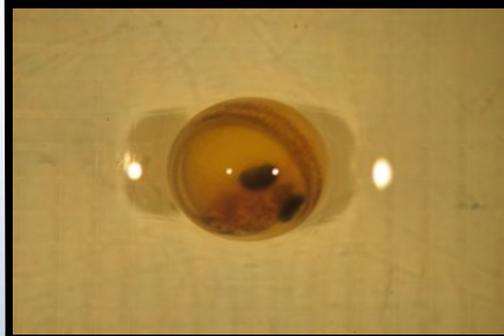


Chapter II: Fish Health & Welfare



THE FARMED SALMONID HEALTH HANDBOOK

CHAPTER II: FISH HEALTH & WELFARE



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CONTENTS

2.1 VETERINARY HEALTH PLAN.....	6
2.2 RECORD KEEPING.....	6
2.3 STOCK OBSERVATIONS.....	7
2.4 SINGLE BAY MANAGEMENT.....	9
2.5 ROUTINE FISH SAMPLING.....	9
2.5.1 Assessing Sea Lice Levels On Marine Farms.....	10
2.5.2 Assessing Gills For Amoebic Gill Disease.....	11
2.5.3 General Health Screening.....	12
2.5.4 Monthly Sample Weights.....	14
2.6 NOTIFIABLE DISEASES.....	16
2.7 DISEASE OUTBREAK.....	16
2.8 NATIONAL SEA LICE MONITORING.....	18
2.8.1 Monitoring & Control Strategy.....	19
2.8.2 Trigger Levels For Treatment.....	20
2.8.3 Synchronous Sea Lice Treatment.....	20
2.9 TRAINING.....	20

Fish Health & Welfare

Over the last number of years the concept of fish health and welfare has been addressed at European level. The European Commission has identified the promotion of animal health and welfare standards as one of the main objectives for the future sustainable development of European aquaculture¹. EU Directives 98/58/EC and 2006/88/EC reflect this increased awareness of farmed fish health and welfare. In 2005 the *Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes* adopted specific recommendations concerning farmed fish and in 2008 the World Organisation for Animal Health (OIE) adopted guiding principles for fish welfare². Furthermore, the European Food Safety Authority has produced specific documents on the welfare of rainbow trout³ and Atlantic salmon⁴.

Good management and husbandry practices are essential for the health and welfare of farmed fish. Key features of good management and husbandry include:

1. Careful site selection.
2. Monitoring of the environment to ensure optimum conditions.
3. Clear delegation of responsibilities.
4. Provision for the training and broadening of the skills of the workforce.
5. Careful stock selection and planned breeding programmes.
6. Effective record keeping.
7. Good hygiene practices.
8. Regular observation of the stock.
9. Regular veterinary inspection of the stock.
10. Regular biomass assessment of the stock.
11. Minimal disturbance of the stock.
12. Forward planning of all harvesting and grading programmes.
13. It is the responsibility of the manager to ensure that good husbandry practices are observed.

Fish must be protected from injury and disease through good management and husbandry practice and by rapid detection and treatment of disease. All fish farmers should develop a *Veterinary Health Plan* (see Section 2.1) in consultation with a designated fish veterinarian.

¹ EC, 2009. Building a sustainable future for aquaculture: a new impetus for the strategy for the sustainable development of European aquaculture. Commission of the European Communities COM (2009) 162 final, 12 pp.

² OIE, 2009. Aquatic Animal Health Code, 12th edition.

³ EFSA, 2008. Animal welfare aspects of husbandry systems for farmed trout. EFSA Journal 796, 1-22.

⁴ EFSA, 2008. Animal welfare aspects of husbandry systems for farmed Atlantic salmon. EFSA Journal 736, 1-31.

The attitudes and competence of staff are a vital factor determining whether high standards of fish health and welfare can be achieved. It is the responsibility of management to ensure that there is a strong awareness of health and welfare issues among staff. It is essential that the staff are suitably trained and are able to recognise indicators of poor health and welfare at an early stage.

All relevant legislation regarding notifiable diseases must be understood and adhered to. All staff must be familiar with normal fish behaviour and appearance and the stock must be routinely monitored for signs of disease. Changes in physical appearance (scale loss, parasites, injury, deformities), changes in general behaviour (swimming and shoaling behaviour, increased respiration, jumping) or changes in feeding response must be recorded and reported to management. Mortalities should be recorded for each unit and any increase should be investigated by a qualified fish health professional.

Important areas for good fish health and welfare include stocking only healthy fish (including cleaner fish), separation of different generations, appropriate stocking densities, good water quality, clean nets or tanks and regular veterinary surveillance.

Regular sampling of the stocks is essential and each farm should have a member of staff specifically trained in this area.

Table 1.

Measurement indices of welfare in farmed fish (adapted from Huntingford *et al.*, 2006⁵).

Changes in colour	Darkening of the skin colour is known to be associated with stress and may be used as an indicator of poor welfare.
Ventilation rate	The rate of opercular (gill cover) beats is increased during stress (e.g. low oxygen levels).
Changes in swimming patterns	Abnormal swimming can be used as a sign of poor welfare in fish. These may include excessive activity, lethargic swimming high in the water column, rubbing to dislodge ectoparasites.
Reduced food intake	Feeding patterns of fish are disturbed during and after stressful procedures, therefore an unexpected loss of appetite can be used as a sign of poor welfare.
Reduced growth rates	Growth of fish can be measured and compared with an expected growth curve. Deviations from the expected growth can be indicative of welfare problems.
Bodily injuries	Damage to the body of the fish may be used as a sign of adverse welfare e.g. damage due to predator attacks.
Disease states	Increased incidence of disease can occur due to a combination of environmental and management factors. Levels of both infectious and non-infectious (e.g. cataracts) diseases should be monitored and recorded.
Impaired reproductive performance	Good welfare of valuable broodstock is essential as stress is known to affect the reproductive capacity in fish.

⁵ Huntingford, F. A., Adams, C., Braithwaite, V. A., Kadri, S., Pottinger, T. G., Sandøe, P. & Turnbull, J. F. 2006. Current issues in fish welfare. *Journal of Fish Biology* **68**, 332-372.

2.1 Veterinary Health Plan

The objective of a *Veterinary Health Plan* (VHP) is to provide a documented outline to assist in the maintenance of a high health status and high welfare standards for cultured salmonids grown in Irish waters. The outline presented in this handbook could form the basis for a site specific VHP that must be developed for each farm in consultation with their veterinary surgeon.

The VHP must be applied by the management and staff of the operation who are responsible for keeping the health status of the fish at an adequate standard. This includes both general operatives on the site and site managers who have to make decisions on fish health. In addition, the VHP should be used during training of site staff.

The VHP is written in conjunction with a designated fish veterinarian and must be frequently updated (at least annually) following regular visits by the veterinarian to the farm. The goals of the VHP are as follows:

1. To prevent and control fish diseases and ensure the maintenance of a high level of fish health and welfare on a particular site.
2. To minimize the environmental impact caused by the aquaculture site.
3. To rear fish in accordance with national and EU regulations, industry guidelines and the current best practices of the industry.

The VHP should cover the following five key areas both in relation to the salmonids stocked on the site and in relation to any cleaner fish which might be used there:

1. General Management & Delegation of Responsibilities.
2. Fish Health Monitoring.
3. Therapeutic Treatments.
4. General Husbandry.
5. Biosecurity.

This handbook will provide useful guidance on the preparation of the site specific VHP.

2.2 Record Keeping

Records should be reviewed on a routine basis by the operator's veterinarian and/or fish health manager to look for epidemiological patterns in fish health and disease. These records must be readily available for inspection by the competent authority or for company audit purposes and all records must be stored for a minimum of five years.

The farm fish health records should include but are not limited to:

1. Inventory records – site name, pen/tank identification, stock type, number and biomass of fish, pen or tank dimensions.
2. Fish movement records – origin, strain, number, transporter details, mode of transport, dates.
3. Mortality records including likely cause of death per farm unit.
4. Harvest records with full traceability from input, treatments and residue certificates.
5. Daily stock observations.
6. Veterinary reports.
7. Medicated feed records.
8. Therapeutant treatment records.
9. Records of mitigative actions (other than therapeutants) taken to prevent or reduce disease, e.g. taking fish off feed due to a plankton bloom.
10. Results of disease surveillance, completed by a veterinary practitioner and by the competent authority (Marine Institute).
11. Disposal and movement of mortalities.
12. Records of water quality parameters tested.
13. Feeding records – feed type, feeding levels, FCR (Feed Conversion Rate).
14. Lice counts (on marine sites).
15. Biosecurity records – a Biosecurity Plan for the site as well as cleaning rotas, chemical logs, visitor records.
16. Training records.

2.3 Stock Observations

Fish must be routinely observed to determine their health status. All staff must be familiar with normal fish behaviour and appearance. Changes in physical appearance (scale loss, parasites, injury, deformities), changes in general behaviour (swimming and shoaling behaviour, increased respiration, jumping) or changes in feeding response must be recorded and reported to management. Removal of mortalities from the holding units should be carried out daily in freshwater and at least twice per week in marine sites. Any significant increase should be investigated by a qualified fish health professional. The cause of death should be classified according to the categories outlined in the *Veterinary Health Plan* and records kept of each mortality recovery.

The fish in each unit should ideally be observed several times per day principally by the feeders. In sea or lake pens, divers should check the fish in each unit at least twice per

week. A trained biologist should observe the fish in each unit at least once per week and a fish veterinarian at least once every two months.

If the appearance or behaviour of a significant number of fish is abnormal the frequency of surveillance should be increased as appropriate and a disease sampling programme should be implemented.

Behavioural changes to look out for include:

1. Altered swim pattern.
2. The presence of moribund fish.
3. Significant numbers of fish pointing into the current.
4. Significant numbers of fish jumping.
5. Reduction in appetite.
6. Increased respiration – gasping.

Changes in appearance to watch out for include:

1. Scale loss.
2. Lesions.
3. High lice levels and lice damage (marine sites).
4. Significant numbers of dark fish.
5. Significant numbers of thin fish.
6. Fin damage.
7. Snout damage.
8. Eye loss.
9. Deformities.
10. Cataracts.
11. Maturation.
12. Furuncles or boils.

The number of mortalities from each unit should be recorded after removal and, if possible, the cause of mortality ascertained using the following categories:

1. Number of runts and good condition fish.
2. Number of marked (lesions) and unmarked fish.
3. Number of feeding and non-feeding fish.
4. Number of fish with predator damage (bird, seal etc.).
5. Number of fish with excessive scale loss.
6. Number of fish with gill damage.
7. Number of fish with deformities and the type of deformities recorded.

8. Number of maturing fish.
9. Number of fish with furuncles or boils.
10. Number of fish with fungal infection.
11. Number of fish with parasite damage and likely cause (e.g. lice, white spot).
12. Other.

2.4 Single Bay Management

Marine farms must operate according to the principles of Single Bay Management a strategy which has been developed to reduce the levels of sea lice (*Lepeophtheirus salmonis*). All farmers within a particular bay must devise a Single Bay Management strategy to coordinate treatments and ensure that lice levels are kept to an absolute minimum. During the months January - May numbers of ovigerous (egg bearing) female lice must be maintained as close to zero as possible on all farmed fish by the use of appropriate treatments (where necessary). Farmers must coordinate treatments, both on farm and between farms, to maximize their effectiveness and minimize lice levels at all times of the year.

2.5 Routine Fish Sampling

Operators must have a plan for routine assessment of fish to determine their disease status and an action plan to prevent the spread of disease. Operators must regularly and systematically sample fish from each unit for signs of disease. If a disease is suspected, sampling levels should be increased.

Routine sampling should include:

1. Marine: Weekly samples from all units to assess sea lice infestation and gill health.
2. Freshwater: Fortnightly health screening from selected batches of fish particularly looking at parasites of the skin and gills.
3. Monthly batch weights of all units.
4. Routine post mortem of freshly dead fish.

Anaesthetising Fish

1. MS-222 (tricaine methane-sulphonate) is the only fish anaesthetic agent licensed for finfish intended for human consumption.
2. It is a white water-soluble powder which is stable when kept cool and dry.

3. A standard stock solution can be prepared by adding freshwater to 100 g of MS-222 to make up a 1 litre solution (10% w/v). Final working concentrations are outlined in Table II below. The stock solution should be stored in a dark bottle as it is sensitive to light.
4. MS-222 solutions are acidic and therefore the pH of the solution needs to be checked prior to use when dissolved in water with low buffering capacity e.g. fresh water. Sodium bicarbonate (250 mg per 100 mg MS-222) is used to buffer the solution.
5. MS-222 is a hypoxic agent, therefore it is best practice for the container used to be constantly aerated.
6. A withdrawal period of 70 degree days is required when MS-222 has been used in fish destined for human consumption or release into the wild.
7. The user should wear protective gloves.

Table II

Suggested dose rates for anaesthetizing fish with MS-222.

SPECIES	SEDATION	LIGHT - HEAVY
Trout	10 – 30 mg/L	30 – 180 mg/L
Salmon	7 – 30 mg/L	30 – 100 mg/L
Carp	20 – 30 mg/L	30 – 200 mg/L
Marine fish	8 – 30 mg/L	30 – 100 mg/L

2.5.1 Assessing sea lice levels on marine farms

On marine farms monitoring of sea lice levels should be conducted by suitably trained staff on a weekly basis, in addition to the national monitoring programme carried out by the Marine Institute (see Section 2.8). Lice counts should be conducted weekly on at least 10 fish from at least one third of the pens on site by a member of staff who has been specifically trained in the methodology and identification of the different stages of lice development. The pens should be sampled in rotation and all pens should be assessed at least once per month. All counts must be recorded and the records retained for at least 5 years. The following methodology should be used:

Ten fish should be sampled from the selected pen and anaesthetised. All the lice from each individual fish should be recorded and categorised into the following stages:

1. Ovigerous (adult female *Lepeophtheirus salmonis* (*Lep.*) with egg strings).
2. Other Adult (adult *Lep.* males plus adult *Lep.* females without egg strings).

3. Sub-adult (small mobile *Lep.*).
4. Attached juveniles (all lice that are at the attached stage).
5. *Caligus elongatus* (adults, including ovigerous are much smaller than *Lep.*).

As part of the control strategy, information from all other farms within an area should be reviewed and a Single Bay Management strategy developed between operators for the control of lice levels within the bay (see Section 2.4).

Staff should receive training on sampling procedures for sea lice from a competent fish health professional.

2.5.2 Assessing gills for Amoebic Gill Disease (Marine)

Amoebic gill disease is a naturally occurring ectoparasitic gill condition of marine fish species particularly Atlantic salmon and rainbow trout. It is caused by the single celled protozoan parasite *Neoparamoeba perurans*. The condition has a very rapid rate of onset and requires a high level of surveillance to ensure that timely treatments can be carried out to control it.

Ten anaesthetised fish should be sampled from each pen at least once per week. During periods of high infestation sampling should take place twice per week. It is essential to check each gill filament on both sides of all the gill arches both on the left and right side of the fish. Any signs of AGD, which consist of raised, white, mucous patches must be recorded for each fish according to the following scale:

0	Clear	Healthy red colour
1	Light, Initial Infection	Single, white, raised mucous patch or undefined necrotic streaks
2	Moderate, Established Infection	2 – 3 raised mucous patches
3	High Infection	Thick mucous patches or groups of spots on 20% of the gill area
4	Very Advanced Infection	Thick mucous patches covering 50% of gill area
5	Very Severe Infection	Thick mucous patches across majority of gill surface

As well as assessing the gill score grossly, it is also essential to carry out microscopic examination to assess the level of amoeba in the affected gills. Using a scalpel a small scrape of material should be taken from a white mucous patch, placed onto a slide with a

drop of seawater and covered with a coverslip. This should be examined using the X10 and X40 microscope objective.

If the weekly gill checks show an increasing prevalence of grade 2 gill scores (or higher) the fish should be treated. The most effective treatment is 3 hour bath in freshwater with salinity <3ppt. The freshwater should consist of soft water low in calcium carbonate. If freshwater is not available the fish should be treated with hydrogen peroxide for 18 – 22 minutes at 1,000 to 1,400 mg/litre. Oxygenation of the water throughout the treatment is essential. Treatment can be carried out within the pen using a fully enclosed tarpaulin or by wellboat. The fish must be checked again immediately following the treatment to ensure that the treatment was successful.

Staff should receive training on sampling procedures for AGD from a competent fish health professional.

Prior to extraction of freshwater from a local source the operator should apply for any relevant permissions.

Please refer to the *Gill Score Guide* developed by CSIRO, Tassal and Marine Harvest ASA, in the Annex.

2.5.3 General health screening

Regular health screening is required to pick up early signs of disease and to allow an effective, rapid response to an emerging problem. In addition to sea lice and AGD monitoring, a fortnightly health screening programme should be devised for each farm. Five fish from at least three units should be screened as follows:

1. Carefully examine each fish for any sign of scale loss, fin damage, lesions, spinal or jaw deformities, cataracts, maturation, lice/parasite damage or injury.
2. Examine the gills for discolouration, erosion or damage. If necessary samples of gill tissue should be examined microscopically.

If necessary the following screening should be carried out:

1. Using the back of a scalpel take a mucous scrape and examine microscopically for skin parasites.
2. In marine farms take a sample of blood for PD (Pancreas Disease) virus and antibody screening. Using a syringe take the blood from the caudal vein and

transfer to a centrifuge tube. Spin the blood and pipette off the serum and transfer to an eppendorf tube and freeze.

3. Examine the internal organs. Check for signs of heart deformity, internal adhesions, abnormal colouration of the organs, blood spots, bloody fluid, abnormal swellings.
4. Place samples of the following tissues (<1cm³) in a pot containing saline buffered formalin (one pot per fish) for histological processing: gills, heart (whole), liver, pyloric caecae, spleen, kidney, muscle (at lateral line below dorsal fin), brain. Ensure a 1:10 ratio of organs: buffered formalin.
5. If necessary take bacterial swabs of suspect tissue.
6. Histology, blood samples and bacterial swabs should be sent to a laboratory as soon as possible and analysed by a trained fish pathologist.

Under Directive 2006/88/EC and SI No. 261 of 2008 site inspections are carried out by the Fish Health Unit of the Marine Institute in accordance with the risk categorisation of the individual site:

1. High Surveillance: 1 visit per year from private services (Active Surveillance) and 1 visit/year by Marine Institute (Active Surveillance & Compliance).
2. Medium Surveillance: 1 visit per year alternating between the private services (Active Surveillance) and the Marine Institute (Active Surveillance & Compliance).
3. Low Surveillance: 1 visit every 2 years alternating between the private services (Active Surveillance) and the Marine Institute (Active Surveillance & Compliance).

The risk category for each farm is determined according to the following criteria:

High Surveillance Level

1. Sites importing live fish and ova (including "open" ornamental facilities).
2. Broodstock sites producing for themselves and others.
3. Sites producing stock for on-growing elsewhere within the country or abroad.
4. Marine sites (except those with protected water).
5. Aquaculture facilities with on-site processing units which process fish from other sites.
6. Quarantine facilities.

Medium Surveillance Level

1. Broodstock sites producing only for themselves.
2. Freshwater sites producing fish for human consumption, including those processing solely their own fish.
3. Sites producing fish for ranching purposes (i.e. those releasing fish back into the system from which the broodstock came).

Low Surveillance Level

1. Put & Take Fisheries.
2. Ornamental commercial aquaria.
3. Sites holding non-susceptible species.
4. Recirculation systems.

2.5.4 Monthly sample weights

Monthly sample weights of livestock in all units are essential for tracking performance and assessing overall health. It allows a large number of fish from each unit to be carefully examined. Any emerging problems will be picked up early, allowing rapid corrective action.

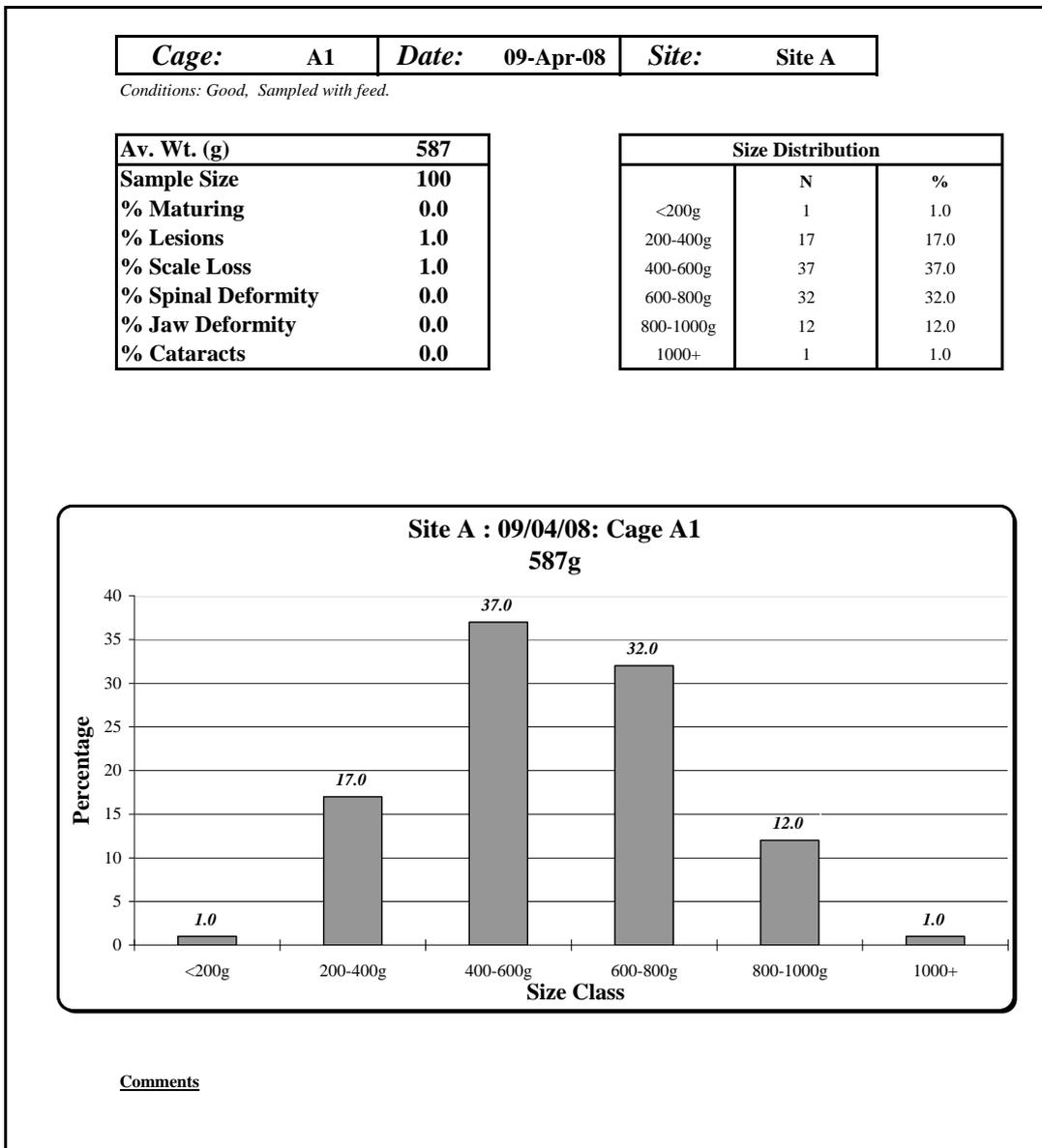
A large sample of 50 – 100 fish should be randomly selected, preferably using a seine or box net, and anaesthetised in manageable batches. All fish must be weighed on accurate, calibrated scales. Smaller fish (<100g) should be weighed in batches and larger fish (>100g) should be individually weighed. Each fish should then be examined for the following:

1. Lesions.
2. Presence of external parasites (e.g. lice on marine fish, white spot on freshwater fish).
3. Fin damage.
4. Snout damage.
5. Eye loss.
6. Deformities.
7. Cataracts.
8. Maturation.
9. Scale loss.

Data from each unit should be compiled and a report produced.

Table III.

An example of a sample weight data sheet.



2.6 Notifiable Diseases

Under Directive 2006/88/EC and SI No. 261 of 2008, certain diseases are listed as *notifiable*. If a notifiable disease is found or suspected then it must immediately be reported to the Marine Institute. These diseases are categorised as follows:

Exotic: These are diseases which are not present in the European Community, but would have serious economic or ecological consequences if they were to appear. They must be eradicated if they are detected anywhere within the European Community. Included in this category is **Epizootic Haematopoietic Necrosis (EHN)**, a disease of perch and rainbow trout.

Non-Exotic: These are diseases which are present within the European Community, but which are confined to certain geographical areas, where they result in serious economic consequences. If a non-exotic disease is detected in Ireland, the Marine Institute, with the assistance of the National Risk Assessment Committee, will decide whether or not immediate eradication is required. Included in this category are the diseases **Infectious Salmon Anaemia** (ISA, salmon and rainbow trout), **Viral Haemorrhagic Septicaemia** (VHS, rainbow trout, cod, turbot and more recently detected in wrasse and lumpfish), **Infectious Haematopoietic Necrosis** (IHN, trout and salmon) and **Koi Herpesvirus Disease** (KHVD, carp).

National Measures: Article 43 of the Directive covers diseases which are not specifically listed there. They are significant diseases which are widespread in certain parts of the European Community, but are absent from other parts. These diseases can cause significant economic losses at a local level. Ireland currently controls **Bacterial Kidney Disease** (BKD, salmon and trout), **Gyrodactylus salaris** (salmon and trout) and **Spring Viraemia of Carp** (Cyprinids) under this measure. If any of these diseases appears in Ireland, the Marine Institute, with the assistance of the National Risk Assessment Committee, will decide whether or not immediate eradication is required.

2.7 Disease Outbreak

It is a statutory requirement that any person who suspects or has had confirmation of the presence of a notifiable disease on a site, must contact The Fish Health Unit of the Marine Institute (Fax: 091 387201, email: notification@marine.ie).

Where increased mortality is observed the veterinary practitioner retained by the company must be contacted in the first instance. Where the cause of the mortality remains unresolved following veterinary consultation, the Marine Institute must be contacted.

It should be noted that "*increased mortality*" is defined as "*that which is unexplained and significantly above the level of what is considered to be normal for the site under the prevailing conditions*".

On marine salmonid sites, where mortality levels exceed

- 1.5% per week over the whole site where fish are <750g or
- 1% per week over the whole site where fish are >750g

A report must be made to the Marine Institute by logging onto www.marine.ie/fishhealth

Once an outbreak is recognized, all fish on site and fish on nearby sites that are epidemiologically linked to the affected fish, must be subject to an intensified monitoring and sampling program. The exact nature of the program should be designed in consultation with a veterinarian, or in the case of a notifiable disease with the Marine Institute.

In the case of a serious outbreak of a non-notifiable disease the following actions should be taken:

(a) Review fish health records of all stocks on site, affected and unaffected, including:

1. Input Dates.
2. Input Sizes.
3. Origins.
4. Strains.
5. Vaccinations.
6. Treatments.
7. Results of previous health screenings.
8. Water quality results.
9. Feed history.
10. Feed analysis results.
11. Mortality rates since input.

- (b) At the veterinarians recommendation the site may be quarantined. This action may be enforced based on clinical suspicion and may occur before definitive disease diagnosis.

- (c) A well designed disease sampling program should be implemented.
 - 1. At least 5 fish sampled from all discrete batches on site.
 - 2. Samples taken of healthy and affected fish to establish disease progress.
 - 3. Samples taken each week if necessary.
 - 4. Samples analysed for bacteriology, histology and virology.
 - 5. Mortalities carefully post-mortemed.

- (d) Mortality removal should be carried out daily if possible. Mortalities should be stored in a secure manner and removed for rendering without delay.
- (e) Strict adherence to biosecurity and disinfection protocols in place on the farm is essential.
- (f) Disinfection procedures should be intensified.
- (g) Fish movement or handling must be stopped.
- (h) Visitors must not be permitted on site except where absolutely necessary.
- (i) Separate equipment and gear must be designated for the affected site/unit.
- (j) Therapeutic treatments or management procedures must be initiated where possible to ameliorate the outbreak.
- (k) Water and feed samples may be necessary to compliment the investigation into the aetiology of the problem.
- (l) Neighbouring farms should be notified as part of the Single Bay Management agreement.
- (m) For notifiable diseases, the provisions of SI No. 261 of 2008 must be followed, under the supervision of the Marine Institute.
- (n) A log of mortalities and unusual behaviour must be maintained throughout the outbreak. These records must be kept for at least 5 years.

2.8 National Sea Lice Monitoring

The ecto-parasitic sea louse, a tiny crustacean, is an economically significant pest of the marine farmed salmon industry worldwide. In Ireland a mandatory national sea lice monitoring and control regime, which features so-called 'treatment-trigger-levels', has been put in place, which aims to keep the level of infestation on marine salmon and trout farms as low as possible.

The control of sea lice has been afforded a high priority by the State since 1991 and Irish marine salmon and trout farms are the subject of a rigorous and transparent inspection regime carried out by the Marine Institute on behalf of the Government⁶. This monitoring programme is backed up by mandatory licensing requirements imposed on marine finfish farmers through a protocol on management and control. In May 2008, the Department of Agriculture, Fisheries and Food published *A strategy for improved pest control on Irish salmon farms*, outlining a new National Sea Lice Monitoring Plan for the control of sea lice in Ireland⁷.

The purposes of the National Sea Lice Monitoring Plan are:

- To provide an objective measurement of infestation levels on farms.
- To investigate the nature of the infestations.
- To provide information to drive implementation of the control and management strategies.
- To facilitate further development and refinement of the control and management strategies.

2.8.1 Monitoring & control strategy

The sea lice monitoring and control strategy has five principal components:

- Separation of generations.
- Annual fallowing of sites and, if possible, synchronous fallowing in bays with multiple sites.
- Early harvest of two sea-winter fish.
- Targeted treatment regimes, including synchronous treatments.
- Agreed husbandry practices.

Together, these components work to reduce the development of infestations and to ensure the most effective treatment of developing infestations. They minimize lice levels whilst controlling reliance on, and reducing use of, veterinary medicines. The separation of generations and annual fallowing prevent the vertical transmission of infestations from one generation to the next, thus retarding the development of infestations. The early harvest of two sea winter fish removes a potential reservoir of lice infestation and the agreed practices and targeted treatments enhance the efficacy of treatment regimes. One important aspect of targeted treatments is the carrying out of autumn / winter treatments to reduce lice burdens to as close to zero as practicable on all fish, which are

⁶ DMNR, 2000. *Monitoring protocol for offshore finfish farms – sea lice monitoring and control*.

⁷ DAFF, 2008. *A strategy for improved pest control on Irish salmon farms*.

to be over-wintered. This is fundamental to achieving zero / near zero egg bearing lice in spring. The agreed husbandry practices cover a range of related fish health, quality and environmental issues in addition to those specifically related to lice control.

2.8.2 Trigger levels for treatment

Treatment triggers during the spring period (March to May) are set close to zero (0.5 egg bearing females per fish). Timing of treatments is also informed by the numbers of mobile lice on the fish. Where numbers of mobile lice are high, treatments are triggered even in the absence of egg bearing females. Outside of the critical spring period, a level of 2.0 egg bearing lice per fish acts as a trigger for treatments. This is only relaxed where fish are under harvest or with the agreement with the Department of Agriculture, Food and the Marine (DAFM) or its agent, the Marine Institute.

2.8.3 Synchronous sea lice treatment

Sea lice management is dependent on the availability of adequate sites and the separation of generations. All fish farms operating in a particular bay undertake appropriate synchronous sea lice treatment and control strategies through the Single Bay Management/CLAMS (Coordinated Local Aquaculture Management System) process. Close co-operation between the industry and government is essential to maximise the benefits of strategic sea lice management.

2.9 Training

All farm staff should receive introductory training in fish health and welfare. All staff should stay informed of emerging fish health and welfare issues and should be encouraged to attend fish health meetings and workshops. Records of all training should be kept.