



Project no. SSPE-CT-2003-502329

PANDA

**Permanent network to strengthen expertise on infectious diseases of
aquaculture species and scientific advice to EU policy (PANDA)**

Coordination Action

Scientific support to policies

Deliverable 11

**Report on knowledge gaps, training needs and strategies for increasing
opportunities in aquatic animal health.**

Due date of deliverable: Month 30
Actual submission date: Month 44

Start date of project:01/01/04

Duration:44 months

Dr Maura Hiney
National University of Ireland, Galway
Ireland

Revision [1.0]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	RE
CO	Confidential, only for members of the consortium (including the Commission Services)	

CONTENTS

1	<i>Executive Summary</i>	3
2	<i>Introduction</i>	3
2.1	Constraints for development of aquaculture	4
2.2	Objectives of deliverable	4
2.3	Focus areas and key tasks	4
3	<i>Methods</i>	5
3.1	Task Force activity	5
3.2	Survey methodology	6
4	<i>Results</i>	7
4.1	Training uptake, provision and needs	7
4.1.1	Survey objectives	7
4.1.2	Demographic information	7
4.1.3	Organisation type/occupation of respondents	8
4.1.4	Training uptake	9
4.1.5	Geographic influences on training consumption	11
4.1.6	Reasons for not participating in training	11
4.1.7	Type of training undertaken	12
4.1.8	Training duration and type	13
4.1.9	Training providers	14
4.1.10	Sources of training information	15
4.1.11	Training Needs	16
4.1.12	Facilitation of training opportunities	18
4.1.13	EC involvement in training policy and provision	18
4.2	Training needs identified by PANDA work packages	20
4.2.1	Work package 2	20
4.2.2	Work package 3	20
4.2.3	Work package 4	20
4.2.4	Work package 5	21
5	<i>Conclusions</i>	22
6	<i>Recommendations</i>	23
6.1	Specific training needs identified	23
6.2	Improvements in the provision of training	23
6.3	Harmonisation of the skills base across Europe	24
6.4	Overall conclusions	24
7	<i>References</i>	25

1 **Executive Summary**

The overall objectives of this deliverable were to identify current training deficits in aquatic animal disease research and diagnosis, including the specific training needs identified by other work packages, and to provide recommendations for future training provisions within the EU and candidate states to raise the skill base, and thus the standard of practice in aquatic animal disease research and diagnosis. The three focus areas of training were: test methods (disease diagnosis, validation, QA), epidemiology/risk analysis and environmentally friendly disease control measures.

In furtherance of these objectives, a survey on training needs and participation among aquatic animal health professionals was carried out over 2005/06. The focus of the survey was training in disease diagnosis, method validation and quality assurance, epidemiology, risk analysis and environmentally sustainable practices. The survey objectives were to:

- identify current uptake of training opportunities
- identify primary stakeholders
- identify primary delivery methods for training
- seek stakeholder experience on utility of, and access to, training (both for themselves and other stakeholder groups)
- seek stakeholder experience on current training deficits
- seek stakeholder opinion on best methods of training delivery.

The survey was primarily distributed in Europe and responses were received, in order of number, from researchers and regulatory personnel, aquaculture and allied services companies and professional associations.

Analysis of the data revealed that in terms of training participation, over 65% of responders had participated in training within the previous 6 months and this training consisted predominantly of short courses or conferences. However, 20% of responders had not participated in training in the previous 3 or more years, with time and money being the major reasons cited for non-participation. Occupation and location in Europe would also appear to have an impact on frequency of training and on the type of training undertaken. Responders own organisations played a key role in training provision, while International training bodies were an important applied training provider. Universities did not play an important role in training.

In terms of training needs, newer diagnostic methods for bacterial and viral diseases were the principle training needs identified. Epidemiology and risk analysis were also identified as training needs that are not been fulfilled at the moment. The majority of responders felt that the EU should have more involvement in training provision and formulation of policy around training. A fuller analysis of the data, along with input on training needs identified by other work package coordinators confirmed the preliminary findings.

2 **Introduction**

Aquaculture is the fastest growing food production system of the last decade, accounting for a quarter of total world food fish landings and 27% of shrimp product. Nine out of every 10 oysters, Atlantic salmon and cyprinids consumed are farmed. With a growing human

population (and consequent demand for protein sources) but declining usable land mass and a decline in populations of wild fish, aquaculture is now expanding to the cultivation of new fish species. Such species include some *Gadidae* (cod, haddock, hake etc), flatfish (turbot, flounder, halibut, sole etc), hybrid striped bass, seabass and other Mediterranean species, wolfishes, lumpfishes and tuna.

2.1 Constraints for development of aquaculture

One of the key constraints to the development and sustainability of European aquaculture is infectious disease, both in terms of direct losses, but also indirectly as trade restrictions to prevent their spread within the EU (Hiney et al., 2002). Policies and regulations on disease control and prevention should be based on best scientific information and advice. Control of diseases in the form of disinfectants and antimicrobials is of increasing concern in terms of the environment and the development of resistant pathogens. Several Member States have improved their national capability to prevent or manage disease situations through enhanced laboratory facilities, diagnostic expertise, control protocols, and therapeutic strategies. The two Community Reference Laboratories, for fish and mollusc diseases respectively, and their corresponding networks of National Reference Laboratories support the improvement and harmonisation of standards in national diagnostic laboratories. However, there is still considerable scope for improved harmonisation of skills and for de-fragmentation of relevant knowledge within the EU and elsewhere in Europe, not only in National Reference Laboratories, but also in other research institutes and laboratories engaged in aspects of aquatic animal health management.

2.2 Objectives of deliverable

In order to ensure that any policy and legislation formulated by the EU reflects the best current understanding of aquatic animal diseases and their control, there is a need to ensure that the level and availability of training across the EU is fit-for-purpose, harmonised and can serve the changing aquaculture landscape. The deliverable described in this report set out to explore the state-of-the-art in terms of training provision, type and needs. From these activities a set of recommendations have emerged on how best to manage the practical deficits identified. The overall objectives of this project were to:

- identify current training participation and needs in aquatic animal disease research and diagnosis, including the specific training needs identified in other work packages being carried out within the overall PANDA project
- to provide recommendations for future training provisions within the EU and candidate states to raise the skill base, and thus the standard of practice in aquatic animal disease research and diagnosis.

2.3 Focus areas and key tasks

Reflecting the concerns of the PANDA project as a whole, the focus areas for this work package were:

1. Test methods (disease diagnosis, validation, QA)
2. Epidemiology and risk analysis
3. Environmentally friendly disease control measures

Therefore, the key tasks undertaken by Deliverable 11 were:

1. Identify current training participation across the spectrum of aquatic animal health management in the EU
2. Identify current training needs across the spectrum of aquatic animal health management in the EU
3. Formulate recommendations based on 1 and 2 above.

3 **Methods**

3.1 **Task Force activity**

A Task force of training experts from universities, institutes, specialist laboratories and agencies was established to assist in this Deliverable.

The Taskforce members were:

- Dr. Sandra Adams, University of Stirling, Scotland
University of Stirling have been running post-graduate courses in aquaculture for many years, and also offer tailor-made courses for industry and academic personnel on request.
- Dr. David Murphy, AquaTT, Ireland
AquaTT provide training and information at all levels of the industry, but in particular for fish-farm operatives, managers and biologists.
- Dr. Hervé LeBris, University of Nantes, France
University of Nantes provides further training for veterinarians in fish pathology and aquaculture related health issues.
- Dr. Bernado Basurco, CIHEAM, University of Zaragoza, Spain
CIHEAM have been involved in professional training of aquaculture personnel, agency personnel and regulatory personnel for many years.

The Taskforce met in Dublin, Ireland on 27th August 2004. Unfortunately, Dr. Basurco was unable to attend the meeting. The objective of the meeting was to appraise the taskforce members about PANDA and its overall objectives and to define the scope and activities of WP 6. The WP Coordinator achieved this through a briefing document and presentation. The Taskforce examined ways in which D11 could gather the information necessary to map the state-of-the-art in terms of training provision and participation and inform recommendations to the EC in these areas.

Taskforce members were invited to attend the 1st PANDA Workshop in CIDC-Lelystad from 5/4/06-8/4/08 and to contribute their expertise. Dr. Alexandra Adams initially agreed to attend but was unable to do so. Dr. David Murphy was in attendance at the Workshop and provided invaluable input into the interpretation of data generated by the Training Needs survey carried out in December 2005.

During 2006, the Taskforce were kept informed by email of developments in Workpackage 6 and contributed advice and assistance with interpretation of the data generated by D11.

With the agreement of the coordinator, an additional Task Force member, Dr. Kurt Buchmann (Leader of the Research School SCOFDA at KVL, Denmark) was invited to participate in WP6 in 2006. Dr. Buchmann, who is the coordinator of the Joint Nordic Programme in Aquaculture and Freshwater Fisheries Management (NOVA), has extensive experience in

structuring distance-learning and modular training programmes in aquatic animal health across the Nordic countries. The WP Coordinator held a meeting with Dr. Buchmann in Copenhagen on 10th October 2006 at which they examined the applicability of the NOVA to other European areas, the organisational management issues of such distance learning approaches and the required capabilities of the participating organisations..

The Taskforce were invited to participate in the final PANDA Workshop of all Taskforces and Workpackage Coordinators being held on the 18-21 March 2006 in CEFAS Weymouth, the UK. None of the Task Force was in a position to attend this meeting. With the agreement of the PANDA coordinator, Dr. Kantham Papanna was invited to participate in this workshop and to contribute his knowledge and experience of aquatic animal health training from an industry perspective.

3.2 Survey methodology

A survey on training needs and participation among aquatic animal health professionals was carried out over 2005/06. The focus of the survey was training in disease diagnosis, method validation and quality assurance, epidemiology, risk analysis and environmentally sustainable practices. The survey took the form of a comprehensive on-line questionnaire covering:

- Levels of participation in training
- Types of training undertaken
- Delivery methods for that training
- Training providers
- Identified training needs
- Availability of opportunities to fill those needs
- Facilitation of training acquisition

The survey was initially piloted among all PANDA work package coordinators in March/April 2005. The revised survey was piloted with a group of 14 scientists from the European National Reference Laboratory. Following this pilot, sections of the questionnaire were revised to reflect the feedback of the pilot groups regarding ease of use, duplication, appropriateness of questions etc. In order to achieve a wide distribution of the questionnaire among a variety of stakeholders (scientists, regulators, practitioners, fisheries biologists etc), a web-based survey tool (WebSurveyor) was evaluated in September/October 2005 with the key evaluation criteria being; ease of use and ease of data input, handling, extraction and analysis. In particular, ease of use was considered critical to achieving a good response rate, and where possible drop-down lists, tick boxes etc were used. A temporary software licence for this tool was purchased in early November 2005.

An email distribution list was constructed from a number of electronic and paper-based sources (EAFP Members Handbook, Panda subscribers mailing list, Coordinators personal list, AquaTT distribution list, Stirling Institute of Aquaculture distribution list and the mailing lists of the Regional Reference Laboratories for both fish and shellfish diseases). Email addresses from the USA, Canada, South America, Asia and Australia were omitted, because this survey was intended to look at the European situation. From these distributions lists, approximately 4000 people received the survey. Valid responses were considered to be those that completed 10 or more of the 20 questions posed.

4 Results

4.1 Training uptake, provision and needs

4.1.1 Survey objectives

The focus of the topics evaluated in the survey undertaken by D 11 was training in disease diagnosis, method validation and quality assurance, epidemiology, risk analysis and environmentally sustainable practices. The survey objectives were to:

- identify current uptake of training opportunities
- identify primary delivery methods for training
- seek stakeholder experience on utility of, and access to, training (both for themselves and other stakeholder groups)
- seek stakeholder experience on current training deficits
- seek stakeholder opinion on best methods of training delivery

There were a total of 281 respondents to the survey, from all over Europe. It is estimated that, taking duplicate postings into account, this represents a response rate of approx 12.5%, which is lower than would be expected for a survey of this type. Valid responses were those that completed 10 or more of the 30 questions posed.

4.1.2 Demographic information

While efforts were made to confine the recipients of this survey to the European area, there were some worldwide responses (Figure 1), although as anticipated, 74% of respondents were European as follows:

- Western Europe – 40%
- Southern Europe – 30%
- Northern Europe – 22%
- Eastern Europe – 7%

For the purposes of data analysis, Europe was divided into 4 geographical, as opposed to political regions, these being Northern, Western, Eastern and Southern Europe. The response rate from the countries within each country block is shown in Table 3.

Figure 1: Respondents by Continent

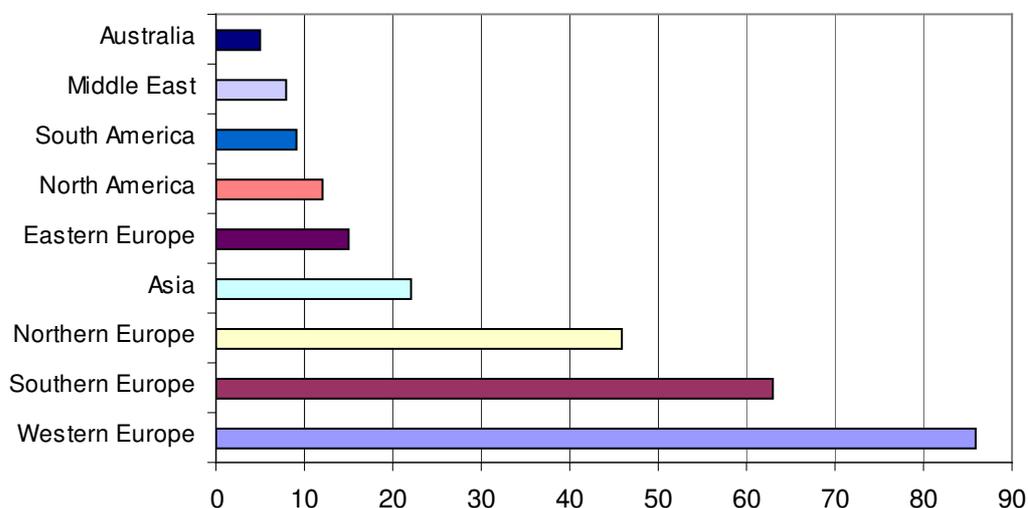


Table 3: Respondents by European Country

Country Block	Country	No. of Valid Responses
Southern Europe	Malta	1
	Turkey	3
	Portugal	8
	Greece	8
	Italy	11
	Spain	32
Northern Europe	Sweden	1
	Iceland	4
	Finland	10
	Denmark	13
	Norway	18
Western Europe	Switzerland	2
	Austria	3
	Belgium	4
	Netherlands	5
	Germany	9
	France	11
	Ireland	14
	UK	38
Eastern Europe	Poland	1
	Croatia	1
	Czech Republic	1
	Estonia	1
	Hungary	1
	Russia	1
	Slovakia	1
	Lithuania	2
	Romania	3
Slovenia	3	

4.1.3 Organisation type/occupation of respondents

Responses were received, in order of number, from researchers and regulatory personnel, aquaculture and allied services companies and professional associations (Figure 2). In light of the distribution lists employed, it was not surprising that the majority of respondents worked in universities, research institutions, fisheries research services and government laboratories, while a smaller number worked with aquaculture companies or professional associations.

In terms of occupation, there was a representative spread of the occupations associated with fish health management (Figure 3). The majority of respondents identified themselves as scientists, veterinarians, graduate students, government agency and regulatory personnel, while there were a smaller number of laboratory and aquaculture technicians, field biologists, fish farmers and specialist consultants.

Figure 2: Organisation type of respondents

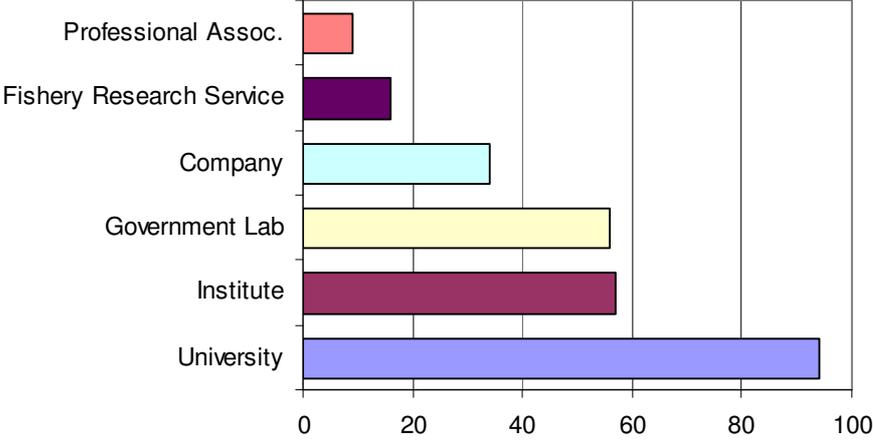
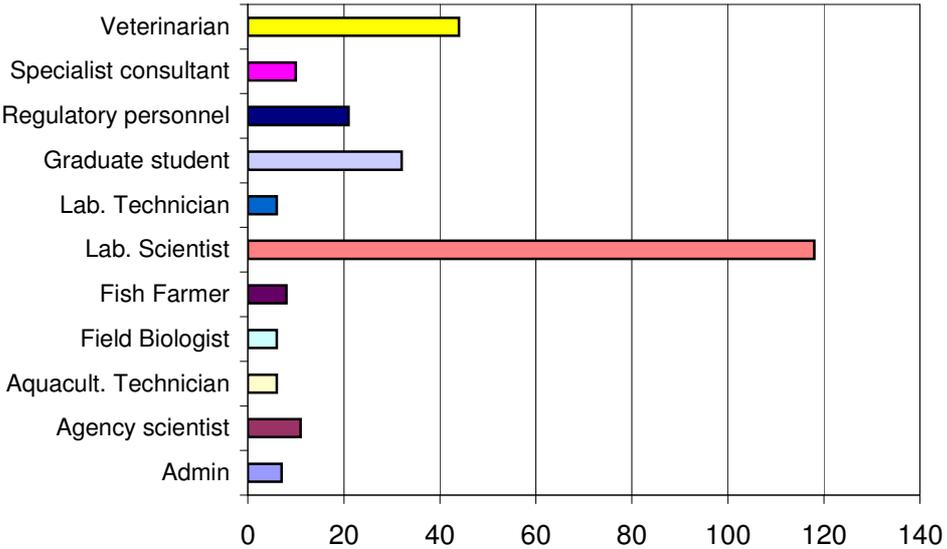


Figure 3: Occupation type of respondents



4.1.4 Training uptake

Over 65% of responders had participated in training in the previous last year, with the majority (2/3) having done so within the previous 6 months. However, 20% of respondents had not participated in training within 3 or more years of completing the survey (Figure 4). Technical staff and fish farmers were less likely to have participated in training in the previous 2 years while administrators, agency scientists, field biologists, graduate students and veterinarians were most likely to have participated in training in the previous two years (Figure 5 & 6). Interestingly, 43% of respondents who described themselves as regulatory personnel had not participated in any kind of training in the previous 3 years. Respondents were also less likely to have participated in training in the previous 3 years if they were located in Eastern Europe countries (Figure 7).

Figure 4: Indication of the last time respondents undertook training

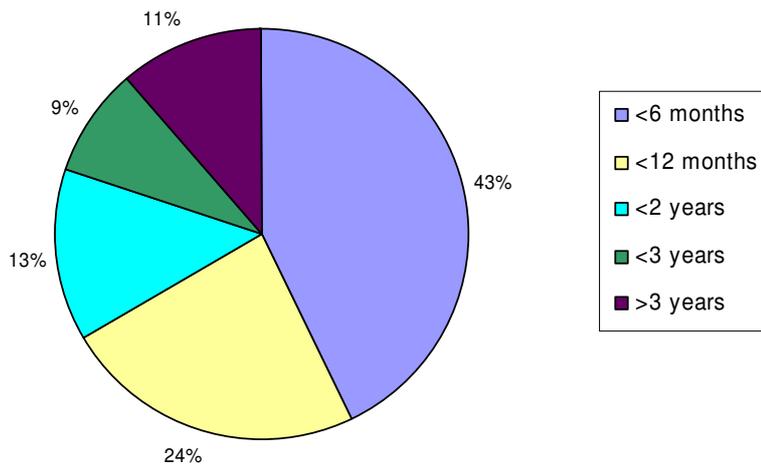


Figure 5: Training Frequency by occupation (%)

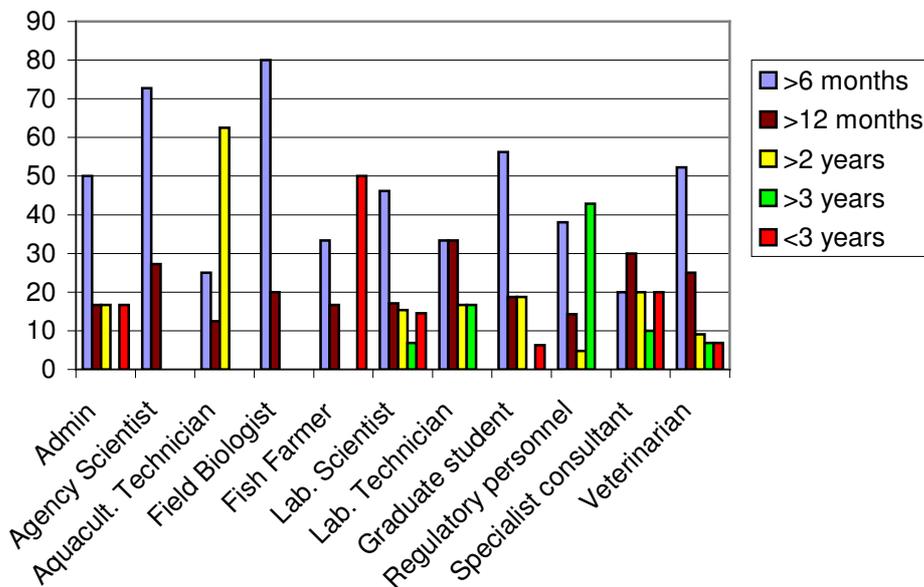
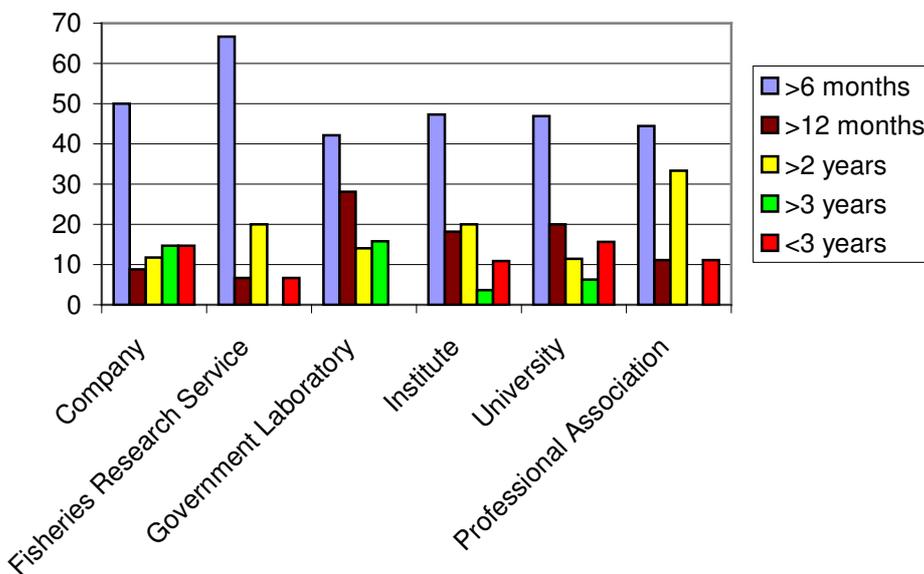


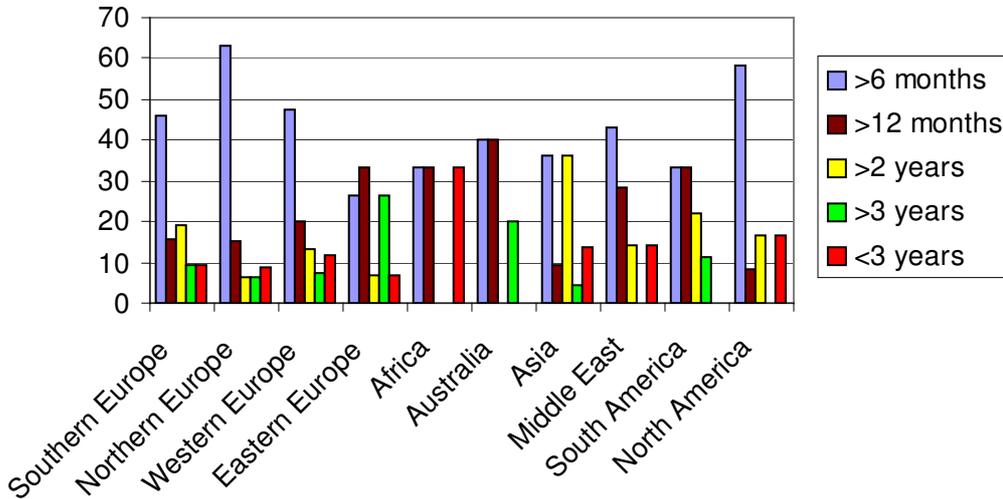
Figure 6: Training frequency by organisation type (%)



4.1.5 Geographic influences on training consumption

The survey indicated that there may be geographic influences on the frequency of participation in training, in that the highest level of participation was reported by respondents from Northern Europe, followed by Western Europe, while the lowest level of participation was reported by respondents in Eastern Europe followed by Southern Europe

Figure 7: Training frequency by country block (%)



4.1.6 Reasons for not participating in training

Figure 8 details the reasons respondents gave for not participating in training. Time and money were the major reasons cited, although lack of information or the unavailability of suitable courses was also considered important impediments to training. Lack of funding and the difficulties this posed in travelling outside their area were key impediments to training identified by respondents in Southern European countries, while lack of time was considered a greater impediment to training in Western Europe (Table 4).

Figure 8: Reasons give for not participating in training

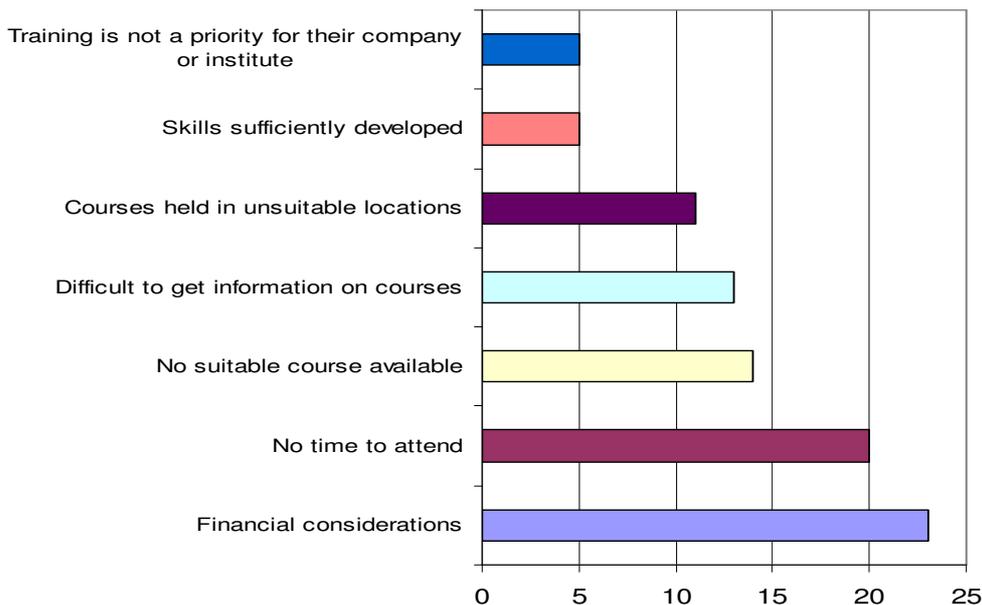


Table 4: Reasons for not participating in training – country comparisons

Reason	% Occurrence			
	Western Europe	Northern Europe	Southern Europe	Eastern Europe
Financial considerations	17	13	61	
No time to attend	40	30	30	
No suitable course available	43	21	36	
Difficult to get information on courses	31	15	38	15
Courses held in unsuitable locations	36	9	55	
Skills sufficiently developed	60	20	20	
Training is not a priority for their company or institute	80		20	

4.1.7 *Type of training undertaken*

The type of training undertaken included disease diagnostic methods (laboratory and field), general laboratory methods, specific courses in aquatic animal health and to a lesser extend laboratory and field QA, and regulatory control (Figure 9). The least training was undertaken in epidemiology/risk analysis. Training type was generally compatible with the occupation of responders (Table 5) and reflected the concerns of the organisation in which they worked (Table 6). In addition, respondents located in Eastern European countries were less likely to undertake training in diagnostic methods than other Europeans and more likely to undertake training in laboratory QA than their colleagues elsewhere (Table 7).

Figure 9: Type of training undertaken by respondents in the previous 3 years

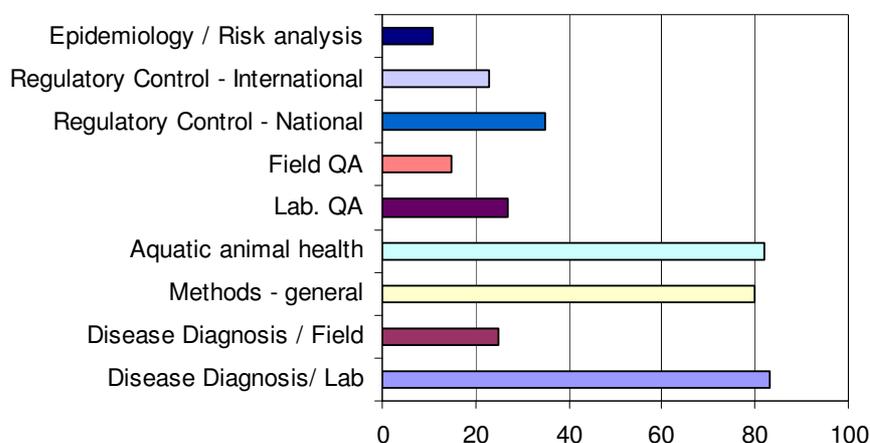


Table 5: Type of training undertaken by occupation (%)

Occupation type	% Occurrence									Total No.
	Disease Diagnosis/ Lab	Disease Diagnosis / Field	Methods - general	Aquatic animal health	Lab. QA	Field QA	Regulatory Control - National	Regulatory Control - International	Epidemiology / Risk analysis	
Administrator	14	14	43	43	29	14	29	14		7
Agency Scientist	27	9	45	36	9				18	11
Aquaculture technician	50	50	88	75						8
Field Biologist	17		33	50		17	17	17		6
Fish Farmer			17	50		17	17	0		6
Laboratory scientist	45	12	36	44	12	7	8	8	2	118
Laboratory technician	33	17	50	50	17					6
Graduate student	16	13	50	44	13	13	9	6	13	32
Regulatory personnel	57	19	10	19	19	10	38	33	10	21
Specialist consultant	40	10	60	70	10	10	20	20		10
Veterinarian	43	23	30	48	11	2	23	11	11	44

Table 6: Type of training undertaken by organisation (%)

Organisation type	% Occurrence									Total No.
	Disease Diagnosis/ Lab	Disease Diagnosis / Field	Methods - general	Aquatic animal health	Lab. QA	Field QA	Regulatory Control - National	Regulatory Control - International	Epidemiology / Risk analysis	
Company	26	18	32	56	6	9	21	12	6	34
Fisheries Research Service	31	13	50	38	6	6	31	31		16
Government Laboratory	51	19	32	28	18	7	19	16	9	57
Institute	42	9	26	46	19	11	11	7	4	57
University	36	15	47	52	6	4	8	6	6	96
Professional Association	22	22	33	33	22	11	22	11		9

Table 7: Type of training by European area (%)

Country	% Occurrence									Total No.
	Disease Diagnosis / Lab	Disease Diagnosis / Field	Methods - general	Aquatic animal health	Lab. QA	Field QA	Regulatory Control - National	Regulatory Control - International	Epidemiology / Risk analysis	
Southern Europe	43	6	35	46	13	10	10	5	3	63
Northern Europe	41	9	43	39	13	4	17	13	9	46
Western Europe	34	17	41	35	14	7	23	14	6	86
Eastern Europe	53	13	20	33	20	7	7	13		15
	83	25	80	82	27	15	35	23	11	210

4.1.8 Training duration and type

Training was predominantly of short duration, with the majority of respondents undertaking training courses of between 1-5 days (Figure 10). The type of course undertaken was normally a short course outside the organisation which did not lead to accreditation or a qualification of any type, but was clearly of professional benefit (Table 8). These courses were normally accessed through either a conference or workshop – a taught/practical approach to training provision proved to be the most popular. E-learning played an almost insignificant role in training provision among respondents.

Figure 10: Duration of training course

9) Duration of training course (select best fit):

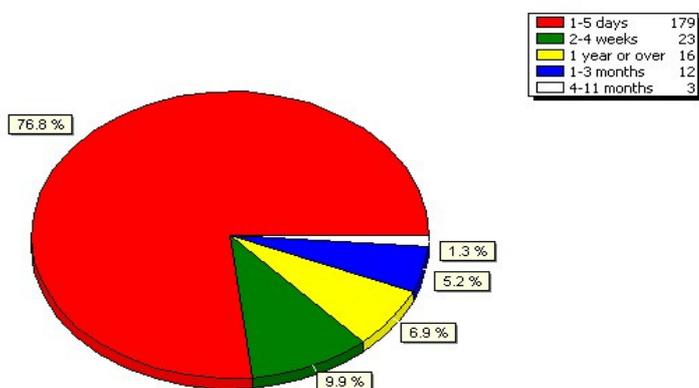


Table 8: Training method and delivery type used

Method type	Percent	Delivery Method	Percent
Workshop	44.30%	Short course outside institute/company	53.00%
Taught/Practical combination	24.80%	Other	15.20%
Class-room (taught)	12.60%	In-house	10.00%
Laboratory based	8.30%	Degree	7.00%
Other	4.30%	Certificate	4.80%
Practical demonstration	3.50%	Accreditation	3.50%
Field based	1.30%	Diploma	3.50%
Distance learning	0.90%	Service training	3.00%

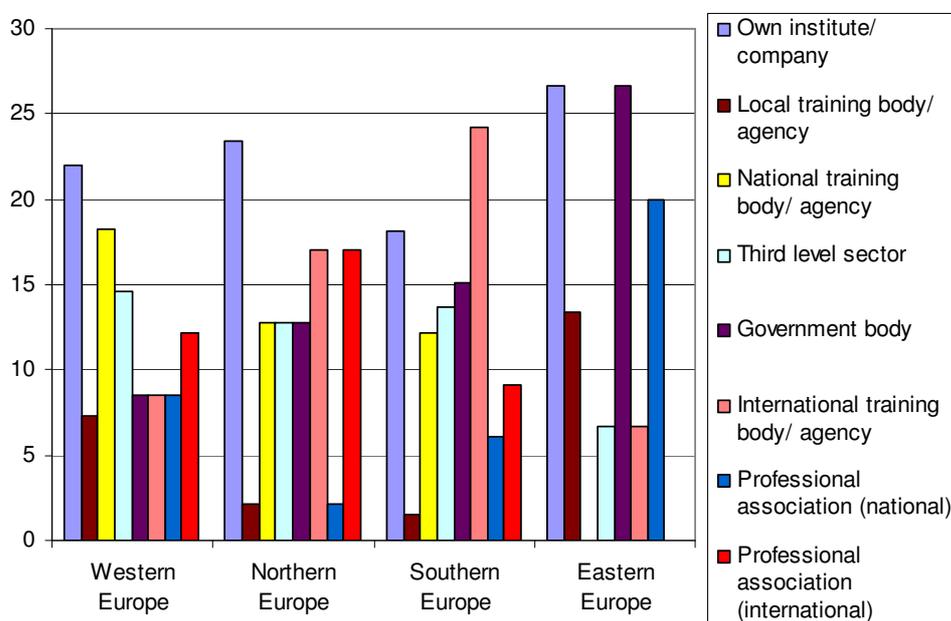
4.1.9 Training providers

Responders own organisations played a key role in providing training in all topics (Table 9). International training bodies (e.g. AquaTT) were an important applied training provider, especially in Northern and Southern European countries, while national training bodies were more active in this role in Western European countries. Professional Associations were also identified as playing a role in applied training provision, especially in Northern and Eastern European countries (Figure 11).

Table 9: Training organiser/Provider (%)

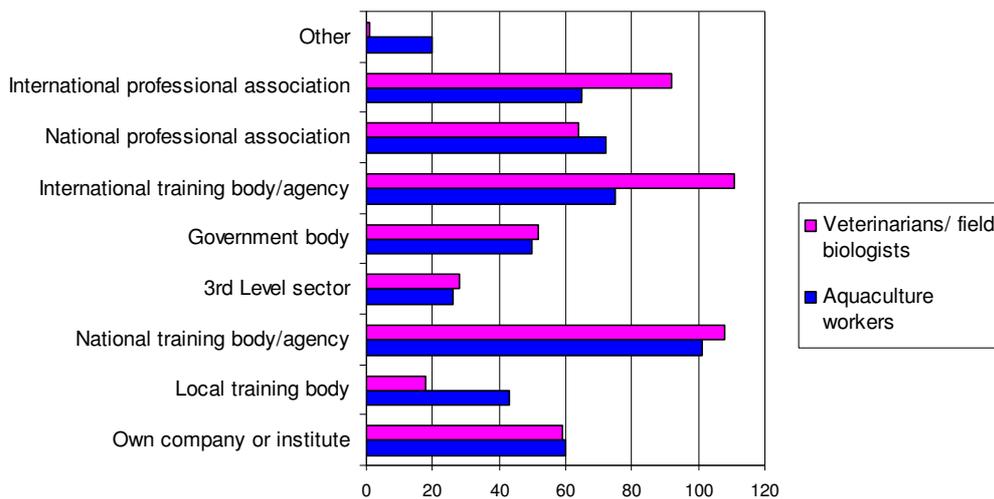
Response	Percent
Own institute/company	18.80%
Other	15.00%
National training body/agency	13.90%
International training body/agency	13.90%
Professional association (international)	11.30%
Government body	9.80%
Professional association (national)	8.30%
Local training body/agency	4.50%
Third level sector	3.80%

Figure 11: Training provider by country block (%)



When questioned on who should take responsibility for the provision of applied training for aquaculture workers, veterinarians and other field specialists, the majority of respondents felt that national and international training bodies and professional associations, and to a lesser extent companies should take on this role (Figure 12). Interestingly, despite the fact that over 70% of respondents were from universities and research institutions, few identified these organisations as having an important role in applied training provision.

Figure 12: Opinion on who should provide applied training



4.1.10 Sources of training information

When questioned about their knowledge of where their desired training might be provided, over 50% of respondents did not know where to look for the training they needed (Figure 13).

Word of mouth and email accounted for almost 50% of information dissemination about training events, while newspaper and magazine advertisements had little impact on dissemination of training information (Figure 14).

Figure 13: Knowledge of training availability

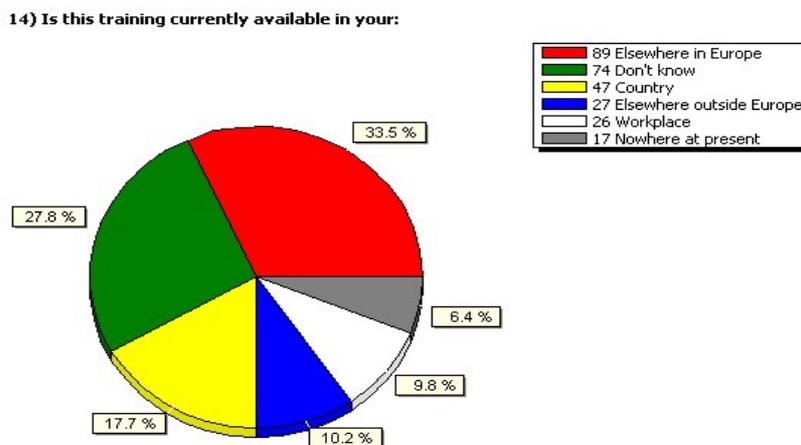
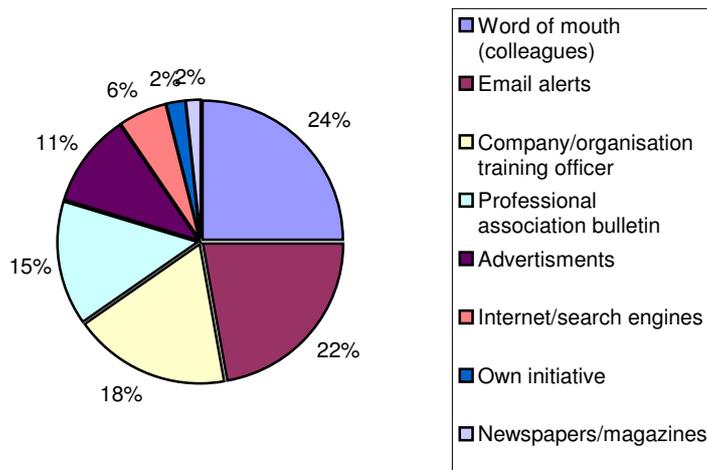


Figure 14: Sourcing of training information by survey respondents



4.1.11 Training Needs

Figure 15 summarises the desired additional training identified by respondents. Diagnostic methods for bacterial and viruses (especially newer molecular methods) were the principle training needs identified. Epidemiology and risk analysis was also identified as training needs that are not been serviced at the moment. For aquaculture workers, field diagnosis and fish health management were the key training topics identified (Figure 16), while for veterinarians and other field specialists disease diagnosis and eradication methods were a key topic identified (Figure 17). Very few respondents overall were interested in, or felt the need for, training in quality assurance, regulatory issues or surveillance methods.

Figure 15: Desired additional training identified by respondents

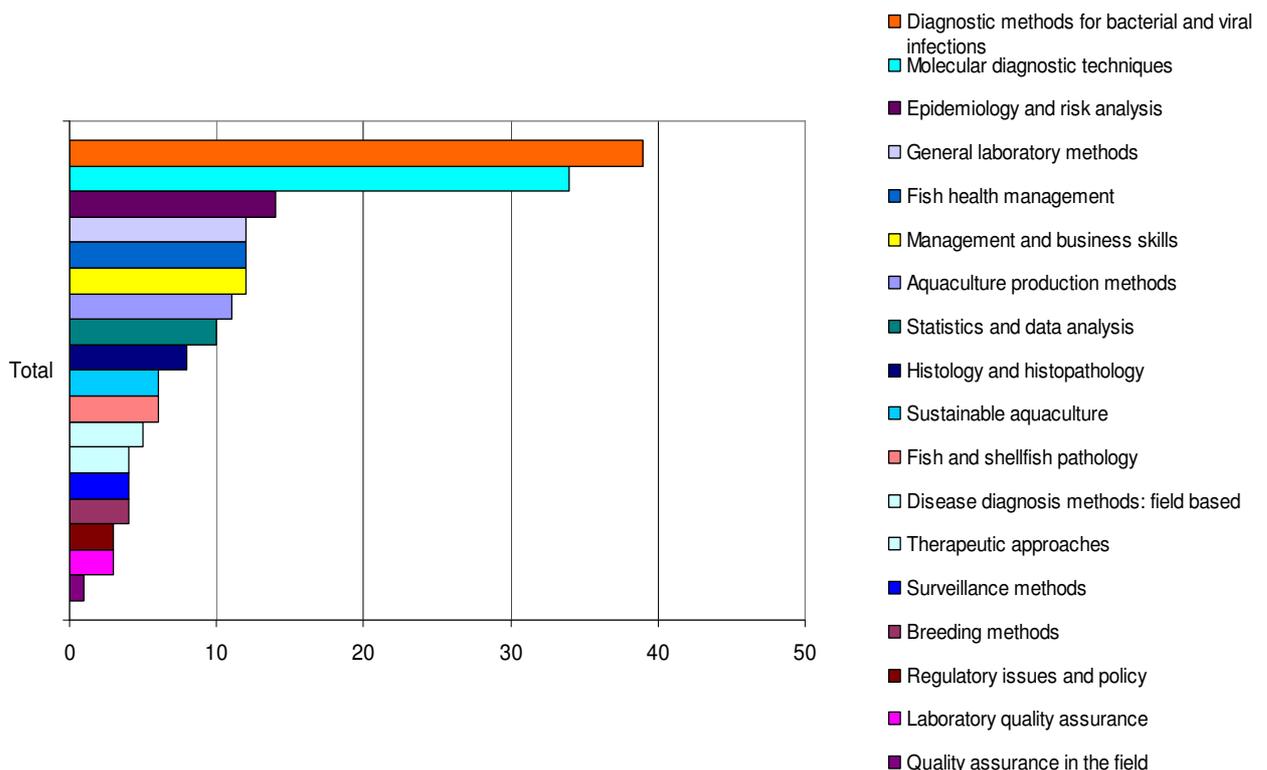


Figure 16: Type of training needed: Aquaculture operatives

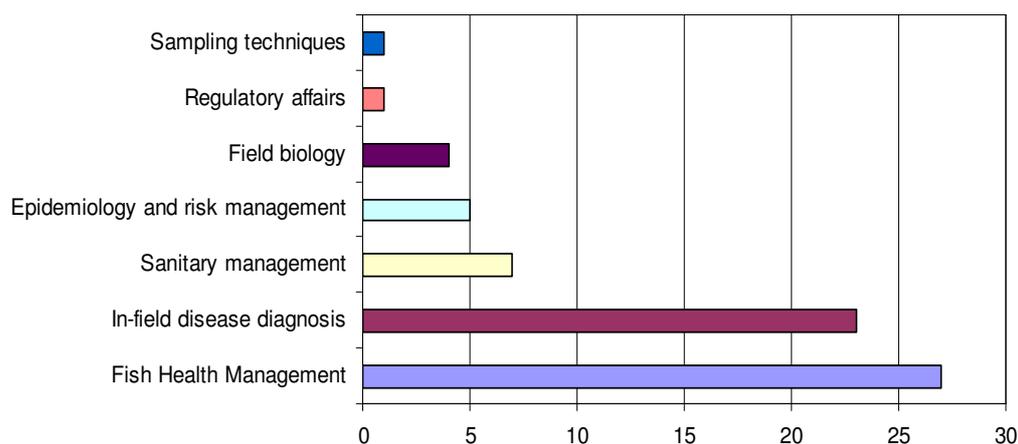
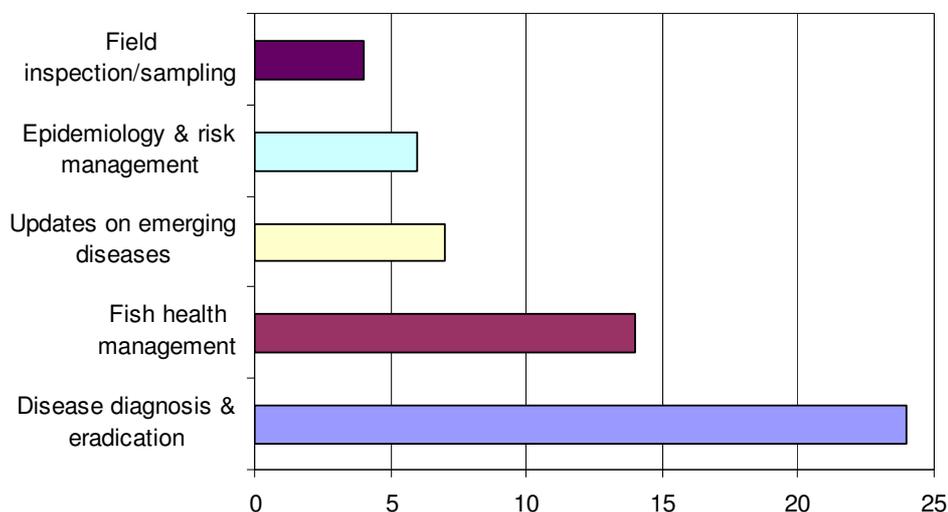


Figure 17: Type of training needed: Field biologists/Veterinarians



Additional training needs were also identified by WP6 Task force members, especially from an industry perspective. For field operatives, it was felt that training courses must be more practical and provide hands-on learning opportunities, in order to have a long-term impact on the skills base in this sector. The industry training needs identified included.

- Availability of molecular diagnostics for viral, bacteria and parasitic diseases either locally or regionally.
- Improved treatment strategies
- Vaccination strategies management
- Methods of assessing immuno-competence of fish
- Techniques for diagnosis of nutritional diseases
- Water quality assessment methods
- Fish farm bio-security measures and appropriate disinfection techniques

4.1.12 *Facilitation of training opportunities*

The major facilitators of training echoed to some extent the reasons cited for not undertaking training, in that respondents felt that availability of funding, specialist workshops and better information on training opportunities would best facilitate them (Figure 18). The availability of distance-learning options was not considered important by respondents as a facilitator to the acquisition of training.

Figure 18: Facilitation of training opportunities



4.1.13 *EC involvement in training policy and provision*

The majority of responders felt that the European Commission (EC) should have more involvement in training provision (Figure 19) and formulation of policy around training (Figure 20) and identified a number of benefits from both. In terms of both policy formulation and training provision, the benefits of EC involvement were considered to be better harmonisation of standards across Europe, leading to improved fish health management; more harmonisation of regulations and policies across Europe; coordinated use of diagnostic and control methods; improved quality assurance and ultimately improved product quality. Some respondents also felt that EC involvement in policy formulation would lead to better awareness of current and developing problems and improved dissemination of information on those problems. In addition to these benefits, respondents also expressed the opinion that provision of training by the EC would result in improvement of the skills base across Europe and provide a better funding base for training provision, which would be more focused and cost effective.

Figure 19: EC and policy formulation?

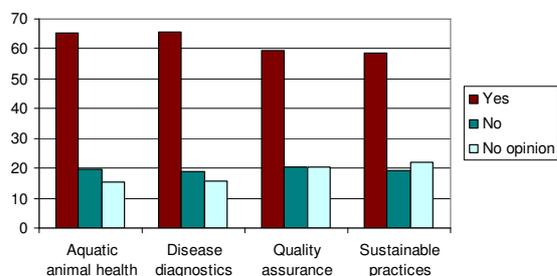


Figure 20: EC and Training provision?

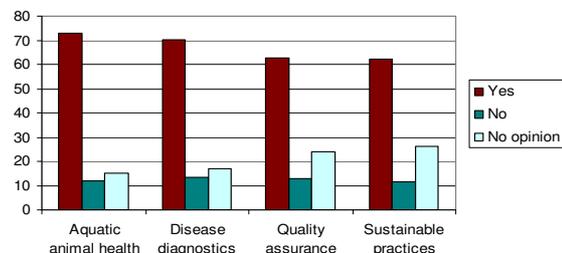


Figure 21: Benefits of EC involvement in training policy formulation

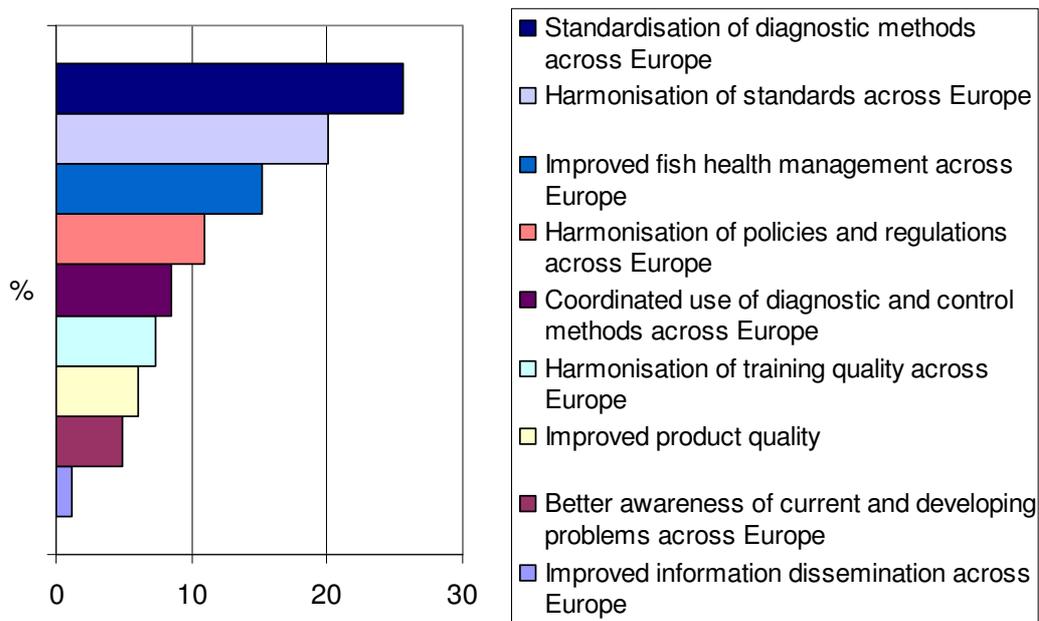
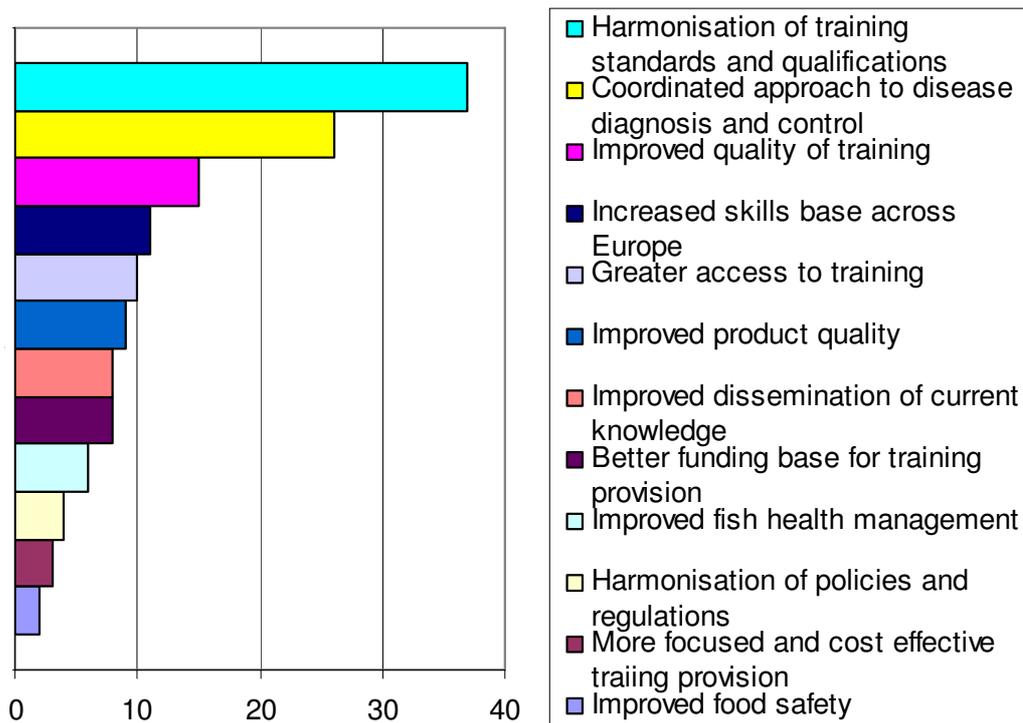


Figure 22: Benefits of EC involvement in training provision



4.2 Training needs identified by PANDA work packages

Training requirements were identified for each work package as follows:

4.2.1 Work package 2

Work package 2 identified that there is a lack of training for the basic concepts of risk analysis applied to aquatic animal health. Therefore there are still too few people with the expertise for conducting risk analyses and this makes the interpretation of data difficult within the context of providing scientific information in support of aquatic animal health programmes. As a result, there is a broad need to provide basic training for understanding the risk analysis (RA) concepts and the process of risk assessment.

Training support, could be related to capacity building and promotion of workshops for RA issues, especially in newer Member States and/or non-EU countries that export to Europe. Additional potential themes include optimal strategies for aquatic animal disease RAs, the likelihood and consequences of exotic disease entry, the assimilation of current opinion and the identification of knowledge gaps, the latter of which will benefit to a certain extent from the uncertainty score built into the hazard scoring exercise. This type of support initiative would help to make risk analysis interpretation more consistent in, for instance, an organization, by dealing more fully with the limits of current knowledge. This would also include the relationship of epidemiology to risk assessment and an introduction to the principles, terminology, tools and techniques used to provide an awareness of the current hazards and disease situation.

Possible core topics:

- Introduction to aquatic animal health risk analysis: Understanding the terminology by providing an introduction to the concepts, tools and techniques used in risk analysis (overview)
- Potential themes should also include capacity and awareness building for the IRA concept, optimal strategies for aquatic animal disease RAs, likelihood and consequences of exotic disease entry, assimilation of current opinion and identification of knowledge gaps, etc.
- How epidemiology relates to risk assessment: Epidemiology Principles
- Dealing with the limits of current knowledge
- Optimal strategies related to the necessities for conducting RAs
- Awareness of hazards and disease situation for candidate EU members or third countries
- As the methodology is similar for whatever is being assessed, it is easy to apply the technique to a variety of situations, so that training need not necessarily be focused on aquatic animal diseases.

4.2.2 Work package 3

Workpackage 3 identified that farmers knowledge of exotic diseases requires improvement and must be kept up to date. In addition, they considered that farmers must be aware of the basic principles of disease surveillance and bio-security. Health inspectors may also need formal training in surveillance.

4.2.3 Work package 4

Workpackage 4 identified that there was a lack of training courses in diagnostic methods. The CRLs are already carrying out training in laboratory methods but it is limited to employees of affiliated laboratories and is not generally available. It was suggested that reference labs

should be assigned for each exotic disease. In addition, Workpackage 4 identified more specific training needs:

General methodologies

- Sampling strategy (number of samples to take when pooling) for diagnosis
- Screening analysis: how to interpret results related to sensitivity and specificity
- Writing good Standard Operating Procedures
- ISO 9001: do what is written with positive and negative controls
- ISO 17025: include proficiency tests
- Mathematical analysis of proficiency test results
- What to do for, and how to write, a validation report.

Specific training needs

- EHNIV: use outcome of RANA project and extrapolate to NRL
- RSIV: no testing in Europe yet: training needed
- ISAV: diagnostic training needed for newer NRL's in Eastern Europe
- KHV: training in diagnostic tests, for national and regional labs inside and outside the EC
- *Lactococcus garviae*, *Streptococcus agalactiae* and *iniae*: diagnostic training needed of at least NRL's
- *Trypanosoma salmositica*: all NRL's should have test methods ready
- *Neoparamoeba pemaquidensis* and *Parvicapsula pseudobranchicola*: training needed especially for salmonid producing countries in detection methods and confirmative methods
- *Gyrodactylus salaris*: Training needed especially for NRL's of newly accessed EC member states
- *Aphanomyces invadans*: Getting to use the available tests (clinical pathology and diagnosis) urgently at NRL's including the needed biologics (training), CEFAS as teaching laboratory
- Mollusc diseases: histopathology training for new pathogens
- Crustacean diseases: 4 viruses, *Coxiella* training needed
- Amphibian ranavirus: training in parallel with EHNIV
- *Batrachochytrium*: no specialist/lab in Europe: training needed
- EUS: training in diagnostic tests.

In general, there are big gaps of knowledge on some of the pathogens and their diagnostic tests above. Many EU countries never have used some of the diagnostic tests above. Therefore, it is important, first to start to use the available tests at EU level, then validate them, and then only decide which are the best methods to use.

4.2.4 Work package 5

Workpackage 5, which was concerned with the development of sustainable aquaculture identified the following training needs:

- Molecular diagnostic techniques for the diagnosis of viral, bacterial and parasitic diseases at a local and/or regional level
- Training in techniques to assess carrier state at an early stage (i.e. prior to the appearance of clinical symptoms).
- Improved treatment strategies (for bacterial, viral and parasitic diseases)

- Vaccination strategies and faster, safer vaccination techniques that are species specific and disease specific (methodologies do not always transfer)
- Methods in assessing the immune-competence or immunological state of fish
- Diagnosis of nutritional diseases and techniques to identify the causative factors
- Water quality assessment methods for health management
- Training on fish farm bio-security measures and appropriate disinfection techniques

5 Conclusions

It is acknowledged that there are a number of constraints to the conclusions that can be drawn from the survey carried out in this project, primarily because of the low response rate of 12.5%. A response rate of 18% would be considered the norm for this type of survey. In addition, the use of a web-based survey may have introduced bias by targeting only those who are both computer literate and have regular access to email. That said, the survey does raise some interesting issues regarding the type, frequency, availability and desired training being undertaken by those engaged in fish health management across Europe.

On-going professional training was clearly important for respondents working in a laboratory setting (agency and laboratory scientists, laboratory technicians and graduate students, veterinarians) and would reflect a need to keep abreast of the latest developments in disease diagnostic methods and emerging or re-emerging disease problems. However, in some instances (10%) respondents in these professions commented that their training needs were quite specialist and that training relevant to those needs was not available to them or difficult to locate within Europe. The low number of respondents in this group who undertook training in laboratory QA might reflect the QA structures in place in many institutes and universities, where responsibility for compliance is given to a specialist in QA, and is not considered a necessary part of the skills-base for laboratory workers. Laboratory and Field QA training were more likely to have been undertaken by respondents from Eastern European countries, perhaps reflecting monitoring and diagnostic laboratory structures in those countries that are still in the development phase.

It might be expected that personnel working in the field (field biologists, aquaculture technicians, consultants, fish farmers) would be less likely to participate in frequent training. Nonetheless, respondents felt that training of aquaculture workers and field biologists was essential, especially in the areas of fish health management and preliminary disease diagnosis. When asked who might provide this training, respondents indicated that Professional Associations, National and International training bodies, and to a lesser extent aquaculture companies, should do this. Universities were not seen to have an important role in provision of training to these stakeholders. A surprising result from the survey was the number of regulatory personnel who reported that they had not participated in any kind of training within the previous 3 years. It was not clear from the survey why this might be the case.

The identified impediments to participation in training would appear to be influenced by geographical area. In Southern European countries lack of funding, and unsuitable training locations outside the geographical area were identified as major impediment while in Northern and Western European countries lack of time and the unavailability of specialist courses were key impediments. Interestingly, a sizable percentage of Western European respondents indicated that training was not a priority for their institutions or that their skills were sufficiently developed already. Where training was undertaken, it tended to be a workshop, symposia or seminar, held as part of a conference (67.8% of respondents). This

would suggest that the addition of ‘add-on’ training events to conferences in the field would facilitate increased training participation for scientists working in the area of fish health management.

The majority of respondents clearly felt the need to improve their skills in diagnostic methods for bacterial and viral diseases, especially the newer molecular diagnostic techniques. A key issue that emerged from the survey was the stated desire of respondents to undertake training in Epidemiology and Risk Analysis where this training is not currently available. This skills deficit has also been identified by the PANDA taskforce on epidemiology and risk analysis in aquatic animal diseases. Important facilitators of training included the availability of funding (especially in Southern European countries), the availability of more intensive workshops, and better information on training opportunities. Networking of experts and collaboration with industry, to share knowledge were also identified as facilitators. Very few respondents considered that the availability of distance and e-learning would be of benefit to them in increasing their skills base.

It was also clear from the survey that respondents considered that the involvement of the EC would be positive in terms of both policy on training and training provision. In particular, a desire for harmonisation methods, policies and regulations, training standards and qualifications across the European area was seen as important to improving the overall skills base and ultimately the level of fish health management and the quality and safety of fish and shellfish products. It was also clear from the survey that respondents saw EC involvement in policy on training and training provision as a means of securing a stable funding base for future training programmes.

6 Recommendations

From the work carried out in D11, a number of recommendations on increased provision of, participation in, and harmonisation of training in the control of diseases of aquatic animals can be made:

6.1 Specific training needs identified

The following training needs were specifically identified both by stakeholders and the PANDA work package participants:

- For laboratory scientists and regulatory personnel the principle training needs were diagnostic methods for bacterial and viruses (especially newer molecular methods).
- Epidemiology and risk analysis was also identified as training needs, but the survey results and the experience of the relevant work packages is that these needs are not been met at the moment.
- For aquaculture workers, field diagnosis and fish health management were the key training topics identified.
- For veterinarians and other field specialists, disease diagnosis and eradication methods were the key topic identified.

6.2 Improvements in the provision of training

There are a number of ways in which the provision of training could be improved across the EU:

- The addition of ‘add-on’ training events to conferences in the field would facilitate increased training participation for scientists working in the area of fish health management.
- Intensive short courses focused on specific topics, and run locally or regionally, would provide access to specialist training within the limited resources available to many scientists, field biologists and veterinarians.
- The availability of funding (bursaries, course design/delivery grants etc), administered either nationally or at a European level would also address the difficulty of many stakeholders to participate.
- In addition, provision of resourcing at a local level of universities, professional associations and specialist training organisations is recommended.
- A central, resourced, portal for information on training opportunities would greatly facilitate participation. This portal should operate at EC, rather than local level.
- Targeting of scientists and other stakeholders in Eastern European countries for particular assistance is recommended.
- Training programmes aimed at practitioners must be more practically orientated and provide hands-on training on specific methodologies. For those that are in immediate need of such training eligibility criteria should be supplied:
 - qualified and working in the field and need training
 - qualified and seeking employment in the sector
 - general graduates hoping to move into the sector

6.3 Harmonisation of the skills base across Europe

The data collected in this project indicated widespread support for the involvement of the EC in both policy on training and training provision. It was perceived that such involvement would:

- Lead to harmonisation of methods, policies and regulations, training standards and qualifications across the European area
- Result in coordinated use of diagnostic and control methods; improved quality assurance and ultimately improved product quality.
- Lead to better awareness of current and developing problems and improved dissemination of information on those problems.
- Improve the overall skills base across Europe and provide a better funding base for training provision, which would be more focused and cost effective

6.4 Overall conclusions

- There is a clear NEED for both basic and on-going professional training right across the spectrum of aquatic animal health management
- Appropriate training is not, in many instances, available or relevant to specific needs
- Where training IS available, it is not, in many instances, fit-for-purpose (theoretical where practical would be better etc.)
- Where training is available, even if fit-for-purpose, the training is often not accessible to potential users (lack of funding, lack of time, priorities elsewhere, geographically remote etc.)

Attention needs to be given to the:

- **Type of training** required across the EU

- The most appropriate **methods of delivery** of that training (e.g. practical vs theoretical, hands on vs distance learning etc.)
- Motivation of the most appropriate **training providers** (e.g. resourcing universities and institutes to offer short courses where there is in-house expertise)
- Motivation of **training consumers** to participate in training (e.g. thought the provision of funding to attend, resourcing of own institutions to mount training etc)

Lessons learned:

- Successful initiatives (Nordic joint MSc, AquaTT Aqualab and Wave projects, University of Stirling bespoke short courses) could provide models for other regions of Europe.
- Curricular planning and harmonisation needs to happen at a European level, in order to ensure portability and recognition of qualifications across the region.
- Importance of EC involvement in both policy formulation around training standards and in training facilitation (if not provision) a key recommendation.

7 References

Hiney, M., Rodger, H, Bricknell, P., Casburn, P. and Mulcahy, D. (2002). Aquaculture development and regulation: incompatibility or harmony? *Bulletin of the European Association of Fish Pathologists Special Issue*. 22(2): 178-184.