Unit 12: Understanding and Undertaking Salmonid Farming

Unit code: H/601/0274

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to the skills and understanding associated with salmonid farming and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

The farming of salmonids has become a large and important industry in many rural areas of the UK and worldwide. The fish produced in these farms are important, not only in the human food chain, but also in supplying the sports fisheries industry and may contribute to the conservation of some important fish species. The industry has produced good quality fish successfully for many years but increasing environmental and animal welfare concerns mean that farming techniques must be monitored constantly and revised to enable the continued success of this industry.

This unit allows learners to explore the principles behind the farming of salmonids before investigating in detail how these principles relate to actual farm practices.

Salmonid species are complex organisms with unusual life cycles. Understanding these fish is a vital first step in understanding the variety of methods used to farm them in commercially realistic and sustainable situations. Understanding the many different systems that are used to farm the various species of salmonids, not just salmon and trout but other species such as the Arctic char, will enable learners to use the best techniques for any given situation.

The second part of the unit aims to allow learners to gain first-hand experience of some of the diverse methods of farming salmonids. The industry is generally split into the hatchery production of young fish and then different systems for on-growing. Learners will explore both types of farming and the methods that are used to farm salmonids, from the selection of broodstock, through obtaining eggs and hatchery processes, to the first feeding of juveniles. In the on-growing section of the unit, learners will explore the nutritional and feeding requirements of salmonids. The will develop husbandry skills and monitoring techniques as they progress through the unit. Adherence to relevant health and safety legislation, appropriate use and care of equipment and carrying out work with due regard to the overall environment will all be important in this practical area.

This unit allows learners to consider one area of fish farming and is extremely useful for anyone wishing to enter the fish farming industry or for anyone interested in entering the fisheries and conservation sectors.

Learning outcomes

On completion of this unit a learner should:

1 Understand the biological requirements of salmonid species and how this relates to their production on the farm

2 Understand the different methods and site requirements for salmonid farming

3 Be able to carry out salmonid hatchery operations

4 Be able to carry out salmonid on-growing operations.

Unit content

1 Understand the biological requirements of salmonid species and how this relates to their production on the farm

Biological requirements: life cycles of farmed salmonids in the UK eg brown trout, rainbow trout, Atlantic salmon; biological requirements eg water quality and quantity, food and feeding

Production cycles: commercial production cycles and systems for farming trout and salmon

2 Understand the different methods and site requirements for salmonid farming

Production methods: advantages and disadvantages of holding units currently available for trout and salmon farming eg tanks, raceways, earth ponds, cages; relevant current legislation and codes of practice; environmental and animal welfare issues

Site requirements: influence of geographical and environmental factors on site selection; water quality and quantity requirements for farmed salmonids; relevant current legislation on flood risk, water abstraction and discharge, farm registration and planning; relevant current codes of practice; health and safety issues; environmental and animal welfare issues

3 Be able to carry out salmonid hatchery operations

Hatchery operations: broodstock selection, assessment and stripping; photoperiodic maturation; temperature control; fertilising, incubating, counting, picking, disinfecting, transporting eggs; shocking and all-female and triploid production; use of artificial incubation substrates; diets and first feeding; juvenile rearing (fry, fingerling, parr and smolt); predator control; health management (main diseases and treatments) and biosecurity; relevant current legislation and codes of practice; environmental and animal welfare issues

4 Be able to carry out salmonid on-growing operations

On-growing operations: calculating feed rations, feed conversion ratios and feed costs; diets and feed storage; calculating fish growth and stocking densities; measuring water flows and volumes; grading stock; live fish transport; harvesting and slaughter; processing; fish spoilage; marketing and quality standards; health management (main diseases and treatments) and biosecurity; predator control; removal and disposal of mortalities; relevant current legislation and codes of practice; environmental and animal welfare issues

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 identify the biological requirements of the main farmed salmonid species		
P2 illustrate how the biological requirements relate to the main production processes in farms [CT]	**M1** explain the biological implications for a named salmonid of moving between fresh and salt water	**D1** discuss the advantages and disadvantages of commonly used farming systems for salmonids in relation to the biological requirements of a selected species
P3 identify the main techniques for farming salmonids		**D2** plan and complete a biosecurity and health management plan for a described salmonid farm
P4 explain the site requirements for a specified method of producing farmed salmonids	**M2** describe the legislative requirements for a salmonid farm in a described location	
P5 plan and carry out salmonid hatchery operations in line with health and welfare requirements [TW]	**M3** describe the methods of egg production for a named salmonid	**D3** explain the methods of producing all female and triploid stock.
P6 recommend improvements to salmonid hatchery operations [RL]		
P7 plan and carry out salmonid on-growing operations [TW]	**M4** describe the nutritional and feeding requirements of a selected salmonid species.	
P8 recommend improvements to salmonid on-growing operations. [RL]		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery is likely to be a mixture of classroom learning and practical salmonid operations. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are carried out so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to undertake salmonid hatchery work and they should ask for observation records or witness statements to be provided as evidence of this. Throughout delivery of this unit it is essential that tutors stress the importance of animal welfare and environmental issues. Health and safety issues relating to working in and around water must be stressed and reinforced regularly and risk assessments must be undertaken before any practical activities. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments. It is particularly important to emphasise the importance of biosecurity before visiting any fish farms.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable salmonid farms and will link to work experience placements.

The first part of this unit will develop learners' knowledge of the biology of farmed salmonids and the production cycles used in commercial fish farms. This will concentrate particularly on the main biological requirements of the farmed species and how fish farms meet those requirements. The different life stages (fry, parr, smolt and adult) and how these are dealt with on a farm will also be discussed. This unit is likely to be delivered using formal lectures, discussion, visits to hatcheries and on-growing farms and independent learner research. Visiting expert speakers could add to the relevance of the subject for learners. For example, a fish farm manager could talk about their systems and how they accommodate the biological requirements of the fish.

Learning outcome 2 will develop learners' knowledge of the different methods and site requirements for salmonid farms. This area will include the geographical, environmental, water quality and quantity requirements for the farm site. Relevant planning, water abstraction, water discharge and registration legislation will also be discussed. Delivery is likely to include formal lectures, discussions, farm visits and case studies. Visiting expert speakers could add to the relevance of the subject for learners. For example, an Environment Agency officer could talk about water abstraction and discharge licensing.

The second half of this unit covers the more practical aspects of salmonid farming, beginning with learners developing the knowledge and skills needed to manage salmonid hatchery operations. Delivery methods should be varied and would be expected to include formal lectures, demonstrations, supervised practical instruction, practical sessions and farm visits to examine commercial hatchery practices. Visiting expert speakers could add to the relevance of the subject for learners. For example, a hatchery manager could talk about their production strategies and how they maintain a safe working environment.

The last learning outcome allows learners to develop their knowledge of and skills in on-growing salmonid farming operations. This will include a wide range of areas including feeding, grading, monitoring, transport and health management. Delivery methods are likely to include formal lectures, demonstrations, supervised practical instruction and farm visits. For both the last learning two outcomes learners will require regular supervised practical sessions in a salmonid farming unit to allow them to develop the necessary specialist skills. Throughout delivery it is essential that tutors stress the importance of animal welfare and environmental issues as well as health and safety. Visiting expert speakers could add to the relevance of the subject for learners. For example, a feed company representative could talk about current developments in feed technology.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Introduction to salmonid biology. Introduce life cycles and physiology.
Biological requirements of salmonids. Introduce concepts of biological limits eg in DO or pH.
Introduce production methods and cycles.
Legislative framework for salmonid farming.
Site visit. Visit to a particular salmonid farm and use it to introduce other possibilities.
Assignment 1: Site requirements (P1, P2, P3, P4, M2, D1, D2) Introduction assignment.
Production methods, describe the various forms with the use of examples.
Introduction to the site selection of salmonid farms. What factors influence site choice and why.
Assignment 2: Salmonid biology (M1) Introduction assignment.
Salmonid hatchery operations. Introduction to the work of a hatchery from broodstock selection to first feeding.
Guided practical involving hatchery tasks.
On-growing operations. Introduction to the main tasks on a fish farm.
Guided practical involving on-growing tasks.
Assignment 3: Practical diaries (P5, P6, P7, P8) Introduction assignment.
Technical aspects to salmonid farming; the production of specialist offspring, nutritional requirements, specialist equipment.
Assignment 4: Practical salmonid farming (M3, M4, D3) Introduction assignment.
Practical guide to feeding fish from diet formulation for different ages to feed delivery methods.
Unit review.

Assessment

For P1, learners must identify the biological requirements of the main farmed salmonid species. Learners should provide evidence relating to at least four species of salmonids. Evidence could take the form of a presentation with notes, or an annotated poster, web page or leaflet or project.

P2 requires learners to illustrate how the biological requirements relate to the main production processes on a farm. This is likely to be completed in conjunction with P1 and learners should use the information presented for P1 to illustrate their evidence for P2. Evidence is likely to be in the same form as P1.

For P3, learners are expected to illustrate the main techniques for farming salmonids. Learners should provide evidence that covers at least four distinct techniques. Evidence could take the form of a presentation with notes, or an annotated poster, web page or leaflet or project

P4 requires learners to explain the site requirements for a specified method of producing farmed salmonids. Tutors should identify the specified method or agree it through discussion with learners. Learners must include geographical, environmental, water quality and quantity requirements for the site. Evidence for this could take the same form as P3.

For P5, learners are required to plan and carry out specified salmonid hatchery operations in line with health and welfare requirements. It is expected that learners will assess broodstock for maturity, strip broodstock, fertilise eggs, set them in a hatchery and undertake the day-to-day husbandry of the eggs, alevins, swim-up and first feeding fry. This will probably be assessed directly by the tutor during practical activities, along with observation records completed by learners and the tutor and appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

P6 requires learners to recommend improvements to salmonid hatchery operations. This is likely to be combined with P5 and learners will be expected to identify at least three areas where improvements could be considered. Evidence could be in the same format as for P5.

P7 requires learners to plan and carry out salmonid on-growing operations. It is expected that learners will provide evidence to show that they can handle and feed stock correctly, calculate feed rations, stocking densities, food conversion ratios, fish growth, water flows and volumes, grade fish, transport live fish, harvest and slaughter fish, undertake legal predator control (which may be by passive methods of preventing predators gaining access to the fish) and undertake health management activities. Evidence could be in the same form as for P5.

For P8, learners are required to recommend improvements to salmonid on-growing operations. This is likely to be combined with P7 and learners will be expected to identify at least three areas where improvements could be considered. Evidence could be in the same format as for P5.

For P5 and P7 the time of year may not allow learners to perform certain tasks for example stripping broodstock. Where this is the case similar tasks should be chosen or a written description of these tasks accepted.

For M1, learners are required to explain the biological implications for a named salmonid of moving between fresh and salt water. Learners should identify and use a single species in discussion with the tutor. Evidence could be in the same form as for P1.

M2 requires learners to describe the legislative requirements for a salmonid farm in a given location. Tutors should identify the location or agree it through discussion with learners. Learners will be expected to identify all the relevant legislation covering the given site. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a project.

M3 requires learners to describe the methods of egg production for a named salmonid. The named salmonid should be agreed in discussion with the tutor. It is expected that learners will describe the process from broodstock selection to obtaining fertilised eggs. Evidence could be in the same form as for M2.

For M4, learners are required to explain the nutritional and feeding requirements of a selected salmonid species. Tutors should identify the species or agree it through discussion with learners. Learners could include examples of work that they have been involved in during this unit in their evidence. Evidence could be in the same form as for M2.

For D1, learners must discuss the advantages and disadvantages of commonly used farming systems for salmonids in relation to the biological requirements of selected species. Evidence for this could include

information gathered from a range of fish farm visits and background research. Tutors should identify the species or agree it through discussion with learners. Evidence could be in the same form as for P1.

D2 requires learners to plan and complete a biosecurity and health management plan for a described salmonid farm. The salmonid farm should be identified through discussion with the tutor. It is best if it is a site with which learners are very familiar, for example through a work placement. Evidence is likely to be in the form of a report for the fish farm manager or an advisory document for the fish farm staff.

D3 requires learners to explain the methods of producing all-female and triploid stock. Evidence for this can be assimilated from information gathered from fish farm visits, together with research findings, and presented to tutors in the form of a written report or project.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment Title	Scenario	Assessment Method
P1, P2, P3, P4, M2, D1, D2	Site requirements	You are planning to develop a salmonid farm but first you must research the industry and the available options. Identify the biological requirements of salmonids and relate these to the main identified production processes and techniques. For your chosen site assess it against the site requirements for your chosen method of farming and species. Describe the legislative framework that will be required to operate the fish farm. What advantages will your farm have in relation to the species chosen and how will you plan health management and bio security into the design?	Written report.
M1	Salmonid biology	Explain the biological implications of farming anadromous fish.	Written report.
P5, P6, P7, P8	Practical diaries	Produce a work log whilst working on a salmonid hatchery and on-growing unit. Include recommended improvements for the routine work.	Work log, witness testimony and observation records.
M3, M4, D3	Practical salmonid farming	Following practical work you have been asked to provide a training manual. Describe the methods of egg production and how this can be manipulated to produce all female or triploid fish. Describe the nutritional requirements and how these are met.	Written report.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Fish Farming	Understanding Fish Health and Welfare
Introduction to Aquatic Ecology	Understanding and Undertaking Mechanisation in Fish Husbandry
	AQU17 Prepare and maintain fish eggs in a hatchery AQU18 Care for Juvenile fish

Essential resources

Learners will need regular supervised access to salmonid farms which use a variety of equipment and holding units. They will also require access to all the equipment necessary to maintain salmonids in a condition that meets the requirements of relevant codes of practice and fish welfare guidelines. Commercially relevant equipment must be used.

Tutors delivering this unit should be competent and experienced fish farmers.

Employer engagement and vocational contexts

This unit focuses on understanding the salmonid farming industry and the fundamental practical skills required to work within the industry. Learners should be encouraged to develop this knowledge during work experience placements. Guest lectures and site visits should also be used to highlight how this knowledge is essential within the industry. It should also be recognised that the effective husbandry skills required for the practical element of this unit are essential transferable skills.

Indicative reading for learners

Textbooks

Beveridge M – *Cage Aquaculture, 3rd Edition* (Fishing News Books, 2004) ISBN 1405108428

Heen K, Monahan R and Utter F – *Salmon Aquaculture* (Blackwell Science, 1993) ISBN 0852382049

Laird L and Needham T – *Salmon and Trout Farming* (Ellis Horwood, 1994) ISBN 0137883242

Lucas J and Southgate P – *Aquaculture: Fish and Shellfish Farming* (Blackwell Science, 2003) ISBN 0852382227

Roberts R and Shepherd C – *Handbook of Trout and Salmon Diseases, 3rd Edition* (Blackwell Science, 1997) ISBN 0852382448

Sedgwick S – *Salmon Farming Handbook* (Blackwell Science, 1989) ISBN 085238158l

Sedgwick S – *Trout Farming Handbook, 6th Edition* (Blackwell Science, 1995) ISBN 0852382324

Shepherd C and Bromage N – *Intensive Fish Farming* (Blackwell Science, 1992) ISBN 063203467X

Stickney R – *Aquaculture: An Introductory Text* (CABI Publishing, 2005) ISBN 0851990819

Wedemeyer G – *Fish Hatchery Management, 2nd Edition* (CABI Publishing, 2002) ISBN 0851996272

Willoughby S – *Manual of Salmonid Farming* (Blackwell Science, 1999) ISBN 0852382456

Journals and magazines

Aquaculture journal

Fish Farmer magazine

Fish Farming International magazine

Websites

www.britishtrout.co.uk	British Trout Association
www.cefas.co.uk	Centre for Environment, Fisheries, Agricultural Science
www.defra.gov.uk	Department for Environment, Food and Rural Repairs
www.environment-agency.gov.uk	Environment Agency
www.hse.gov.uk	Health and Safety Executive
www.lantra.co.uk	Sector Skills Council for the Environmental and Land-based Industries
www.scotland.gov.uk	The Scottish Governement
www.thecrownestate.co.uk	The Crown Estate

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Creative thinkers	illustrating how biological requirements relate to the main production processes in farms
Reflective learners	recommending improvements to salmonid hatchery operations recommending improvements to salmonid on-growing operations
Team workers	planning and carrying out salmonid hatchery operations planning and carrying out salmonid on-growing operations.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	explaining the biological implications for a named salmonid of moving between fresh and salt water
Reflective learners	discussing the advantages and disadvantages of commonly used farming systems for salmonids in relation to the biological requirements of a selected species
Self-managers	planning and carrying out salmonid hatchery operations planning and carrying out salmonid on-growing operations.
Effective participators	recommending improvements to salmonid hatchery operations recommending improvements to salmonid on-growing operations.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	identifying biological requirements of the main farmed salmonid species
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	explaining the biological implications for a named salmonid of moving between fresh and salt water
ICT – Develop, present and communicate information	
Present information in ways that are fit for purpose and audience	describing the methods of egg production for a named salmonid
Mathematics	
Select and apply a range of skills to find solutions	recommending improvements to salmonid feeding operations in relation to ration and food conversion rate calculations
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing improvements to salmonid on-growing or hatchery operations
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	explaining the biological implications for a named salmonid of moving between fresh and salt water.