Chapter 35
Commercial Production: Factors for Success and Limitations in European Percid Fish Culture

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Abstract Percid farming is still in its infancy; however there are already a handful of commercial ventures successfully producing percids. The underlying factors for success for these companies include the introduction of technology that allows a more intensified production that is independent of season, such as RAS systems and the development of out of season spawning. General know how in these companies and research institutions is also accumulating over time. Continued investment in "learning" has resulted in some companies being able to break the barrier of pilot production and move into commercial production. There are still limitations for further upscaling of production. For established companies these include, domestication, stabilizing and streamlining production, slow growth in larger fish and nutrition. New enterprises find it difficult to find financial backing when there is a lack of general information on Percid markets; basing their sales projections on local traditional market prices. Lack of veterinary knowledge of percids and a working knowledge of RAS systems are also limiting in some countries. Finally, there are recommendations for future development necessary for improving production.

Keywords Eurasian perch • Pikeperch • Production system • Investment • Market

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35.1 Introduction

Percid culture is still in its infancy, where the level of production development is farm specific. Limitations for further expansion and/or the criteria for success are therefore also site dependent. The challenges that affect operators in the infancy of their production (e.g. implementing husbandry protocols, reducing losses due to deformities and cannibalism, establishing controlled breeding and water quality management) are very often different to those companies that have an established production. There may still remain some bottlenecks in scaling up their production, such as market development, development of broodstock management and domestication, or financial issues in the currently depressed financial climate. The perceived success criteria and current limitations described in this section are summarised from information gathered from individuals assisting the industry or directly involved with percid farming.

35.2 Successes

35.2.1 Technology Driven Production

As described in Chap. 32, there are different forms of production, from outdoor traditional ponds mainly producing percids as bycatch, to intensive, highly recirculating indoor production. In Europe, the traditional production of percids has been extensive and in ponds. In USA percids have been largely produced for restocking, stock enhancement or replenishment of the natural fishery. Eurasian perch and pikeperch have been stocked in Europe as a byproduct or have been regarded as a method of biocontrol (feeding off smaller fish species in ponds) and secondary species to e.g. carps. What is common for all types of production is that in order to rationalize and at the same time increase commercial production, pikeperch and perch farming has been transformed from traditional extensive production in ponds to more controlled and intensified production in indoors facilities with full water treatment and recirculation; if not for all of the production cycle then for parts of it.

With a shift of focus for percids as a farmed species, traditional large earthen ponds do not lend themselves to intensifying production. Percids are highly carnivorous and require nutritional supplementation with a high protein diet if they are to be farmed in more intensive conditions. In addition to this, many locations chosen for percid culture have less than optimum ambient water temperatures required for good growth. The location of the farms is usually determined by the natural distribution of percids; within the northern hemisphere in temperate or semi temperate environments. In these instances production time can be as much as 3–5 years for both Eurasian perch and pikeperch production (Adámek and Kouřil 2000; Adámek et al. 2012; Policar et al. 2009, 2011). The use of controlled temperature conditions in indoor facilities has drastically shortened the production time (12 months for market sized Eurasian perch and 13–15 months for market sized pikeperch). Problems of “Winter kill” that are experienced by some farmers are avoided in indoor facilities.

In addition to this, production can be better rationalised with indoor recirculated systems (as the standing biomass is known continuously throughout the cycle) and harvests can be forecasted well in advance, allowing the possibility to secure a decent market price. These basic improvements in production make an indoor facility more appealing.

35.2.2 Out of Season Spawning

The spawning season for percids is controlled by water temperature and/or light profiles (as described in Chap. 3). Percids are single spawners and their natural spawning time is already well synchronized, where spawning can be completed within a matter of weeks. Traditionally in ponds there is a single spawning event per year, following the natural breeding cycle. This single spawning effect is seen as a limitation. Firstly, all production would occur at the same time resulting in a glut of fish on the market competing with the wild fishery. Secondly, development of production techniques and relevant experience are retarded. Efforts have been made to expand this window of spawning in natural systems by exposing females to hormonal intervention and/or forced temperature photoperiod changes by removing some fish from ponds and artificially heating the water earlier than is experienced in nature. This can allow for multiple spawning events a year, e.g. one in March/April and a second in August, thereby leading to efficient utilization of hatchery facilities. This protocol has been used in the Czech Republic and in Germany (e.g. Müller-Beleke and Zienert 2008). In indoor facilities, spawning time can be completely controlled and several spawnings a year can be achieved. Where several breeding periods have been achieved, there has followed acceleration in experience and development of appropriate husbandry techniques early on in the investment phase, leading to the successful production of juveniles and market sized fish.

Controlled reproduction, using hormonal intervention, is also perceived as a way of improving the synchronicity of wild breeders, and to make use of the phytoplankton community for pond reared juveniles as used in traditional systems. However, for several farms, use of hormones is not preferred, mainly due to the current legislative rules for use of hormones in farmed fish for consumption. In addition to this, the amount of handling stress for the fish under hormone treatment may affect the quality of the gametes produced. It is well known that wild breeders that are exposed to handling tend not to survive after the spawning season and cannot be reused.

35.2.3 Continued Investment

Examples of successful percid production have been based on continued investment during the "learning phase". In most cases, the successful percid farms have been established by large companies that have their main income in another service and/

or production that have branched out into percid farming as a form of diversification in production. These companies have also rationalized and accepted the long payback time on investment.

35.2.4 Knowhow

The knowledge of production has reached a critical mass where it can be the driving force to look at production of these species more seriously. In Europe, two EU CRAFT projects (Percatech and Luciopercimprove) with a main goal to secure the production of juveniles for both Eurasian perch and pikeperch succeeded in creating a network for knowledge transfer between participating companies (from Ireland, Denmark, The Netherlands, France, Poland and Czech Republic) and researchers that is still viable today. Similar networking efforts are being made by the newly established European Percid Fish Culture (EFPC) forum.

In both the US and in Germany there are practical training courses for the production of Walleye and Pikeperch respectively.

In Ireland, through support from state funded BIM, production of perch increased relatively quickly by taking the basic production knowledge created at a pilot farm and replicating it to further units that could then start producing right away. Through technology transfer such knowledge has been to the benefit of companies across Europe. It is symptomatic in the history of development of new species that it is quite often the farms created further down the road that succeed, having learnt from the mistakes of the pioneers. In Denmark, national funding supported a local university (Danish Technical University) in collaboration with a local fish farming company to improve the performance of pikeperch production in intensive recirculated systems (Steenfeldt et al. 2010).

35.3 Limitations

Potential for RAS based production is large and there is talk of many new RAS farms producing up to 500 tons. As yet, few are reality. There are still some perceived challenges in production that need to be addressed for the industry to expand and develop.

35.3.1 Domestication

Domestication of percids is at different levels depending on the individual farms level of development. However in general the level of domestication in Europe is around level four, i.e. "*where the entire life cycle is closed in captivity without wild* *inputs*, *but no selective breeding program is used*" (as defined by Teletchea and Fontaine 2012). As yet both pikeperch and Eurasian perch broodstock material has not been through a process of active selection. Moreover, the most important traits for selection have still to be identified. Up to now, a relaxed form for selection has been performed where potential candidates from the first generations of fish that have survived captivity have been selected for by the farming system itself. It is now agreed among farmers that a more proactive form for selection is required. Active selection in other fish species (such as Atlantic salmon and to a lesser degree European seabass) has shown an improvement of growth rates (around 113 % over just five generations for salmon, Gjedrem and Baranski 2009). Another issue with percids is that the potential for inbreeding is relatively high, as females are extremely fecund and there is a temptation to use few females to fill a hatchery over a short period of time. Although it is accepted that some kind of breeding program for these species could be useful, it is extremely costly to maintain a breeding station in indoor facilities, and in most cases outside the financial scope of an individual farmer. In USA, a domestication programme is underway for yellow perch (described by Rosauer et al. 2008). For restocking/stock enhancement/replenishment programs, selection is based on the best genetic representation of the standing stock of fish they are replenishing and selection is not an aim. Such a broodstock program for percids in Europe would no doubt be of benefit to the industry but requires a production scale not yet achieved. A successful broodstock program may require transnational funding and be based at an independent facility for the benefit of all commercial companies.

35.3.2 Stability of Production

As stated earlier, production of both perch and pikeperch in Europe is small and scattered, with only very few farms producing over 100 tons per year. In the low production farms, which are mainly traditional farms, production is unknown until harvest and can vary from year to year. The main bottleneck in instability is in production of juveniles. This can be due to poor environmental conditions (e.g. cold spring or late summer for outdoor systems) or bad egg/larval quality or a combination of factors. For those establishing a production there is a tendency in their management plans to budget first with growout and buy in juveniles, mainly to avoid the complexity of rearing juveniles in the startup phase. However, this results in these farms being vulnerable to both the price change for juveniles (one of the higher expenditures in production) and a lack of juveniles available on the market during the time when they need fish. Also for the juvenile producer, there is instability of sale as a result of on growers assessing the juveniles available from the local fishery (which are cheaper). This decoupling of production of juveniles and demand of fingerlings for growout needs to be solved. In many cases farms that have a larger established production have been forced to produce juveniles themselves due to a lack of juveniles available on the market. Indeed the majority of the larger successful percid farms in Switzerland, Denmark and Ireland all have vertical integration of juvenile production, on growing and processing ability. Such integration removes the reliance on external third party operators and gives the companies more control of the entire process.

35.3.2.1 Slow Growth

There is still much room for improvement with respects to growth rates (as described in Chaps. 12, 13, 14, 15, 16, 17, 18, and 19) particularly in the later stages of growth. Efforts to address this genetically are being considered, such as, all female production, genetic selection, hybridization and triploidy (as described by Rougeot and Melard 2008, and Chap. 23 of this book). As yet, the only example of this type of genetic advances is with the successful hybridization of Walleye and Sauger in the U.S. and Canada (this hybrid being known as the saugeye). This hybridization of walleye eggs with sauger sperm produces a hybrid which is a superior production fish to both pure walleye and saugere (Malison et al. 1990). Growth rates are faster and it is more robust to suboptimal water quality conditions. In general, the markets are already extremely sensitive so various possibilities for advances in production by genetic manipulation must be rationalized by the markets acceptance for these products. Percid producers can to an extent minimize the effects of slow growth by producing multiple spawnings of large quantities of larvae and selectively culling slow growers. Whilst not the most efficient method, it is none the less the most economical approach at the present time.

35.3.2.2 Nutrition

Live food is still superior for both broodstock and larvae, which is not possible to produce in indoor facilities. However, there are many commercial diets for other fish species that have most of the dietary needs, particularly for ongrowing (see Chap. 20).

Larval and juvenile production in pond systems is reliant on the natural food available. With careful control of plankton composition it may be possible to allow a longer period of potential juvenile production. This is currently still in the testing phase. It is certainly not possible to produce fingerlings during the winter months in natural systems, due to lack of available food.

Deformities in fingerlings are usually associated with larval rearing in RAS systems. Inadequate nutrition both at the broodstock and larval stages (see Chap. 20) and husbandry practice (see Chap. 9) can result in high percentages of deformity. Traditional production usually results in fewer but high quality fingerlings. A limiting factor for most percid growers is the lack of proprietary diets for pikeperch and perch. A range of diets designed for seabass, seabream, cod, catfish and turbot are used by the sector. Such diets may include most of the required constituents for acceptable percid growth but also could be limiting performance. Whilst some work has been done on assessing nutritional requirements for percids (see Chaps. 20 and 22) it is unlikely that commercial proprietary diets will be developed until the scale of the industry is commercially attractive to feed companies.

35.3.2.3 Finance

Percid species lend themselves to recirculation technology in that they are, at the moment, a high value species, which is necessary to cover the costs of current recirculation technology. However there is still some effort needed to reduce the cost of investment and maintenance of recirculation technology. RAS systems also require a substantial crop to be produced to pay off operating costs. It is suggested that a minimum production of 300 tons Eurasian perch or pikeperch (most development plans are for 500 tons pikeperch RAS systems) is necessary to cover the costs of investment in a reasonable payback time.

Establishing the production of percids in RAS is a large initial capital investment and a continued investment for operational costs until stabilization of production is in effect. Experience with small enterprises has shown early bankruptcy due to lack of financial support when it is needed at the start. Most investors are not willing to pay the "learning fees" at the start of production development.

Financial support through local, municipal and national funding schemes to support in initial building phase and through networking with other producers and local research institutes, has boosted the interest in Percid farming (e.g. Kupren et al. 2010; Turkowski et al. 2010). Production at the end of the day should not be solely dependent on funding. Where this has happened, production has only been possible for 2–3 years and then development stops.

35.3.2.4 Markets

Percids are still a niche product and the unit price is bound to the auction price for capture fisheries (Watson 2008; Dil 2008). There is a lot of tradition surrounding the products and small markets are based where the fish is traditionally caught, which in some cases can be seasonal. These markets are extremely sensitive to saturation with locally caught product, and the low prices that ensue. It is natural for these markets to demand that the product comes from the local area whether it is fished or farmed. This puts a limitation on where the fish can be produced, how much can be produced, and that the fish resembles the locally caught product. However, it has been experienced recently with other newer aquaculture species, e.g. turbot, that as more products enters the market there are new side markets being created. The market size for pikeperch in Germany is around 800–1200 g whole fish. However there is currently a growing demand for smaller fish of 500–700 g. This cuts down the production time by 3–4 months for market sized fish. In France larger pikeperch are more desired (2 kg plus) which requires a longer production time. These factors have to be included when making a business plan.

There is currently a lack of good quality data on percid catches and market prices, thus there is little data to base a business model on production needs (Watson 2008). Understanding the market needs is crucial. In most cases new farms are being rationalized around local traditional market demands. However, export markets are vital for long term survival.

Success for established percid producers has been based on a thorough knowledge of the market and an already well-established market chain for fish products that could be used to channel their farmed product on to the market already early on in the production development phase. Reliability of product delivery is important to create a stable income. It is therefore hard for a novice fish producer to have stability in their production early on so that payback on investment is within a reasonable period of time. Fish and fish processing markets in central and Eastern Europe are still underdeveloped (Turkowski and Lirski 2010).

35.3.2.5 Veterinary Control

There is still a lack of veterinary surgeons that have a working knowledge of fish diseases in general. Diseases of pikeperch are even less well known (Chap. 31). Therefore it is up to the farmer to learn what the symptoms are for percids and be able to interpret them for an effective treatment. Pikeperch (AquaPri pers. com) and walleye (Barton and Barry 2011) have a reputation for being particularly sensitive to bacterial loading and stress. Thus handling regimes during e.g. grading or transport have to be well thought out. Also, finding the right therapeutics for treatment (particularly those that are not also detrimental to the biofilter system in RAS systems) is currently empirically tested on site.

35.3.2.6 Knowhow on RAS Systems

Expertise in biological factors associated with production is well established within the university system; however, RAS still requires expertise, also with designing a new system. Carp protocols have already been successfully used for development of percid farming in Eastern Europe. However the move over to more intensive systems is currently limited by the local knowledge of large scale water treatment systems for fish culture.

35.3.3 Future Developments for Percids

Below is a list of topics requiring further development for improving the performances and profitability of percid production.

1. Suitable diets for broodstock, fry stages. Broodstock diets will influence the egg quality and therefore the larval robustness and viability. Removal of need

for live feeds would be a major step forward. Bioavailability of nutrients in fry/weaning diets. Deformities occur even when diets contain adequate levels of nutrients required for normal growth and development of larval and juvenile fish.
2. Good therapeutics that can be used in RAS systems.
3. More formalized domestication and selection programs for percids. National, regional or international (centralized) programs or a combination of these.
4. Development of all female production.
5. Triploids and hybrid productions producing sterile and/or faster growing fish. Will future markets accept these products? Reduce costs of production.
6. Understanding of recirculation technology and development for further intensifying production and introducing greener technologies (energy saving).
7. Market development and expansion local – supermarket chains.
8. Development of a market price that is not directly coupled to capture fisheries.
9. Product development to include value added products.
10. Policy and infrastructure at local and national level to allow development into fish farming.

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