Project no. RICA-CT-2005-022802

Genimpact

Evaluation of genetic impact of aquaculture activities on native populations - A European network

Instrument: **Coordination action**

Thematic Priority: **Integrating and Strengthening the European Research Area**

Publishable final activity report (6.1)

Period covered: **from 1.11.2005 to 31.10.2007** Date of preparation: **29.02.2008**

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Project coordinator name: **Dr Terje Svåsand**
Project coordinator organisation name: **Institute of Marine Research, Norway**

Revision [1]

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

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1. Project execution

The continuing global decline of the wild fish stocks has been accompanied by a parallel increase in aquaculture. Over the past ten years, worldwide production of farmed fish has more than doubled, with farming activities now producing half of the fish directly consumed by humans. Similar trends are seen for shellfish.

The potential for genetic effects of aquaculture on natural fish populations have aroused a great deal of concern among scientists as well as the general public. The perceived risks are often associated with cultured and native fish, and the adverse effects of ecosystem interactions. Public health issues are also a matter of concern.

The project Genimpact, financed by the European Commission, started in November 2005 to review existing knowledge necessary to assess genetic effects of aquaculture on biodiversity, review future research needs, and disseminate this information to a wider public. To achieve this, Genimpact convened a series of expert workshops on risk assessment and interbreeding and aquaculture ecosystem interactions (Fig. 1):

- Genetics of domestication, breeding and enhancement of performance of fish and shellfish, Viterbo, Italy, 12 -17 June 2006 (WP1, Responsible: Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare, ICRAM)
  http://genimpact.imr.no/workshops/viterbo

- Monitoring tools for evaluation of genetic impact of aquaculture activities on wild populations, Tenerife, Spain, 19-21, October 2006 (WP2, Responsible: Departamento de Biologia Funcional, Universidad de Oviedo, UOVE)
  http://genimpact.imr.no/workshops/tenerife

- The use of modelling to assess the risk of genetic impacts on wild populations from escapes of cultured fish, Pitlochry, Scotland, UK, 15–17 February 2007 (WP3, responsible: Fisheries Research Services, FRS)
  http://genimpact.imr.no/workshops/pitlochry

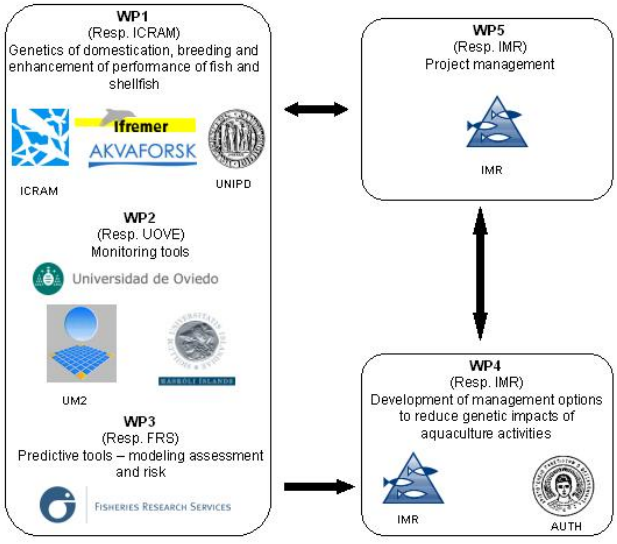

Fig.1 Workplan - Genimpact

All reports were made available on the projects web page (WP4.1, http://genimpact.imr.no).

The gaps in our current knowledge, and the suggested research priorities identified during these expert workshops were discussed with stakeholder representatives during a fourth workshop:

- Development of management options to reduce genetic impacts of aquaculture activities, Thessaloniki, Greece, 19-22 April 2007. (WP4.2, responsible: Aristotle University of Thessaloniki (AUTH) http://genimpact.imr.no/workshops/thessaloniki)

The discussions held in Thessaloniki were used to develop consensus statements on the "state of the art" as regards genetic impact of farming activities and its implications for aquaculture management, stock conservation and environment safety. (http://genimpact.imr.no/__data/page/7653/management_options.pdf).

The report below gives a comprehensive overview of the three expert workshop and the Management workshop:

> Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). (2007).Genetic impact of aquaculture activities on native populations.Genimpact final scientific report (EU contract n. RICA-CT-2005-022802). 176 p. http://genimpact.imr.no/compendium

The outcomes of the workshops were presented and made available for public discussion in the International Symposium on "Genetic Impacts from Aquaculture: Meeting the Challenge in Europe" (WP4.3, http://genimpact.imr.no/symposium). The Symposium was held on 2-4 July 2007 in Bergen, Norway, a centre for marine science in northern Europe close to areas with large farming activity of Atlantic salmon and advanced research facilities for new aquaculture species such as Atlantic cod.

The Symposium, hosted by the Institute of Marine Research in Norway, was attended by key figures from science, industry, NGOs and governmental and intergovernmental organisations. The symposium offered an opportunity to take part in defining the European agenda with regards to management of this threat and setting future research priorities. More than 60 participants from 12 countries attended.

This report from the Symposium (WP4.4) focuses on the discussion held at the Symposium and further research priorities:

Overview of Discussions

The themes, results, topics and issues presented at the four previous Genimpact workshops were discussed with Symposium participants. The text below takes into consideration comments from symposium participants, but is not necessarily consensus statements.

The discussion evidenced that there are still major research gaps to be filled, in particular in relation to the differences in species biology, and how this affects interaction outcomes, and levels of present knowledge available for the different species. Addressing these gaps in the near future needs to be a key research priority.

This research is essential for the definition and establishment of the best management practices to minimise the genetic impact of aquaculture activities on wild populations. The maximum number of escapes which might be able to be sustainably tolerated is likely to vary among the different species considered, though for most species there is still not enough information available on wild populations and on the fitness of escaped individuals in the wild.

Building on this basic work, it was generally agreed that more research is needed to understand the real negative impact of escapees. Besides Atlantic salmon, for which a lot of work has been done, there is virtually no or limited information for most other species.

Biological work needs to focus on basic population demographic studies and better understanding of the biology and ecology of each species in the wild. Given major differences in species' biology, comprehensive studies for individual species are needed in order to develop appropriate measures and policies to properly manage the potential interactions relating to each; to be successful, management strategies need to be planned at a species level.

In combination with this, the following are also seen as key research concerns:

- Understanding of the population genetic structure of the species: one of the first aims of a conservation genetic programme would be to identify the population(s) to protect. Wild stocks composition and structure must be evaluated, but for some species, even the definition of what is a population is still a problem. The definition of populations is also needed in order to detect possible local adaptations.
- Accurate knowledge for site selection of hatcheries: this includes insight into spawning sites of wild populations, migration routes, etc, since a relationship certainly exists between farm location and genetic impact on wild populations. Based on the underlined knowledge of genetics and demography, it will appear that some sites must be protected. It's important to notice that some species could be managed in the same area: interactions between species are possible (genetic, behavioural interactions). Therefore, since species belong to a community, an ecosystem approach is needed in many cases in order to protect the wild populations.
- Development of realistic predictive models for risk assessment: the implications of the basic empirical knowledge collected must be comprehensively assessed in a formal, objective species-specific biological frameworks or models. However, useful models cannot yet be developed as basic knowledge on the biology and ecology of the species is missing, with the possible exception of Atlantic salmon. For example, critical to the development of such models is an understanding of the fitness of farmed strains in the wild, something about which nothing is known in most species. In this regard, the importance and the applicability of molecular markers for assessing the actual reproductive success of both farm and wild individuals in nature was stressed.
- There was a general acceptance that technical improvements for the industry are needed to limit the number of escapes from hatcheries and the pressure posed on wild populations. It was stressed that, in relation to this, "Codes of Best Practice" should be developed, underpinned by legislation.

There were two views on what level of escapes should be regarded as acceptable:

- The concept of zero escapes: this was supported by some participants although this target is impossible to achieve at least for the foreseeable future for most if not all farmed species.
- Others agreed that, since the notion of "no escapes" is impossible, the acceptable level of escapees should be determined. In such a case results on acceptable levels will be species specific and case dependent. Additionally, the impact will always depend on the recipient population size.

Much discussion concentrated on the importance of genetics and the application and development of more molecular markers. It was felt that molecular markers can be expensive but escapes also have high economical costs. Nowadays, however, molecular genetics technology is improving and prices are decreasing, thus creating an optimistic future for the use of genetics in the aquaculture industry.

Nevertheless, apart from random non-coding DNA molecular markers, much more information is needed on actual DNA regions under selection during hatchery practices. In this regard, the identification of markers linked to QTLs (locations in the DNA which control the expression of quantitative traits) would be useful and is needed. It was pointed out that breeding stocks are under a continuous process of strain development, as a result of domestication and selective breeding, and genetic changes in these cases can be expected to be great enough to allow the identification of farmed fishes: therefore, research on this topic would be invaluable for the identification of farm fish in the wild and for the discrimination of different farm strains. It was indicated that the ability to identify escaped farm fish in the wild could be considerably enhanced by selecting for discriminating molecular markers as part of breeding programmes.

These remarks also served to underline a more fundamental point, which we need to better understand the domestication process and the genetic architecture of domestication to identify what genes are changing in culture. This will both help to identify the most useful markers of farm fish as well as to understand the genetic basis of fitness differences between farm and wild fish. With regard to the latter, it is essential that genomic work be carried out in conjunction with fitness studies in the wild (common garden experiments) which assess the relative performance of farmed and wild fish.

The question of creating sterile strains for farming with techniques such as gametic sterilization, polyploids and hybrids was also raised. Sterility of farm escapes would help to avoid impacts associated with interbreeding. However, it was again clear that more research is necessary before the quality of sterile fish which can be produced is able to fit aquaculture needs. To ensure that fish produced meet aquaculture needs, research should be formulated and performed in collaboration with the industry.

The use of sterile fish will not address all the potential impacts of escapees on wild populations. Even if sterile, farmed fish could threaten wild populations through competitive or disease interactions e.g. sterile fish may increase densities on spawning sites, exhibit sexual behaviour or compete for food. Thus research is also needed into the ecology of escapees in the wild.

All participants agreed that the environment is changing fast (due to global change, fragmentation, isolation) and that this is likely to affect the nature of interactions and their outcomes. There was general agreement that we have to take this into account in the future possibilities and threats to the adaptation of wild stocks (populations). Everyone, scientists and stakeholders alike, agreed that the protection and conservation of wild populations is a principal that must guide any policy on the decrease of escapees.

Areas of Research Priority

The Genimpact Steering Committee met after the Symposium to consider the points raised in the discussions regarding the priority areas for research. They considered those areas which were key to informing the development of management approaches to address cultured-wild interactions which will aid the development of a sustainable balance between aquaculture and the need to conserve wild fish stocks. Following this, the list of four priority research areas

was distributed for comment among the contracting partners of Genimpact, and then among all the participants of the Genimpact symposium.

The list of these four priority research areas set out below (not in order of importance) takes into consideration comments from Symposium participants, but is not necessarily a consensus statement.

I. Baseline demographic and genetic information on life-history and structuring of wild populations of key EU aquaculture species to monitor and assess the actual genetic impact of aquaculture activities.

II. Elucidation of the genomic architecture of domestication in key European aquaculture species to advance understanding fitness differences between wild and cultured stocks, and to identify cost effective molecular markers for tracing farm stocks/individuals, and assessing levels of introgression of farm stocks into wild populations.

III. The development, parameterisation, and field corroboration of simulation models to investigate, across the full range of interaction scenarios, the direct and/or indirect genetic interactions of cultured individuals with wild populations in key EU aquaculture species, including conducting common garden experiments to measure fitness differences and surveys to measure actual levels of mixing and introgression.

IV. Development of practical technologies for the reproductive isolation of farmed species from wild populations using triploids based on the development of commercial protocols for triploidisation and the evaluation of the biological and economical performance of triploids both in wild as well as hatchery conditions.

These general areas of research priority are considered in the Symposium report (WP4.4: http://genimpact.imr.no/__data/page/7248/SymposiumReport_19_11_2007_Final.pdf).

2. Dissemination and use

Section 1 - Exploitable knowledge and its Use

The co-ordination project Genimpact has not produced exploitable results, defined as knowledge having a potential for industrial or commercial application in research activities or for developing, creating or marketing a product or process or for creating or providing a service. The aim of the project was review existing knowledge necessary to assess genetic effects of aquaculture on biodiversity, review future research needs, and disseminate this information to a wider public.

Section 2 – Dissemination of knowledge

The dissemination of the results of 'Genimpact' was embedded in the project from an early stage. A web site (http://genimpact.imr.no) was set up and advertised to science and stakeholders in order to keep those interested in the subject updated. See **Appendix 1** for web statistics.

The results of the project were also presented and discussed with scientists and stakeholders in several workshops and symposiums (see **Table**), and finally worked out in information available for policy makers (See **Section 3 - Publishable results).**

Planned /actual Dates	**Type** [1]	**Type of audience**	**Countries addressed**	**Size of audience**	**Partner responsible /involved**
From Dec. 2005	Project web-page: http://genimpact.imr	General public, stakeholders, scientists, internal		Web statistics in Appendix 1	IMR
Jan. 2007	Flyers for the International Symposium	General public, stakeholders, scientists, internal	Widely distributed		IMR
April 2007	Management workshop Thessaloniki, Greece	Stakeholders and scientists	Participants from 12 countries mainly European	45	AUTH all contracting partners
July 2007	International Symposium, Bergen Norway	General public, stakeholders, scientists	Participants from 12 countries mainly European	>60	IMR and all contracting partners
Sept. 2007	Annual ICES meeting, Helsinki, Finland	Scientists		>40	IMR
Sept. 2007	13th Greek Ichthyologists Congress	Stakeholders and scientists	Greece	>100	AUTH
Oct. 2007	EAS meeting Istanbul, Turkey	Scientists and stakeholders		>100	IMR

Section 3 - Publishable results

The Genimpact project has produced two major reports available on the web:

1. Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds.) (2007). Genetic impact of aquaculture activities on native populations. Genimpact final scientific report (EU contract n. RICA-CT-2005-022802). 176 p. http://genimpact.imr.no/compendium

2. Svåsand T., Crosetti D., García-Vázquez E., Triantafyllidis, A.,Verspoor E. (eds.) (2007). Symposium report. The international symposium on genetic impacts from aquaculture: meeting the challenge in Europe, 1-4 July 2007, Genimpact (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/__data/page/7248/SymposiumReport_19_11_2007_Final.pdf

[1] The three expert workshops are not included.

These two reports provide a comprehensive overview evaluation of the genetic impact of aquaculture activities on native populations in Europe. The Genimpact project further discussed this information with the aquaculture, breeding, environmental and animal welfare organizations, and provided information for policy makers.

Report 1 contains the following chapter:

1st year: Oct 05-Nov 06

Beaumont A. and Gjedrem T. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Scallops - *Pecten maximus* and *P. jacobaeus*. p 62-69, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Beaumont A., Gjedrem, T. and Moran P. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Blue Mussel – *Mytilus edulis* and Mediterranean mussel – *M. galloprovincialis*. p 83-90, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Colombo, L. (2006). Performance improvements by polyploidization, gene transfer and DNA vaccination in aquaculture. IV. The semantics of the term "genetically modified organism". p 123-124, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Danancher D. and García-Vázquez E. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Turbot – *Scophthalmus maximus*. p 55-61, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Devlin, R., Traavik, T. and Colombo, L. (2006). Performance improvements by polyploidization, gene transfer and DNA vaccination in aquaculture. II. Applicability of gene transfer into the germinal line in fish culture. p 104-116, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Flajšhans M. and Hulata G. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Common carp – *Cyprinus carpio*. p 32-39, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Haffray P., Tsigenopoulos C. S., Bonhomme F., Chatain B., Magoulas A., Rye M., Triantafyllidis A. and Triantaphyllidis C. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. European sea bass - *Dicentrarchus labrax*. p 40-46, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Joerstad K.E., Fjalestad K.T., Ágústsson T. and Marteinsdottir G. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Atlantic cod – *Gadus morhua*. p 10-16, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Lapègue S., Beaumont A., Boudry P. and Goulletquer P. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. European flat oyster - *Ostrea edulis*. p 70-75, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Lapègue S., Boudry P. and Goulletquer P. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Pacific cupped oyster - *Crassostrea gigas*. p 76-82. In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Genetic impact of aquaculture activities on native populations. GENIMPACT final scientific report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Nerland, A., Traavik, T. and Colombo, L. (2006). Performance improvements by polyploidization, gene transfer and DNA vaccination in aquaculture. III. DNA vaccination in fish culture. p 117-122, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Piferrer, F., Beaumont, A., Falguière, J.-C. and Colombo, L. (2006). Performance improvements by polyploidisation, gene transfer and DNA vaccination in aquaculture. I. Performance improvements by polyploidization in aquaculture. p 100-103, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Prodöhl P. A., Jørstad K. E., Triantafyllidis A., Katsares V. and Triantaphyllidis C. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. European lobster – *Homarus gammarus*. p 91-98, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Sola L., Moretti A., Crosetti D., Karaiskou N., Magoulas A., Rossi A.R., Rye M., Triantafyllidis A. and Tsigenopoulos C.S. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Gilthead seabream - *Sparus aurata*. p 47-54, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Verspoor E., Olesen I., Bentsen H.B., Glover K., McGinnity P. and Norris A. (2006). Genetic effects of domestication, culture and breeding of fish and shellfish, and their impacts on wild populations. Atlantic salmon – *Salmo salar*. p 23-31, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

2nd year: Nov 06 – Oct 07

Blohm D., Bonhomme F., Carvalho G., Crosetti D., Cross T., Dahle G., Danancher D., Devlin R.H., García-Vázquez E., Glover G., Guinand B., Hulata G., Joerstad K., Kohlmann K., Lapègue S., McGinnity P., Marteinsdottir G., Moran P., Primmer C., Prodöhl P., Rise M.L., Saavedra C., Skaala Ø., Svaasand T., Triantafyllidis A., Verspoor E. (2006). Assessment of tools for identifying the genetic origin of fish and monitoring their occurrence in the wild. p 128-134. In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Genetic impact of aquaculture activities on native populations. GENIMPACT final scientific report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Gilbey J., Verspoor E., Bacon P., Barton N., Crosetti D., Cross T., Devlin R., Diserund O., Ernande B., García-Vázquez E., Gjerde B., Glover K., Hindar K., Marteinsdóttir G., McGinnity P., Tufto J., Vähä J-P., Svåsand T. (2007). Predictive tools - Modelling assessment and risk of genetic impact on wild fish populations from escapes of cultured fish and shellfish. Why use modelling?. p 142-145, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Gilbey, J., Verspoor E., Bacon P., Barton N., Crosetti D., Cross T., Devlin R., Diserund O., Ernande B., García-Vázquez E., Gjerde B., Glover K., Hindar K., Marteinsdóttir G., McGinnity P., Tufto J., Vähä J-P., Svåsand T. (2007). Predictive tools - Modelling assessment and risk of genetic impact on wild fish populations from escapes of cultured fish and shellfish. Modelling of impacts. p 146-155, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Gilbey J., Verspoor E., Bacon P., Barton N., Crosetti D., Cross T., Devlin R., Diserund O., Ernande B., García-Vázquez E., Gjerde B., Glover K., Hindar K., Marteinsdóttir G., McGinnity P., Tufto J., Vähä J-P., Svåsand T. (2007). Predictive tools - Modelling assessment and risk of genetic impact on wild fish populations from escapes of cultured fish and shellfish. Research priorities in modelling. p 156-160, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Evaluation of genetic impact of aquaculture activities on native populations: a European network. GENIMPACT Final Report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Marteinsdottir G., Cross T., Juanes F., McGinnity P., Moran P., Primmer C., Rise M., Skaala O., Triantafyllidis A. (2006). Tools for monitoring fitness of aquaculture individuals in the wild. p 135-140, In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Genetic impact of aquaculture activities on native populations. GENIMPACT final scientific report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/

Triantafyllidis A., Karaiskou N., Bonhomme F., Colombo L., Crosetti D., Danancher D., García-Vázquez E., Gilbey J., Svåsand T., Verspoor E., Triantaphyllidis C. (2007). Management options to reduce genetic impacts of aquaculture activities. p 162-167. In: Svåsand T., Crosetti D., García-Vázquez E., Verspoor E. (eds). Genetic impact of aquaculture activities on native populations. GENIMPACT Final scientific report (EU contract n. RICA-CT-2005-022802). http://genimpact.imr.no/.

Other Reports

Svåsand, T. Crosetti, D., García-Vázquez, E., Verspoor, E., Bonhomme, F., Colombo, L., Lapégue, S., Marteinsdottir, G., Olesen, O., Triantaphyllidis, C. (2007) . Evaluation of genetic impact of aquaculture activities on native populations. ICES CM 2007/L:06

Svåsand, T. Crosetti, D., García-Vázquez, E., Verspoor, E., Bonhomme, F., Colombo, L., Lapégue, S., Marteinsdottir, G., Olesen, O., Triantaphyllidis, C. (2007) . Evaluation of genetic impact of aquaculture activities on native populations. Aquaculture Europe 2007 October 24-27, 2007. Istanbul, Turkey.

3. Appendix I. Usage statistics for http://genimpact.imr.no

Monthly statistics for the period: 01 December2005 – 31 December 2006

	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Visits	**185**	**605**	**789**	**946**	**356**	**354**	**335**	**331**	**332**	**417**	**449**	**380**	**531**
Hits	**11299**	**18210**	**6830**	**3653**	**2448**	**3380**	**2441**	**15103**	**3348**	**2108**	**5236**	**7958**	**6634**
Files loaded	**3411**	**4368**	**3036**	**2807**	**1757**	**2580**	**1957**	**3731**	**1686**	**1392**	**2862**	**4596**	**3031**
Nationality	Norway 96 % France 1 % Greece 1 % Other 2 %	Norway 89 % France 1 % Greece 1 % Iceland 1 % Other 8 %	Norway 66 % France 1 % Italy 1 % UK 1 % Spain 1 % Iceland 1 % Greece 1 % Other 28 %	Norway 29 % Italy 7 % Spain 3 % Canada 3 % Iceland 2 % UK 1 % Turkey 1 % Other 64 %	Italy 15 % Norway 6 % France 6 % Germany 4 % Poland 3 % Belgium 2 % Spain 1 % Other 63 %	Norway 21 % UK 9 % France 3 % Italy 3 % Greece 3 % Canada 2 % Poland 2 % Other 57 %	Norway 10 % Italy 9 % France 8 % Uk 6 % Czech Republic 5 % Spain 4 % Germany 3 % Other 55 %	Norway85 % Italy 1 % Czech Republic 1 % Germany 1 % Other 12 %	Norway 57 % Germany 6 % Italy 2 % Greece 1 % Ireland 1 % Czech Republic 1 % Monaco 1 % Other 31 %	Norway 14 % Germany 4 % Spain 4 % Canada 3 % Italy 3 % US Educational 2 % Czech Republic 2 % Other 68 %	Norway 32 % Italy 4 % Spain 4 % UK 3 % France 3 % Ireland 2 % Germany 2 % Other 49 %	Norway 9 % France 7 % UK 5 % Canada 2 % Greece 2 % Spain 2 % Italy 1 % Other 78 %	Norway 4 % Greece 2 % Spain 2 % Czech Republic 2 % UK 2 % Israel 1 % Italy 1 % Other 86 %

Nationality among visitors with a usage lower than 1 % is not listed. Those visiting countries are among others: Netherlands, Mexico, Chile, Egypt, Finland, Sweden, Japan, Australia, Brazil. Those in the group “Other” may also be users from those countries already listed.

Monthly statistics for the period 1 January – 31 december 2007 (continued)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Visits	**481**	**513**	**1150**	**1094**	**1311**	**1899**	**1655**	**1180**	**912**	**797**	**1067**	**1045**
Hits	**6193**	**6513**	**10890**	**11568**	**14586**	**18445**	**13564**	**9940**	**11251**	**9955**	**14816**	**9587**
Files loaded	**3336**	**3788**	**7231**	**7767**	**9765**	**11308**	**7962**	**5861**	**6205**	**5496**	**7280**	**5093**
Nationality	Italy 4 % France 3 % Germany 2 % Greece 2 % Iceland 2 % UK 2 % Spain 2 % Other 83 %	Norway 6 % Italy 4 % Greece 4 % UK 3 % France 2 % Portugal 2 % US Educational 3 % Other 74 %	Norway 9 % France 4 % Iceland 4 % UK 3 % Italy 3 % UK 3 % Czech Republic 2 % Greece 1 % Other 74 %	Norway 9 % Greece 9 % UK 4 % Italy 3 % France 3 % US Educational 2 % Chile 2 % Other 68 %	Norway 7 % UK 4 % Italy 3 % Spain 3 % France 2 % Greece 2 % Canada 2 % Other 77 %	Norway 7 % Uk 3 % Chile 3 % Italy 2 % Spain 2 % Canada 2 % Netherlands 1 % Other 80 %	Norway5 % UK 3 % Spain 3 % Germany 3 % Italy 1 % Canada 1 % Ireland 1 % Other 83 %	Norway 5 % UK 3 % France 2 % Chile 2 % Germany 2 % Finland 1 % Australia 1 % Other 84 %	Norway 5 % Spain 3 % UK 3 % France 3 % Italy 3 % Chile 2 % Canada 2 % Other 79 %	Norway 4 % France 4 % UK 3 % US Educational 2 % Italy 2 % Canada 2 % Chile 1 % Other 82 %	Norway 5 % UK 3 % Greece 2 % Italy 2 % Japan 2 % Canada 2 % France 1 % Other 83 %	Norway 5 % Spain 4 % Turkey 3 % France 3 % Italy 2 % Greece 2 % Other 89 %

Nationality among visitors with a usage lower than 1 % is not listed. Those visiting countries are among others: Netherlands, Mexico, Chile, Egypt, Finland, Sweden, Japan, Australia, Brazil. Those in the group “Other” may also be users from those countries already listed.