



## New species for EU aquaculture

### Deliverable Report

<b>Deliverable No:</b>	D31.32	<b>Delivery Month:</b>	59
<b>Deliverable Title</b>	Atlantic halibut “Know-how Transfer” seminar for the aquaculture industry presenting the progress achieved through DIVERSIFY in the production technology		
<b>WP No:</b>	31	<b>WP Lead beneficiary:</b>	P18. CTAQUA
<b>WP Title:</b>	Dissemination		
<b>Task No:</b>	31.5	<b>Task Lead beneficiary:</b>	P7. IMR
<b>Task Title:</b>	This title should come from the DOW and should be complete and descriptive.		
<b>Other beneficiaries:</b>	P22. SWH		
<b>Status:</b>	Delivered	<b>Expected month:</b>	58

**Lead Scientist preparing the Deliverable:** Norberg, B. (IMR),

**Other Scientists participating:** Mylonas, C.C. (HCMR)

**Objective:** The objective of this Deliverable was to organize an Atlantic halibut “Know-how Transfer” seminar for the aquaculture industry, presenting the progress achieved through DIVERSIFY in the production technology: A full-day seminar directed to the coldwater aquaculture industry, covering the knowledge obtained in DIVERSIFY for Atlantic halibut (potential location: Norway). The seminar will include 30 min presentations on selected aspects (e.g., reproduction and spawning induction, final product diversification and quality, socioeconomic issues and marketing, etc.), given by DIVERSIFY Partners, but also from any authorities in the species, whose work was not part of the project. Aquaculturists (mainly), but also European aquaculture support companies (feed, pharmaceutical, equipment, engineering, etc.), researchers and educators, government organizations and other important institutions (FAO, Globefish) will be invited to attend these meetings.

**Description:** A full-day seminar was held on September 11, 2018, at SPA Hotel Velvære, Hjelmeland, Norway. A specially prepared dinner, with five different halibut courses, was arranged at the main office of P.22, Sterling White Halibut. The seminar was followed by an excursion to the production sites of Sterling White Halibut on September 12.



All active European Atlantic halibut producers were invited and were present at the workshop. A number of presentations were given and the most important results from the DIVERSIFY project (**Fig. 1**) were presented by the project partners: HCMR (Mylonas), IMR (Norberg, Hamre, Sæle, Harboe, Nerland and Patel) and SWH (Erstad).



<b>Agenda (Tuesday, 11 September 2018)</b>	
<b>8:30 – 9:00</b>	<b>Welcome and registration</b>
<b>9:00 – 9:15</b>	The DIVERSIFY project ( <b>Constantinos C. Mylonas</b> , Coordinator, Hellenic Centre for Marine Research, Greece)
<b>9:15 – 9:45</b>	Development of aquaculture of Atlantic halibut – a historical perspective ( <b>Ólafur Halldórsson</b> , Akureyri, Iceland)
<b>9:45 - 10:00</b>	Current status of Atlantic halibut culture in Norway and world-wide ( <b>TBA</b> ).
<b>10.00 - 10.30</b>	Branding and marketing of Atlantic halibut ( <b>Magnus Skretting</b> , CEO Sterling White Halibut)
<b>10.30 - 11.00</b>	<b>Coffee break</b>
<b>11:00 - 11:20</b>	Reproduction and genetics: GnRHa induction of spawning in female Atlantic halibut ( <b>Constantinos C. Mylonas</b> )
<b>11:20 - 11:40</b>	Reproduction and genetics: Reproductive performance of farmed and wild-caught halibut in aquaculture ( <b>Birgitta Norberg</b> , Institute of Marine Research (IMR))
<b>11:40 - 12:10</b>	Nutrition: Development of the gut and digestion in Atlantic halibut ( <b>Ivar Rønnestad</b> , University of Bergen)
<b>12:10 - 13:00</b>	<b>LUNCH (Compliments of DIVERSIFY)</b>
<b>13:00 - 13:20</b>	Nutrition: Early weaning ( <b>Kristin Hamre</b> , IMR)
<b>13:20 - 13:40</b>	Larval husbandry: Protocols for RAS in yolk sac and first feeding larvae ( <b>Torstein Harboe</b> , IMR)
<b>13:40 – 14:00</b>	Larval husbandry: Metagenomics in RAS systems for halibut larvae ( <b>Audun Nerland</b> , University of Bergen and IMR)
<b>14:00 – 14:20</b>	Larval husbandry: Industry applications and challenges ( <b>Børre Erstad</b> , SWH)
<b>14:20 – 14:50</b>	Fish health: Development of the immune system and vaccine development ( <b>Sonal Patel</b> , Vaxxinova and IMR)
<b>14:50 – 15:20</b>	<b>Coffee break</b>
<b>15:20 – 16:00</b>	New challenges in Atlantic halibut aquaculture research and development ( <b>TBA</b> )
<b>16:00-16:30</b>	Future development – from the perspective of salmon farming ( <b>TBA</b> )

**Figure 1.** Agenda of the Atlantic halibut workshop (day 1).

In addition, a number of invited presentations were given, and the non-participating halibut farmers each presented their results and challenges. These presentations are summarized below:

**Olafur Halldorsson (Iceland, one of the pioneers in halibut). History of halibut farming**

Started in 1980 with 2 juvenile production in Norway. Early production with extensive methods, using lagoons and natural plankton. Later (2000) intensive methods were used, with supplied plankton and *Artemia*. Production was about <500,000 from 1990-2005. After Norway, Canada, Scotland and Iceland started producing, mainly with *Artemia*. Early problems were solved by using lipid enrichments in the live



food. Knowledge was obtained from the turbot and seabream/seabass industries in France, Spain and Greece. Important breakthroughs were the production of high quality *Artemia* in 1996, continuous spawning after 1998 using a stable bloodstock in FISKEY (Iceland). Between 1993-2000 working routines were developed in terms of light and temperature, flow rates and feeding strategies, as well as health management. Knowledge transfer from Norway to Iceland was instrumental for the development of Atlantic halibut production in Iceland. The larval rearing protocol/manual from Iceland had then helped the development of three hatcheries in Norway (SWH, Marine Harvest).

### **Magnus Skretting, SWH (Norway) CEO**

The company started in 2001, and it markets the fish as “A gourmet fish for special occasions”. Not an everyday fish! The company is a family business, passionate with the production of halibut. Production for the time being is 1200 mtn. There is a demand also for smaller size fish and testing have been done in England for 800 g fish, as opposed to the 5 kg typical size for harvest (5 years to produce). The company has protected the name “Stirling” for its products. The stress was on the passion one has to have for its job and business, and strive to produce the best product possible. Biggest does not mean the best, and an important requirement for excellence is the use of the best people.



### **Roberts Stokkers, WER/WUR**

Presented the economic feasibility study for halibut cage production. The model was for the culture of 500 g to 5 kg fish, in 4.5 - 5.5 year production. Cost of production is 7.5 to 5.5 euro/kg, moving from 500 to 1500 mt production. The major costs are juveniles (3-2.2 euro per kg) and labor, the latter being rigid vs production level, at ~ 2 euro per kg. Regarding the cash flow, a 500 mt farm never makes any profit, while a 750 mt farm breaks even in 20 years. So to be profitable, a farm must be producing at 1000 mt, with an initial investment of 5 million, increasing the investment to 15 million in 4 years, and then breaking even in 10 years, with significant profits of 2 million euro per year (at a price of 7 euro per kg).

### **Ivar Ronnestad (Norway) Uni Bergen**

Description of the digestive function in fish. Then a description of the ontogeny of the digestive system in halibut, with very nice 3D recreation of the GI tract. Acid and pepsin production start at the time of metamorphosis in stage 9 fish. Also, Ghrelin production by the stomach signals to the brain that one must eat (orexigenic hormone), is produced after stage 8. This should stimulate increased feeding behavior. Another hormone, CCK, response to the movement of the chyme into the gut and signals satiety to the brain. It also stimulates release of bile in the gut. CCK is produced after 52 dah (stage 8-9) in individual cell located mainly in the first 30% of the gut. First feeding larvae do not have a stomach and do not have pyloric caeca, but do have some digestive ability from enzymes. As a result, less amino acids are being absorbed when intact proteins are being offered to the fish. Protein processing capacity increased after metamorphosis. Gut-brain axis signals (hunger/satiety) signals changes during development.



### Industry presentations

#### **Nordic Halibut (Edvard Henden, Ann-Kristin Flatseth and Christine Hunskar)**

Showed videos of larvae and juveniles in the facility. The last year they had very good success with juvenile production. The cycle includes the hatchery part of 0.5 y, then 1-1.5 years in the juvenile stage in another facility and then 2-3 years of growing in sea cages. The cages are 120 m in diameters and 20 m deep. The fish are moved to the sea cages and processing by well boats. Brood stock selection is key for the future. Now in the 3 generation of selection. Market size is 7 kg. Important to have stable quality to have a good price in the market. Sex-specific growth differences are not so obvious, so the need for all-female production is not so important for the farm. The production needs to grow hand-in-hand with the market, otherwise the price will suffer. Selling price around 12-13 euro per kg, whole fish gutted. Smaller fish have a smaller price. The company produces 700 mt, and will increase in the near future.



#### **Sogn Aqua (Ole Kristian)**

This company has followed the establishment of SWH and Nordic Halibut (more recent), and it is completely land-based. Ole is a microbiologist and has partnered with another person for the creation of the company (2007). The product is marketed as “GLITNE” (Snow white halibut from GLITNE), which is the name of a mythical god, that is related to the ice, snow, white! Two locations, one for the nursery and one for grow out, plus the hatchery. This is the largest land-based halibut farm in the world. Using gabions (wire and stones) and plastic liners. ~Production o 400 mt, and increasing to 700 mt next year. Often, market requests more than the company can supply. Feed improvement should come in the future, including feed substitution.

#### **and Sigbjorn Hjetland (Sogn Aqua Juveniles)**

The company was established in 2015 without any knowledge on halibut. The facility was first producing haddock. Production was based on RAS system, with 2 employees only dealing with broodstock, live feed and larval production. In addition to *Artemia* the company uses also copepods (*Acartia spp*). About to build and new broodstock facility with three square tanks.

#### **Sande Sea Farm (Leif Ole Stockseth)**

Just a small company of three brothers, working mainly in the afternoons /evening /weekends. Their product is 400,000 juveniles (only) and they have some issues with eye migration, supporting other farms. Interested in starting an grow out, but it requires a lot of funding (200 million over a period of 10 years, to become profitable).

#### **Otter Ferry Seafish -Gigha Halibut (Alistair Barge, one of the pioneers in halibut)**

A very old company, but never made it to lead the industry. In 1967 was farming trout, and then in 1973 doing salmon. Started with halibut in 1991, then in 1998 they declined the production, and in 2010 the



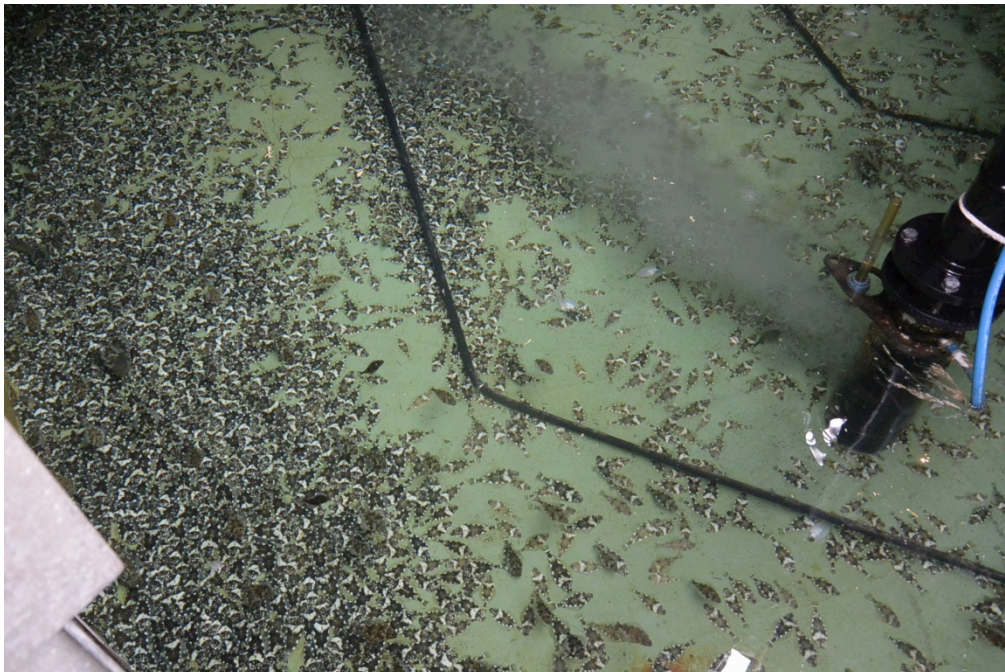
halibut production was expanded again. Currently they produce wrasse (2009) and lumpfish (2014). Also evaluated lobster, turbot, cod and finally decided on the halibut as the best alternative to the salmon (declining wild stock, high market price, excellent growth and yield). The fish is marketed as “Gigha halibut - Sustainable fish from God’s Island” since 2006. The juveniles are produced in the hatchery and then are moved to Gigha Island for grow out in land-based production. Current production is 100,000 juveniles, F2 generation with 100 females of Iceland-Canadian-Scotland origin. Neomales are produced in order to have all-female population for grow out, which is seen as a good method to avoid the male problem with growth. Selling between 9 and 15 pound-sterling, depending on the size (1-7 kg). Great potential for this fish!!



### Conclusions:

The workshop attracted quite all representatives from the Atlantic halibut industry in Norway and Scotland. The attendees were very interested in the findings of the project, but also to hear what the industry representative had to say about their experience with the species, and their strategy for further expansion.

For this event a technical manual (**Fig. 3**) has been elaborated and it is available in the project webpage, <https://www.diversifyfish.eu/halibut-workshop.html>, with the results and advances in the study of the species within DIVERSIFY project.





**Figure 3.** First page of the Technical Leaflets on Atlantic halibut, available in the project web <https://www.diversifyfish.eu/halibut-workshop.html>

**Deviations:** No deviations



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