its goal is to increase knowledge on the effect of mild freezing on the physical and chemical factors of fish flesh and also to compare products resulting from the new processing technology with traditional products. The project is being done in cooperation with several Icelandic companies, and its first findings are immediately noteworthy, because they indicate that the new processing technology increases both utilization and shelf life, thus opening up new possibilities for export of fresh fish to foreign markets by cargo ships.

Last but not least, a mention must be made of the project *Quality Index Method* (QIM). The goal of this project is to promote a coordinated and comprehensive use of quality index methods in evaluating the quality of fish in production and distribution chains in Europe. The project began in 2002 and ends in 2004, but it has already drawn considerable attention, and the quality index method is gradually making inroads in European fish markets.

## Environmental research and food quality

As previously mentioned, the emphasis on environmental affairs has increased in recent years. IFL has for some time been engaged in research on the marine biosphere and monitored alien substances and trace

elements in marine biota. One such surveillance project that has been going on since 1989 is called AMSUM; its goal is to collect data annually, making it possible to identify changes in the concentration of trace elements in the marine biota around Iceland over a certain period and between different marine coastal areas. Various organizations, such as the Environmental and Food Agency of Iceland, the Marine Research Institute, the Icelandic Radiation Protection Institute and the Icelandic Meteorological Office participate in the project in addition to IFL. IFL supervises the testing for various inorganic trace elements and PCB substances in dab, cod and mussels collected around Iceland. IFL is responsible for submitting the biota data to the data bank of the International Council for the Exploration of the Sea (ICES). This information is extremely important for Iceland, not only to have the latest information possible about the biosphere at all times but also to have the prerequisites for marketing Icelandic seafood products as unpolluted and wholesome.



Being nosy has not always been considered an admirable quality. However, man's nose is one of his most important assets when it comes to evaluating food quality. Now in an age of major global food commerce, the need has grown for a technological replacement for man's nose, which is literally no longer "long" enough; it goes without saying that it is impossible to smell every fish being landed or imported to check its freshness.

Because of how sensitive fish products are, with their short shelf life, it is in the interest of everyone involved in fisheries and fish distribution to be able to measure quality continuously to ensure freshness and quality of the final consumer products. It therefore

comes as no surprise that the development of rapid instruments, built around sensor technology, for assessing the quality of food has for years been a subject of research in the food industry, including fish processing. IFL is a participant in the EU project *Fishnose*, which aims at the development of an efficient and simple device to use in industry for automatically monitoring the quality of smoked fish. The French company AlphaMOS, which is a world leader in electronic nose technology, developed a prototype of the electronic nose, but laboratories in Norway and Germany in addition to IFL conduct the research on the spoilage pattern of smoked salmon and adaptation of the technology for producers. Smoke houses in three European countries, along with the Icelandic company Reykofninn, are participants in the project.

Electronic noses are currently used for quality assessment in various branches of food manufacturing today, for example, in cheesemaking, but up to now it has been little used in the seafood industry. There are various indications that this will change in the near future because of increased pressure from buyers for information regarding the quality, safety and traceability of food. An electronic nose, for example, could be useful in electronically confirming quality during the buying and selling of fish in fish markets, and such commerce is now increasing steadily.

## Food Processing and Technology

In changing times adapting quickly to new circumstances and seeing potential possibilities is all

important. This pertains as much to fisheries and fish processing as other occupations, and there the expertise and skills of scientists can often prove useful. At IFL specialists work with companies to create new opportunities and seize the opportunities presented.

Among the projects worked on at IFL in the field of processing and development, research on the use of fish protein as a food supplement can be mentioned, where the goal is to process proteins from fish for use as a food supplement. The benefit of the project could be an increased diversity in fish processing and more valuable products.

Research has shown that the utilization ratio of cod varies extremely by season and ocean area. The report "Cod condition factor, processing yield and processing management", which was published in 2001, states:

*"It is important to be able to utilize as much of what is caught as possible, and the utilization can be improved with knowledge about condition factor so that more cod is caught from areas that have good yield. Catching fish when it has higher condition factor and yield increases product value. The total quota is then based on fewer individuals and the stock's productivity will thus increase. A good yield for the cod stock will not be achieved by catching a lot of emaciated cod, yielding little in consumer products. It is better to catch cod at a time and place where each fish yields more."*

The project *Cod Processing Forecast* is a continuation of the aforementioned project, where factors that could affect the value and quality of products were mapped, and models were developed to facilitate decision-making for choosing fishing areas yielding the best fish for processing at any given time. Thus, processing management can be strengthened.

*"Fish protein as a food supplement"* is the name of a project with the goal of developing fish proteins usable as a food ingredients. Building up skills and knowledge in Iceland on the production of fish proteins as food supplements can create new opportunities for the Icelandic fishing and food industries. This project, along with others, is a part of the build-up in the field of protein processing that IFL aims at in cooperation with domestic and foreign parties.





## Presentation of selected projects

### Consumers and Food Safety

#### Effect of undercooling on fish fillet quality

**Project manager: Emilía Martinsdóttir**

This is a two-year research project that began in 2003 and it is supported by Rannís - The Icelandic Centre for Research and the AVS-Fisheries Research Fund, while collaborators on the project are IFL, Skaginn plc. and HB plc. in Akranes, Tros hf. plc. Sandgerdi, Tangi plc. in Vopnafjörður and Matra.

Skaginn plc. has applied for a patent on the new processing technology (CBC cooling) for fresh and frozen fillets. The technology is based on two basic principles: maintaining a low temperature of the raw material during the entire process (from landing to delivery to the customer); and on a new deboning technology, which ensures that the fillet can endure skinning and trimming without damage. The goal is to increase knowledge of the effects of superchilling on the physical and chemical factors in fish flesh and also to compare the products produced with the new processing technology with traditional products. During the project a comparison will be made between fresh fillets, on the one hand, and CBC cooled fillets, on the other, with respect to yield, quality and storage life. Research will be done on whether CBC cooled fresh fish fillets are different from unfrozen fillets, and the quality and yield of traditional frozen fillets will be compared with CBC cooled fillets, with respect to shelf life after thawing. The effect of raw material and handling will also be investigated.

Part of the project is to follow up on the design of new processing equipment, with respect to cleaning and potential microbial growth, consideration of the choice of material when setting up a processing line, etc.

In the project's first year, work was done with a new CBC line at Tangi hf. in Vopnafjörður. The first findings indicate that CBC cooling considerably increases the shelf life of fish fillets, which can be very important for export of fresh fillets by air, but more importantly, it also substantially increases the chances of

#### Wholesomeness of foods and design of processing equipment

**Project manager: Birna Gudbjörnsdóttir**

exporting fresh fish fillets by sea freight. This would substantially reduce transport costs.

The design of processing equipment is very important in the food processing industry, i.e., it is important that equipment and machinery used in manufacturing food is designed in such a way that it is easy to clean and disinfect. IFL has recently been working on two projects in this field, one of the projects is supported by the Collaborative forum of the fisheries and industry and Marel plc. and the other by Rannís - The Icelandic Centre for Research. In 2003 IFL, in cooperation with Marel plc. published an instruction manual for manufacturers of processing equipment regarding hygiene and wholesomeness of food (IFL report 19-03). The manual also contains work procedures along with checklists that processing equipment manufacturers can refer to.

IFL is also researching how microbes affix in different ways to different surface materials, such as differently treated stainless steel (AISI-304-2B) and various kinds of plastic material (PE; PVC; PU and VOLTAREIMAR) that are common in the food industry. This research was conducted both in the laboratory as well as in the industry, where sample steel plates were placed in different locations.

The most common microbe groups identified in processing were Gram-negative bacteria, many of which are sometimes called specialized spoiling bacteria. Bacteria classified as *Enterobacteriaceae* were also identified. The Gram-positive bacteria that were identified are usually not deemed to be spoiling or infectious bacteria. Clearly all these bacteria were quite capable of affixing to the surfaces tested here. This supports the theory that nearly all bacteria, given the right conditions, are capable of affixing to surfaces and forming biofilms.

By making hygiene a priority in the selection of materials and design work and by disseminating information, Icelandic equipment manufacturers can gain more trust which should give them a competitive edge vis-à-vis other manufacturers.

## Aquaculture projects

### Controlling the bacterial flora in the startfeeding tanks of halibut larvae

Project manager: Rannveig Björnsdóttir

Poor survival is a well known problem during the first developmental stages in farming of marine fish, and only a small fraction of roe develop into viable fry. During first feeding the larvae are fed seawater shrimp (Artemia), and research indicates that poor survival chances can to a large extent be explained by the high number and unfavorable composition of bacteria accompanying the Artemia as well as the algae that is commonly used to create the "correct" environmental conditions during first feeding of the larvae.

The main goal of this project was to investigate whether the organic load in the tanks could be reduced by using inorganic materials instead of algae to create the right environmental conditions. The possibilities of using inorganic substances along with algae or instead of the algae were explored and these methods compared by using bacterial load and diversity, as well as the metamorphosis and survival rates of halibut larvae in the tanks. The findings reveal that the organic load can be reduced considerably and the survival rate of the halibut larvae improved by reducing the count of bacteria in the Artemia and startfeeding tanks of the larvae. It was also investigated whether the composition of the bacterial flora in the young could be improved through the use of harmless or probiotic bacteria that lead to reduced growth of undesirable bacterial flora during first feeding of halibut larvae.

### Development of artificial bait for line fishing

Project manager: Soffía Vala Tryggvadóttir

"Artificial Bait Alternatives, mainly based on fish waste" is the name of a EU project which IFL has been working on since 2001 (Q5CR 2000-70427). The project was concluded in 2003.

The bait is mostly made out of waste from fish processing and/or fish used for fishmeal, such as capelin and blue whiting. Research shows that the new bait not only stands up in comparison with traditional

bait regarding catching power but also has additional advantages.

It is inexpensive since it is processed especially from underutilized raw material; in addition, the price of fish species that have been popular as bait until now, such as squid and mackerel, has increased in recent years because of increasing demand. The new bait is made by grating frozen blocks of bait raw material, such as capelin, sand eel, squid and scrap fish and then shaping the grated material into cubes that are packed in bags made of paper-fibre material. The company Adlöðun plc. - Dímon Beitutækni, which was founded for the project's development work, has procured a patent for the bait production method and the machinery that was specifically designed for the production. A bait factory has been set up in Ísafjörður, and production of the bait has already begun.

As previously mentioned, the new bait has various advantages, e.g. it is not necessary to moisten the tub after freezer storage since the bait does not freeze together like natural bait. Research also shows that seabirds do not go after the bait; when the line with the artificial bait is lunged, it gives off so little smell that the birds are not attracted to it.

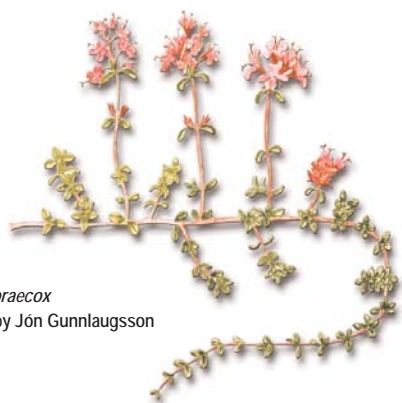
Using the new bait is much more hygienic than using natural bait; it is also much quicker to bait the lines because the bait is always ready for the hook. Thawing up and cutting the bait into correct sizes now belongs to history.

## Environmental Research and Food Quality

### Effect of seaweeds and therapeutic plants on the shelf life of capelin oil

Project manager: Margrét Bragadóttir

Finding viable ways to increase the ratio of pelagic species (herring, capelin, blue whiting) caught for human consumption has long been discussed, but these species are today mainly utilized for fishmeal and fish oil. There are various reasons, historical as well as others why these species have not been utilized for human consumption. One is that until recently, there has been a sufficient supply of other, more traditionally consumed species. However, it is only a question of time when and how it will be possible to increase the consumption of these species.



*Thymus praecox*  
Drawing by Jón Gunnlaugsson

One of the obstacles of using e.g. capelin is its instability as a raw material. In 2003 the effect of Icelandic therapeutic plants and seaweeds on the stability of capelin fish oil were studied at IFL. The purpose of the project was to investigate whether Icelandic plants and seaweeds could be used to increase the shelf life of fish oil made from capelin. Well-known therapeutic and health plants, such as Angelica, birch, creeping thyme, lupine and Iceland moss were tested, in addition to seaweeds, which has been utilised for human consumption.

The outcome of this project is a basis for further research on capelin oil for human consumption. Although the contents of the plants and seaweeds tested did not generally increase the stability of capelin oil, they contain water-soluble anti-oxidants, which showed considerable activity in emulsions of lipid and water. It is therefore possible that health plants like birch leaf and creeping thyme can indeed be used to inhibit rancidity and improve flavour in emulsions like salad dressing or in other food products containing both water and lipid. Since this was a preliminary project, its findings will be utilised as preparation and foundation for continuing research in this field. The results of this project are therefore quite valuable for further research into capelin oil for human consumption, and a project with this name received a grant from the AVS Research Fund of the Ministry of Fisheries at the end of 2003.

#### Undesirable substances in seafood products

Project manager: Guðjón Atli Auðunsson

The Ministry of Fisheries finances a project involving evaluation of the concentration of various undesirable substances in the edible portion of marine catches. This is the first time that systematic collection of

information is carried out for a number of substances and many kinds of marine catches from Icelandic fishing grounds; in addition, information is being gathered on numerous substances that have not been previously examined. The substances being investigated are trace elements (mercury, cadmium, lead and the total concentration of arsenic as well as the concentration of inorganic arsenic), PAHs (17 of them), polychlorinated dibenzodioxins and dibenzofurans (17), dioxin-like PCBs (12), marker PCBs (6), polybrominated flame retardants (10 PBDEs), organotins (10 substances), and numerous organochlorines, mostly pesticides (HCB, DDTs, HCHs, aldrin/endrin/dieldrin, chlordanes, toxaphenes and endosulfan substances, altogether 29 chemical compounds).

The purpose of this collection of samples and measurements is, on the one hand, to examine how products measure up against the new limits for dioxins (polychlorinated dibenzodioxins and dibenzofurans) and, on the other, to check the concentration of dioxin-like PCBs as a basis for setting maximum values within the EU before the end of 2004. The plan is to lower the limits for both dioxins and dioxin-like PCBs before the end of 2006. Thirdly, the purpose of these measurements is to gather information on the concentration of marker PCBs for the purpose of setting limits; a risk assessment is now in progress regarding this class of substances, and its completion is planned at the end of this year. Information on marker PCBs will also be utilised for this risk assessment. Fourth, the findings will be utilised to evaluate how products measure up to limits currently in effect in Iceland, the EU and Iceland's trading partners (inorganic trace elements and pesticides). Finally, it can be mentioned that this information will be utilised for a risk assessment and the setting of maximum values that are now under consideration within EU (PAHs, inorganic arsenic, organotins and brominated flame retardants).

The collection of samples and quality criteria for the analytical methods were in accordance with the conditions set out by the EU for the information gathering campaign on dioxins and dioxin-like PCBs, but countries were also directed to collect information about marker PCBs. The collection of samples was divided among the member states, Iceland and Norway, in proportion to the production quantity in each country. Regarding food, the collection of samples covers seafood products (29 annual samples of fish and 12 annual samples of fish oil from Iceland,

a total of at least 41 annual samples) and agricultural products (at least 26 annual samples from Iceland). In addition, Iceland is supposed to gather samples of compound feeds and feed components: 35 samples of fishmeal and fish oil and 32 samples of other feeds, for a total of at least 67 samples. The EU campaign continues until 2006.

Regarding information about feed fish oil and fishmeal, in addition to fish oil for human consumption, there was a close collaboration with the industry, for in these industries the sellers must provide numerous tests and analyses on their products. A collection of samples and their analysis will continue in 2004.

## Food Processing and Technology

Among the undertakings of this R&D group is to find ways to increase the value of catch, both demersal fish, such as cod as well as to increase the value of pelagic species which is the traditional raw material for fishmeal production. In 2003, several projects, which all had the goal of increasing the value of cod, were finished and work on new projects started. All of these projects were done in collaboration with fishery companies and universities and funded by Rannís - The Icelandic Centre for Research. The latter group of projects, i.e. the ones which had to do with pelagic species were funded by various funds, both Nordic as well as Icelandic.

### Processing forecast of cod

**Project manager: Sigurjón Arason**

In this project several factors that are considered to affect the value and quality of cod products were identified and models were developed to facilitate decision-making for choosing fishing areas yielding the best fish for processing at any given time. In this way, processing management can be reinforced. The first stage of the project concluded with the MSc thesis of Sveinn Margeirsson from the Engineering Department of the University of Iceland.



### Light salting of cod fillets

**Project manager: Kristín Anna Þórarinsdóttir**

In this project, which started in 2000 and was finished in 2003, the objective was to find methods to enable the fishing industry to produce fillets or fillet parts of more stable quality than before.

Among the goals of the project was to study the utilization and effects of processing on the chemical composition of cod muscle during light salting. Furthermore, the processing of functional proteins from seafood were studied.

### Fish glue

**Project manager: Guðjón Þorkelsson**

The goal of this project was to develop a method to reshape bits of fish from cuttings produced during the filleting process. Cod cuttings, along with salt and water, were used to produce glue and it was discovered that it is possible to bind bits of fish together by using a mixture of water, salt and chopped cod muscle. Blue whiting also proved to be a good material for making fishglue, and this could possibly be a way of increasing the value of blue whiting. The MSc dissertation of Mei Manxue from China, who worked on the project at IFL, was part of this project.

The overall gain from all of these projects, besides adding new scientific knowledge, is a basis for product development that could lead to improved utilisation and added value and new ways to process round fish. New projects have been started in continuation of these projects.

Three other projects that have the aim of increasing the value of traditional raw material for fishmeal production should be included in this recitation. The first two are supported by the Nordic Industrial Development Fund and the third by AVS. They are also all done in collaboration with companies, universities and other organisations.

**Storage technology for pelagic fish** (project manager: Sigurjón Arason) focuses on developing storage technology to improve the quality of catches landed from seine pursers, which is a pre-requisite for processing more pelagic species for human consumption.

The project "**Protein isolation from herring**" (project manager: Margrét Geirsdóttir) is about the development of the production process to extract protein for human consumption from herring. Two possible ways for use will be developed. Firstly, the protein mass will be frozen as surimi, and, secondly, a drying method will be developed and the mass used in mixtures for food production.

The aim of the project "**Fish proteins as food supplements**" (project manager: Margrét Geirsdóttir) is to develop fish proteins to be utilised as a food ingredient. Building up expertise in Iceland on the production of fish proteins as food ingredients can create new opportunities for the Icelandic fishing and food industries. All these projects are a part of the build-up in the field of protein processing that IFL aims at, in cooperation with domestic and foreign parties.

The project "**Yield and stability of by-products from cod**" (project manager: Sigurjón Arason), which is funded by the EU, began in 2000 and will be finished in 2004. The participants come from seven countries, most of them from research institutes, but also from SME's. The project entails finding new possibilities for utilising by-products, i.e., viscera, skin, heads and cuttings. The Icelandic part of the project includes defining the quantity and composition of the by-products, potential uses of proteins in fish products and the stability of protein powder and liver during storage. Foreign participants have been examining how to separate viscera using robots, how enzymes can be used to isolate proteins and fat, whether bioactive substances are present, and what characteristics fish collagen has.

The value of the project lies in both the innovations in processing equipment and the development of by-products into more valuable products that can be utilised in the food, pharmaceutical and biotechnology industries.

It should be noted that it is important that research into the possible uses of proteins is done parallel with research on the processing of proteins from poorly utilised raw materials and fish species. In this way the maximisation of product value is achieved, where emphasis is placed on both good utilisation and use characteristics.



## Publications and lectures 2003

In 2003 31 project reports were published at IFL. One third were from projects funded by Rannís - The Icelandic Centre for Research, one third were for projects supported by other Icelandic parties and, finally, one third were from projects supported by foreign funds, mainly funds of the EU and various Nordic funds.

Fourteen articles, written or co-written by IFL employees were published in foreign scientific journals. This is especially gratifying, for stringent requirements must be met to publish articles in such journals.

Several consultancy reports were submitted directly to various funds without being recorded specifically as IFL reports since their contents were confidential.

There was a flurry of activity at IFL in 2003; among other things, the institute organised an international conference, TAFT 2003, which was held in June and attended by 250 people from more than 20 countries. TAFT 2003 was a great venue for exchanging ideas and information and IFL employees used the opportunity and gave several talks and presented projects on posters.

IFL employees also gave numerous talks at other conferences and meetings, both in Iceland and abroad. The IFL held e.g. a well-attended meeting on 13. November at the Nordica Hotel in Reykjavik.

During the year several articles were published by IFL employees in domestic newspapers and magazines, and they were featured in addition in several interviews.



## IFL reports

(\*in Icelandic)

**Guðjón Atli Auðunsson, Hafsteinn Helgason.** 2003. *Discharge of industrial effluents to the municipal sewage system: proposed guidelines.* IFL report 1-03, 11 pp, restricted access.\*

**Eva Yngvadóttir.** 2003. *ORKUSPAR-The Energy Efficiency Improvement Simulator: 3rd report.* IFL report 2-03, 19 pp, open.

**Gústaf Hjálmarsson, Margrét Geirsdóttir, Páll G. Pálsson.** 2003. *Developing methods to tenderise bones in herring fillets.* IFL report 3-03, 28 pp, restricted access.

**Gústaf Hjálmarsson, Emilía Martinsdóttir, Páll G. Pálsson, Kolbrún Sveinsdóttir, Ása Porkelsdóttir, Soffía Vala Tryggvadóttir.** 2003. *Radio-Frequency Heating Technology for Minimally Processed Fish Products.* IFL report 4-03, 17 pp, restricted access.

**Emilía Martinsdóttir, Kolbrún Sveinsdóttir, Ása Porkelsdóttir,** Bjarni Áskelsson. 2003. *Sensory evaluation of fish freshness with the Quality Index Method (QIM).* IFL report 5-03, 20 pp, open.\*

**Eva Yngvadóttir, Helga R. Eyjólfsdóttir, Halla Jónsdóttir, Bryndís Skúladóttir.** 2003. *Life Cycle Analysis of Icelandic Frozen Cod Products: An environmental evaluation.* IFL report 6-03, 48 pp, open.

**Kristín Anna Þórarinsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *Stability and yield of light-salted, frozen cod products. Trial II. Effects of adding phosphates and soy proteins by injection and brining.* IFL report 7-03, 65 pp, restricted access.\*

**Sigrún Guðmundsdóttir, Birna Guðbjörnsdóttir.** 2003. *Typing of Listeria in food-Biofilm formation.* IFL report 8-03, 12 pp, open.\*

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**Kristín Anna Þórarinsdóttir, Guðný Guðmundsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *Stability and yield of light-salted, frozen cod products. Comparison of trial II, III and IV. Effects of added soy proteins and fish proteins in different forms.* IFL report 12-03, 27 pp, restricted access.\*

**Kristín Anna Þórarinsdóttir, Guðný Guðmundsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *Stability and yield of light-salted, frozen cod products. Summary of main results from all trials.* IFL report 13-03, 10 pp, restricted access.\*

**Kristín Anna Þórarinsdóttir, Guðný Guðmundsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *Stability and yield of light-salted, frozen cod products. Trial II, III and IV. Materials and methods.* IFL report 14-03, 10 pp, restricted access.\*

**Margrét Geirsdóttir.** 2003. *Stability of frozen herring as raw material for food processing.* IFL report 15-03, 52 pp, open.\*

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**Rannveig Björnsdóttir.** 2003. *Control of microflora in the first feeding tanks of halibut larvae - Annual report 2. year.* IFL report 20-03, 21pp, restricted access.\*

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**Emilía Martinsdóttir.** 2003. *Introduction of the Quality Index Method (QIM) in the European fishery chain (QIMCHAIN).* IFL report 26-03, 75 pp, open.

**Eva Yngvadóttir.** 2003. *Monitoring of the marine biosphere around Iceland 2001 and 2002.* IFL report 27-03, 45 pp, open.

**Eva Yngvadóttir.** 2003. *Life Cycle Assessment of seafood - 3rd workshop.* IFL report 28-03, 14 pp, open.

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**Guðjón Atli Auðunsson.** 2003. *Accumulation of some trace elements in deployed blue mussels at the discharge point of the effluent from the landfilling site of Sorpa at Álfsnes in the autumn 2002.* IFL consultancy report 2-2003, 28 pp, restricted access.

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**Guðjón Atli Auðunsson.** 2003. *Organic and inorganic contaminants in biota from Icelandic waters.* Seminar at the Department of Chemistry, University of Iceland., 4. April.

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**Guðjón Atli Auðunsson.** 2003. *Seafood safety,-implication of EU legislation.* IFL Autumn meeting, Reykjavík, 13. November.

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**Guðjón Þorkelsson.** 2003. *SEAFOOD PLUS - Profitability for Iceland.* IFL Autumn meeting, Reykjavík, 13. November.

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**Helga Gunnlaugsdóttir, Eva Yngvadóttir, Birna Guðbjörnsdóttir.** 2003. *Safety of food - Risk assessment.* IFL Autumn meeting, Reykjavík, 13. November.

**Helga Gunnlaugsdóttir.** 2003. *General introduction of the EuroSalmon project. - Interaction between process parameters and smoked salmon quality.* Two lectures delivered at a Symposium called "Smoked salmon in Europe", Brussel, Belgium 7. May.

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**Helga Gunnlaugsdóttir.** 2003. *Quality of smoked salmon - results from consumer studies in five European countries.* Lecture held at the Agricultural Research Institute, Keldnaholt 20. February.

**Heiða Pálmadóttir.** 2003. *Education in Icelandic fish industry: Viewpoint of IFL.* Lecture held in the Faroe Islands 4. December.

**Kolbrún Sveinsdóttir, Ása Þorkelsdóttir, Emilía Martindsdóttir.** 2003. *Consumer survey: Cod fillets packaged in air and modified atmosphere (MAP).* TAFT-2003 - First Joint Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Kristín Anna Þórarinsdóttir.** 2003. *Salted cod - development in processing and products.* IFL Autumn meeting, Reykjavík, 13. November.

**Kristín Anna Þórarinsdóttir, Guðný Guðmundsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *The effects of brine injection on yield, water holding capacity and chemical content of cod fillets.* TAFT 2003 - The First Joint Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Margrét Geirsdóttir, Guðjón Þorkelsson.** 2003. *Proteins and peptides from fish novel components from fish by-products "Valuable products from by-raw materials".* Conference held at IceTec 7. November.

**Arnar Jónsson, Rannveig Björnsdóttir.** 2003. *Marine aquaculture - What has been achieved and future perspectives.* IFL Autumn meeting, Reykjavík, 13. November.

**Rósa Jónsdóttir, Guðrún Ólafsdóttir, Sigurður Hauksson, Jón Magnús Einarsson.** 2003. *Volatile flavor compounds in seafood flavorants.* TAFT 2003 - The First Joint Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

**Sigrún Guðmundsdóttir.** 2003. *Use of molecular methods for identification of Campylobacter.* Conference on Campylobacter held at Hótel Loftleiðir, Reykjavík 11 April.

**Sigurjón Arason.** 2003. *The drying of fish and utilization of geothermal energy; the Icelandic experience.* "Multiple integrated use of geothermal resources, held to celebrate the 25th anniversary of the U.N. University Geothermal Training Programme in Iceland." Reykjavík September 2003.

**Sigurjón Arason.** 2003. *Utilization of fish by-products in Iceland.* TAFT 2003 - The First Joint Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Sigurjón Arason.** 2003. *The drying of fish products; the Icelandic experience.* Lecture held in Aba, Nigeria in November.

**Sjöfn Sigurgísladóttir.** 2003. *Feed and Quality of farmed cod.* Lecture given at the conference "Nordisk Nettverkmöte for torskeoppdrett", 13-14 February in Bergen, Norway.

**Sjöfn Sigurgísladóttir.** 2003. *Alternative feed and its effect on quality of the fish product.* 1st FORM Meeting in Santorini, Greece, 7-10 May.

**Soffía Vala Tryggvadóttir,** Björn Björnsson 2003. *The influence of different feeding strategies on the flesh quality of farmed Atlantic cod (Gadus morhua), Iceland.* TAFT 2003 - The First Joint Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

## Posters

**Guðrún Ólafsdóttir, Rósa Jónsdóttir.** 2003. *Detection of volatile compounds by an electronic nose to monitor freshness of haddock stored in ice.* TAFT 2003 - First Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

**Guðrún Ólafsdóttir, Rósa Jónsdóttir, Soffía Vala Tryggvadóttir,** Sigurður Einarsson, **Hélène L. Lauzon.** 2003. *Prediction of freshness quality of haddock fillets using electronic nose, texture and TVN measurements.* TAFT 2003 - First Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Kristín Anna Þórarinsdóttir, Guðný Guðmundsdóttir, Sigurjón Arason, Guðjón Þorkelsson.** 2003. *The effects of brine injection on yield, water holding capacity and chemical content of cod fillets.* TAFT 2003 - First Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Margrét Bragadóttir.** 2003. *Methods for measuring lipid oxidation and their application to fishmeal.* TAFT 2003 - First Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

**Mei Manxue, Guðný Guðmundsdóttir, Kristín Anna Þórarinsdóttir, Guðjón Þorkelsson, Sigurjón Arason, Kristberg Kristbergsson.** 2003. *Development of methods for evaluating gel-forming properties in restructured fish products.* TAFT 2003 - First Trans-Atlantic Fisheries Technology Conference, Reykjavík, 11-14 June.

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**Sigrún Guðmundsdóttir**, Hjördís Harðardóttir, Eggert Gunnarsson, Franklín Georgsson, Jarle Reiersen. 2003. *Comparison of Campylobacter jejuni Isolates from Humans, Foods and Animals in Iceland using Pulsed-Field Gel Electrophoresis (PFGE)*. CHRO 2003 12th International Workshop on Campylobacter, Helicobacter and Related Organisms. Denmark, 6-10 September.

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## Miscellaneous

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**Rannveig Björnsdóttir**, **Heiðís Smáradóttir**. 2003. *Halibut farming in Iceland - first feeding of halibut larvae*. The Icelandic TV program "Science for all", RUV, July.

**Sjöfn Sigurgísladóttir**, **Guðrún Ólafsdóttir**. 2003. *Health benefits*. Interview. Morgunblaðið, 14. June.



## IFL Management and Staff 2003

### Board of Directors

**Friðrik Friðriksson**

*Economist  
Chairman of the Board*

**Pétur Bjarnason**

*Managing Director of the Fisheries Association of Iceland*

**Arnar Sigurmundsson**

*Chairman of the Federation of Icelandic Fish-processing Industries*

**Sjöfn Sigurgísladóttir, Ph.D.**

*IFL Director General  
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### Administration Division

**Aðalbjörg Elín Halldórsdóttir, Cand. oecon.**

*Business Administration. IFL 2002  
Director of Finance*

**Björn E. Auðunsson, B.A.**

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**Eiríkur Einarsson, B.A.**

*Librarian. IFL 1971*

**Guðlaug Þóra Marinósdóttir**

*Office Manager. IFL 1995*

**Hjördís Bergstað**

*Clerk. IFL 1991  
Reception and archivist*

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*Chemist. IFL 1990  
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*Food Scientist. IFL 1999  
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*Librarian. IFL 1988  
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*Mechanical Engineer. IFL 1986  
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### R&D Division

The research division is divided into 4 departments, which specialise in R&D in the following areas: Aquaculture; Consumers and Food Safety; Food Processing and Technology; Environmental Research and Food Quality. The research is carried out both in Reykjavík and Akureyri.

#### *Aquaculture*

**Rannveig Björnsdóttir, M.Sc.**

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**Þorvaldur Þóroddsson, B.Sc.**

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#### *Consumers and Food Safety*

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Project manager*

**Birna Guðbjörnsdóttir, B.Sc.**

*Food Scientist. IFL 1980  
Project manager*

**Hélène Liette Lauzon, M.Sc.**

*Food Scientist. IFL 1992*

*Project manager*

**Kolbrún Sveinsdóttir, M.Sc.**

*Food Scientist. IFL 1999*

*Project manager*

**Sigrún Guðmundsdóttir, M.Sc.**

*Microbiologist. IFL 1995*

*Project manager*

## ***Food Processing and Technology***

**Guðjón Þorkelsson, M.Sc.**

*Biologist and Food Scientist IFL. 1998*

*Head of Department.*

**Jón Ragnar Gunnarsson**

*M.Sc. student in Food Science. IFL 2000, retired in 2003*

**Jón Þór Þorgeirsson, M.Sc.**

*Food Engineer. IFL 2003*

*Project manager*

**Kristberg Kristbergsson, Ph.D.**

*Food Scientist IFL. 1998*

*Project manager*

**Kristín Anna Þórarinsdóttir, M.Sc.**

*Food Scientist. IFL 1999*

*Project manager*

**Mai Manxue**

*M.Sc. student in Food Science. IFL 1999, retired in 2003*

**Margrét Geirsdóttir, M.Sc.**

*Food Scientist IFL. 1998*

*Project manager*

**Ragnar Jóhannsson, Ph.D**

*Physical Chemist. IFL 2003*

*Project manager*

**Sigurjón Arason, M.Sc.**

*Chemical engineer. IFL 1978*

*Project manager*

**Sveinn Margeirsson, M.Sc.**

*PhD studies in Industrial Engineering. IFL 2003*

## ***Environmental Research and Food Quality***

**Helga Gunnlaugsdóttir, Ph.D.**

*Food Scientist. IFL 2003*

*Head of Department*

**Elín Árnadóttir, B.Sc.**

*Chemical Technologist. IFL 1976*

*Assistant*

**Eva Yngvadóttir, M.Sc.**

*Chemical Engineer. IFL 1989*

*Project manager*

**Guðjón Atli Auðunsson, Ph.D.**

*Chemist. IFL 1988*

*Project manager*

**Guðrún Ólafsdóttir, M.Sc.**

*Food Scientist. IFL 1988*

*Project manager*

**Helga Halldórsdóttir, B.Sc.**

*Chemist. IFL 1994*

*Project manager*

**Margrét Bragadóttir, M.Sc.**

*Food Scientist. IFL 1985*

*Project manager*

**Rósa Jónsdóttir, M.Sc.**

*Food Scientist. IFL 1999*

*Project manager*

**Þuríður Ragnarsdóttir**

*Chemical Technician. IFL 1994*

*Assistant*

## ***Analytical Service Division***

**Heiða Pálmadóttir, M.Sc. Siv.ing.**

*Chemical Engineer. IFL 1982*

*Director of Analytical Services*

## ***Chemical Laboratory***

**Ingibjörg Jónsdóttir, B.S.**

*Food Scientist. IFL 1997*

*Project Manager*



**Erla H. Karelsdóttir**

*Assistant. IFL 1999*

**Eyrún Þorsteinsdóttir**

*Assistant. IFL 1974*

**Gréta M. Garðarsdóttir**

*Assistant. IFL 1990*

**Helga Hafberg**

*Food Scientist. IFL 2002, retired in 2003*

**Ingibjörg Rósa Þorvaldsdóttir, B.Sc.**

*Food Scientist and Industrial Technologist. IFL. 1998*

**María Guðjónsdóttir**

*Summer Assistant 2003*

### ***Microbiology Laboratory***

**Hannes Magnússon, M.Sc**

*Microbiologist. IFL 1977*

*Project Manager*

**Ásthildur Eyjólfsdóttir**

*Assistant. IFL 1971*

**Jarmíla Hermannsdóttir**

*Assistant. IFL 1972*

**Páll Steinþórsson, B.Sc.**

*Food Scientist. IFL 1985*

*Project Manager*

### ***IFL in Akureyri***

**Jón Jóhannesson, B.Sc.**

*Chemist. IFL 2000 (First in 1974).*

*Branch Manager*

**María Pétursdóttir**

*Assistant. IFL 2000*

**Svanhildur Gunnarsdóttir**

*Assistant. IFL 1987*

**Þrúður Aðalbjörg Gísladóttir**

*Assistant. IFL 2000*

### ***IFL in Ísafjörður***

**Kristinn Þór Kristinsson, B.Sc.**

*Fisheries Scientist. IFL 1995*

*Branch Manager (On sabbatical)*

**Karl Rúnar Róbertsson. B.Sc.**

*Food Scientist. IFL 1997*

*Quality Manager \* Temporarily appointed Branch Manager in Isafjordur*

**Halldóra Jóhannsdóttir**

*Assistant. IFL 1997*

**María Guðrún Halldórsdóttir**

*Assistant. IFL 1989*

### ***IFL in Neskaupstað***

**Þorsteinn Ingvarsson**

*Fisheries Technologist. IFL 1977*

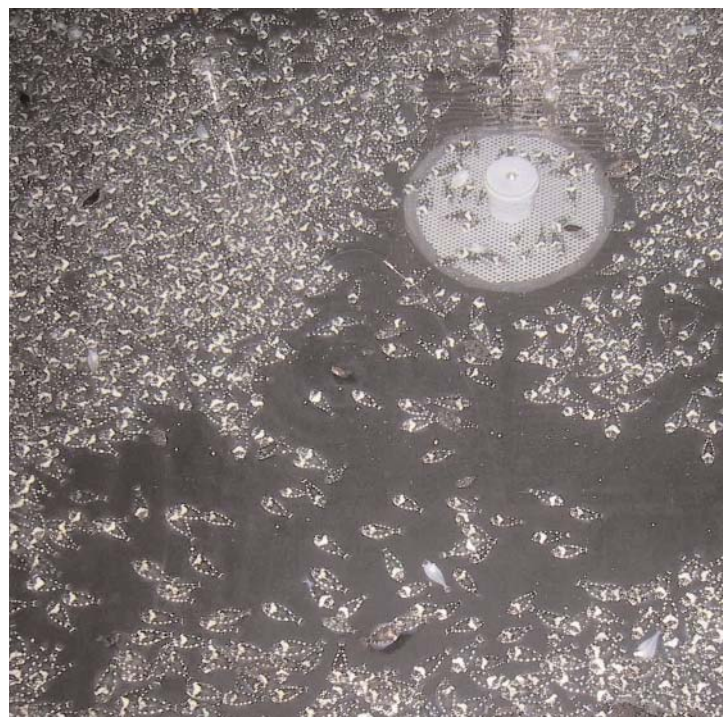
*Branch Manager*

**Lilja H. Auðunsdóttir**

*Assistant. IFL 1985*

**Sóley Þórðardóttir**

*Summer Assistant 2003*



## *IFL in Vestmannaeyjum*

**Sigmar Hjartarson, cand. scient.**

*Fisheries Biologist and Aquaculture Scientist. IFL 1995  
Branch Manager*

**Áslaug Rut Áslaugsdóttir, B.Sc.**

*Biologist. IFL 1994*

**Sigurbjörg Vilhjálmsdóttir.**

*Assistant. IFL 1996*



## **Master's degree students at IFL**

**Birna Guðbjörnsdóttir**

*Student in Food Science. IFL 2001*

**Bjarki J. Magnússon**

*Student in Industrial Engineering. IFL 2003*

**Helga Halldórdóttir**

*Student in Chemistry. IFL 1999*

**Hildigunnur Rut Hermannsdóttir**

*Student in Fish Microbiology. IFL 2003*

**Mei Manxue**

*Student in Food Science. IFL 1999*

## **PhD students at IFL**

**Guðrún Ólafsdóttir**

*Student in Food Science. IFL 2002*

**Sigrún Guðmundsdóttir**

*Student in Microbiology. IFL 2000*

**Sveinn Margeirsson, M.Sc.**

*Student in Industrial Engineering. IFL 2003*

**Rannveig Björnsdóttir**

*Student in Microbiology. IFL 2003*

**Margrét Geirsdóttir**

*Student in Food Science. IFL 2003*



## IFL's Financial Statements 2003

# Board of Directors' Report

Icelandic Fisheries Laboratories is an independent organization under the Ministry of Fisheries. It operates under the Act on industry research, no. 64/1965, with subsequent amendments. The organization is a research and service organization for fisheries, other food industries and related occupations. The organization's function is, on the one hand, to increase the value, quality and safety of marine catches with research, development, dissemination of knowledge and consulting.

In 2003 there was a surplus of ISK 22,353,512 from the organization's operations. According to the balance sheet, the organization's assets were ISK 96,670,199, and its equity capital was positive by ISK 8,025,335 at the end of 2003.

The Board of Directors and managing director of Icelandic Fisheries Laboratories hereby confirm with their signatures the organization's financial statements for 2003.

Reykjavik, 20 April 2004

Fridrik Fridriksson  
Chairman

Petur Bjarnason

Arnar Sigurmundsson

Director General:  
Sjofn Sigurgisladottir

## Auditors' Report

To the Board Of Directors and Managing Director of Icelandic Fisheries Laboratories

We have audited the financial statements of Icelandic Fisheries Laboratories for 2003. The financial statements includes the income statement, balance sheet, cash flow statement and notes. The financial statements are submitted by the Icelandic Fisheries Laboratories management on their responsibility in accordance with laws and regulations. Our responsibility is to express an opinion on these financial statements on the basis of the audit.

The audit was conducted in accordance with the provisions of the National Audit Bureau Act and icelandic generally accepted auditing practice, which entail:

- verifying that the financial statements is, in all material respects, without defects
- checking internal control and evaluating whether it ensures appropriate results
- checking whether accounts are in accordance with the authorization of the Budget Act, supplementary budget act and other laws, lawful instructions, work practices and operational tasks, as appropriate, and
- checking and certifying the reliability of key figures on operations and results of activities published in the Financial Statement.

The audit includes sampling of data to verify amounts and other information presented in the financial statements. The audit also entails checking the accounting practices and valuation rules used and applying to Part-A governmental organizations on preparing the financial statement, as well as its presentation as a whole. We believe that the audit is a sufficiently reliable as a basis for our opinion.

It is our opinion that the financial statements present fairly, in all material respects, the financial position of the Icelandic Fisheries Laboratories as as of 31 December 2003 and the results of its operations and its cash flows during 2003, in accordance with the law, regulations and general accepted accounting practices for Part-A organizations in Iceland.

The Icelandic National Audit Office, 21 April 2004

Sigurdur Thordarson  
Auditor General

Sigurjón I. Haraldsson  
Audit Manager

## Income Statement for the Year 2003

<b>Operating Revenues</b>	<b>Notes</b>	<b>2003</b>	<b>2002</b>
Revenue from sale of services .....	1	120,933.489	109,727.912
Contributions .....	2	110,556.169	91,740.489
		231,489.658	201,468.401
<b>Operating Expenses</b>			
Payroll .....	3	240,052.586	231,606.269
Traveling costs and other work-related expenses .....	4	17,801.092	16,915.308
Specialist and other services .....	5	31,521.796	23,912.493
Costs for premises .....	6	32,200.414	32,525.439
Other operating expenses .....	7	31,496.623	31,593.827
Grants and other transfer payments .....	8	3,222.969	1,488.126
		356,295.480	338,041.463
Asset purchases .....	9	19,869.796	15,137.498
		376,165.276	353,178.961
Surplus (deficit) from operating activities .....		(144,675.618)	(151,710.560)
Financial income and (financial expenses) .....	10	29.130	(335.752)
Surplus (deficit) before State appropriation .....		(144,646.488)	(152,046.312)
State appropriation .....		167,000.000	180,000.000
<b><i>Surplus (deficit) for the year</i></b>		<b>22,353.512</b>	<b>27,953.688</b>



## Balance Sheet as at 31 December 2003

	Notes	2003	2002
<b>Assets:</b>			
<b>Investments</b>			
Ownership shares in companies .....		<u>100.000</u>	<u>100.000</u>
<b>Current assets</b>			
Receivables .....	11	56.526.251	51.138.050
Cash and cash equivalents .....		<u>40.043.948</u>	<u>22.952.971</u>
		<u>96.570.199</u>	<u>74.091.021</u>
<i>Current assets</i>			
<b>Total assets</b>		<u><u>96.670.199</u></u>	<u><u>74.191.021</u></u>
<b>Equity and Liabilities:</b>			
<b>Equity</b>			
Capital at start of year .....		(14.328.177)	(42.251.848)
Revaluation transferred to capital .....		-	(30.018)
Surplus (deficit) of the year .....		<u>22.353.512</u>	<u>27.953.688</u>
	14	<u>8.025.335</u>	<u>(14.328.177)</u>
<i>Total Equity</i>			
<b>Liabilities</b>			
<b>Current Liabilities</b>			
State Treasury .....	13	13.134.439	44.789.387
Trade and other payables .....	12	<u>75.510.425</u>	<u>43.729.811</u>
		<u>88.644.864</u>	<u>88.519.198</u>
<i>Total Liabilities</i>			
<b>Total equity and liabilities</b>		<u><u>96.670.199</u></u>	<u><u>74.191.021</u></u>

## Cash Flow Statement 2003

	Notes	2003	2002
<b>Cash flow from operating activities</b>			
<i>Working capital from operations:</i>			
Surplus (deficit) .....		<u>22.353.512</u>	<u>27.953.688</u>
<i>Working capital from operations</i>		<u>22.353.512</u>	<u>27.953.688</u>
<i>Adjustments in assets and liabilities related to operations:</i>			
Increase in receivables .....		(5.388.201)	(7.472.342)
Decrease in current liabilities .....		<u>31.780.614</u>	<u>19.340.515</u>
		<u>26.392.413</u>	<u>11.868.173</u>
<i>Net cash flow from operating activities</i>		<u>48.745.925</u>	<u>39.821.861</u>
<b>Cash flows from financing activities:</b>			
<i>Changes in State Treasury balance:</i>			
State Treasury appropriations .....		(167.000.000)	(180.000.000)
Payments from State Treasury .....		<u>135.345.052</u>	<u>154.252.122</u>
<i>Net cash flows from financing activities</i>		<u>(31.654.948)</u>	<u>(25.747.878)</u>
<b>Net increase (decrease) in cash and cash equivalents ...</b>		17.090.977	14.073.983
<b>Cash and cash equivalents at beginning of year .....</b>		<u>22.952.971</u>	<u>8.878.988</u>
<b>Cash and cash equivalents at end of year</b>		<u><u>40.043.948</u></u>	<u><u>22.952.971</u></u>



# Notes to the Financial Statements 2003

## **Accounting procedures**

### **Basis for accounting**

The financial statements of Icelandic Fisheries Laboratories is prepared in accordance with the State Finances Act, no. 88/1997, the Act on annual financial statements, no. 144/1994 and the Regulation on presentation and contents of financial statements and consolidated annual financial statements, no. 696/1996.

Under the State Finances Act, Part-A state organizations should not capitalize fixed tangible assets, but they shall be expensed in the year of purchase. The organizations should generally not take long-term loans, and they may not undertake long-term obligations unless so authorized in the Budget Act.

### **Foreign currencies and domestic indexes**

Monetary assets and liabilities in foreign currencies are converted to ISK at the purchase exchange rate at the end of the year, while liabilities are converted at the sale exchange rate. Foreign currency transactions during the year are converted to ISK on the transaction date.

### **Taxes**

Icelandic Fisheries Laboratories does not pay income tax or equity tax on general operations, but taxes are calculated for competitive operations.

### **Recording of revenues**

The organization's revenues are booked upon the issue of invoices.

### **Recording of expenditures**

Expenditures are booked when the accounting party receives invoices from the organization. At the end of the year, accrued expenses, associated with the relevant fiscal year, are entered into the profit and loss account as well as unpaid expenses at the end of the year.

### **Work organization and internal transactions**

The operations are divided by subject areas tailored to IFL's organization. Specified projects compete with companies in the private market. Sales of products and services between projects are on the same terms as those applying to transactions with unrelated parties, or according to a price list, if appropriate. In the presentation of the Financial Statements, internal transactions and the balance of transactions between projects are excluded and are not specifically shown.

# Notes to the Financial Statements 2003

## Receivables

Receivables are entered at face value after taking into account exchange-rate differential and accrued interest, where applicable.

## Cash

Cash consist of bank balances.

## Pension obligation

There is an unpaid pension obligation in respect of the organization's employees. In accordance with the State Treasury's accounting rules for Part A, pension obligations are not entered in annual financial reports of particular Part-A state organizations, but are rather entered as a lump sum for the State Treasury. The organization's pension obligation for current and former employees has not been separately calculated.

## Payables

Accounts payable are entered at face value after taking into account exchange-rate differential and accrued interest, where applicable.

## Accounting and financial custody

The Joint Office of the Industry Research Institutes is responsible for accounting and financial custody for the organization along with accounting for payroll, which is paid through the State Accounting Office.

## Appropriations and operations

The Budget Act appropriations for Icelandic Fisheries Laboratories were ISK 135,500,000. Indexation for wages was ISK 200,000 and waghertribution ISK 100,000 during the year. Unspecified revenues were increased by ISK 200,000. The organization received an appropriation from a supplementary budget act totalling ISK 31,4 million to meet accumulated operational difficulties of the last several years. The total appropriations for 2003 were therefore ISK 167 million.

After deducting unspecified revenues, total operating expenses were ISK 144,646,488, therefore being ISK 22,353,512 less than the appropriations authorized for the year. The breakdown is as follows:

Amounts in thousands of ISK	Appropriation	Account	Deviation
Payroll .....	186.000	240.053	(54.053)
Other expenses .....	122.900	112.990	9.910
Transfers .....	19.500	3.223	16.277
Unspecified revenues .....	<u>(178.700)</u>	<u>(231.490)</u>	<u>52.790</u>
	149.700	124.776	24.924
Asset purchases .....	<u>17.300</u>	<u>19.870</u>	<u>(2.570)</u>
	<b><u>167.000</u></b>	<b><u>144.646</u></b>	<b><u>22.354</u></b>



## Notes to the Financial Statements 2003

Profit and loss account 2003, broken down by types:

	<b>2003</b>	<b>2002</b>
Payroll .....	240.052.586	231.606.269
Other operating expenses .....	112.990.795	105.282.820
Transfers .....	3.222.969	1.488.126
Revenues .....	<u>(231.489.658)</u>	<u>(201.468.401)</u>
	124.776.692	136.908.814
Asset purchases .....	<u>19.869.796</u>	<u>15.137.498</u>
<b>Total</b>	<b><u><u>144.646.488</u></u></b>	<b><u><u>152.046.312</u></u></b>