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IS COMMERCIAL YELLOW PERCH PRODUCTION IN THE US feasible?

by Bill Manci

Historically, yellow perch, *Perca flavescens*, has been an important species in the North American Great Lakes region and in other areas of the United States and Canada (Scott and Crossman, 1973). Prized as a foodfish and sportfish, yellow perch populations in the Great Lakes underwent dramatic decline during the 1960s and early 1970s (Lesser and Vilstrup, 1979). Despite the severe decline in yellow perch supplies from the wild, demand for yellow perch remained high for more than 30 years (Riepe, 1998). For this and other cultural and economic reasons, interest was sparked during the early 1970s and in subsequent years at several academic institutions (e.g., University of Wisconsin, Michigan State University, North Carolina State University, Purdue University, Ohio State University) in the development of technologies to produce yellow perch in aquaculture systems.

As with any candidate aquaculture species, questions of life history, reproduction, feeding ecology, nutrition, adaptability to culture environments, as well as many other biological and economic factors required assessment, characterization, and analysis before successful full-scale commercialization of yellow perch as an aquacultured species could occur. Malison (1999) recently prepared a review of the status of research, assessments, and other efforts toward commercialization. Research efforts on yellow perch continue today. Indeed, past and ongoing efforts paved the way for the current and growing interest in yellow perch aquaculture.

While other candidate species may have progressed to commercialization in the United States more rapidly than yellow perch (e.g., tilapia, hybrid striped bass), the move to bring yellow perch to true commercial status is, in my view, undeniable and well founded. This view, however, is not held by all. In this article I opt for a comparative approach with 'real world' fishes. My approach compares yellow perch to some commercially established US aquacultured species.

Rankings Comparison

Grow Rapidly To A Large Size

It is generally claimed that yellow perch grow more slowly than other aquacultured species. However, the market size for yellow perch foodfish (115-150 g, whole fish) is consistently smaller than for most other aquacultured foodfish. As such, required grow-out times tend to be shorter than they would be if the market demanded larger fish. This market characteristic tends to mitigate slower growth rates for yellow perch. Also, note that good management practices (e.g., maintenance of good water quality, low levels of stress) play important roles in maximizing the growth potential of fish in general (Schreck and Li, 1991), including yellow perch, and can play a critical role in achieving the economic goals of a yellow perch production facility, and ultimately can influence facility success or failure.

Reach Market Size Before Reaching Sexual Maturity

Yellow perch rely on environmental cues—specifically, decreasing photoperiod and temperature (Heidinger and Kayes, 1986)—to trigger gametogenesis. In the absence of these cues, such as is the case in environmentally controlled grow-out systems (indoor and outdoor), gametogenesis and a subsequent attenuation in somatic growth are not issues, and maximum somatic growth can continue unabated. Even in outdoor pond systems, the onset of gametogenesis before reaching market size is not a foregone conclusion, and is manageable if some control over system water temperature, nutrition, and other exogenous factors is possible. In time and as research with yellow perch progresses, some believe that genetic selection and manipulation will produce yellow perch that display postponed sexual maturation.

Readily Accept a Formulated Diet

Based on 24 years of personal experience, I conclude that yellow perch are no less likely to accept artificial feeds than other aquacultured species after reaching a size of 50 mm TL. My opinion is strongly supported by other professionals who worked with yellow perch for many years. First feeding can be problematic, but yellow perch feed vigorously on formulated diets and perform well, even on diets not specifically designed for yellow perch.

Feed Fairly Low On The Food Chain

Yellow perch do in fact feed low on the food chain with a diet in the wild that consists of zooplankton, insects and other benthic organisms, and only occasionally (when presented with an opportunity) small fishes (Scott and Crossman, 1973; Becker, 1983; Thompson, 1985; Heidinger and Kayes, 1986; Craig, 1987). By all accounts, yellow perch are poor swimmers (Heidinger and Kayes, 1986; Craig, 1987) and therefore lack the physical competency to compete effectively at higher levels in the food hierarchy. Research has shown that the optimal dietary crude protein requirement for yellow perch is in the range of 21-27% (Ramsmeyer and Garling, 1997), suggesting that relatively low-cost diets should produce acceptable results when used for yellow perch aquaculture.

Not Cannibalistic

I find the behavior of yellow perch with respect to cannibalism to be relatively benign, both on an absolute basis and certainly relative to many or most other aquacultured species, even other species within the family Percidae. For example, based on my experience and the experience of others, walleye (*Stizostedion vitreum*) can be very cannibalistic (Kinnunen, 1996; Summerfelt, 1996), while yellow perch are much less so than walleye. Popular aquacultured species of the family Centrarchidae (e.g., bluegill [*Lepomis macrochirus*] and largemouth bass [*Micropterus salmoides*]) are generally considered cannibalistic (Avault, 1996). The same may be true for rainbow trout (*Oncorhynchus mykiss*), Atlantic salmon (*Salmo salar*), and other salmonids. My viewpoint that yellow perch are relatively less cannibalistic than many other aquacultured species is supported by other professionals, both in the public and private sectors, who also cite good management as a key factor in minimizing cannibalism, regardless of species. At a minimum, others assign yellow perch a neutral ranking.

Show Uniform Growth In Size

I argue that the value of uniformity in size is marginal at best, and in fact could in many cases present a problem from the perspective of marketing fish. If all fish in a production cycle achieve market size at the same time, a producer may be forced to flood the market with fish and could drive down the price received for the fish. Conversely, fish within a species that grow at different rates (because of sexual dimorphism or individual genetic variability, as is the case with yellow perch) could be viewed as more valuable from a marketing perspective, as they achieve market size in a less uniform manner. However, another argument could be made that uniform growth is important as a means to minimize management effort and costs (i.e., sorting and grading), and the effects on prices are negligible. Finally, management plays a key role in managing and minimizing growth differences. Regardless of one's position on this issue, undoubtedly (as seen with fully commercialized species) differences in yellow perch growth between individuals and populations will diminish as more control is exerted over time through artificial selection and genetic manipulation. As such, I reject this as a valid characteristic.

Readily Reproduce

By definition, all extant species readily reproduce. More characteristic of yellow perch is that they "Readily spawn in captivity." (Heidinger and Kayes, 1986; Malison, 1999).

Produce Large Numbers Of Offspring

Oviparous fishes produce large numbers of offspring, particularly those species that do not exercise parental care over eggs and offspring (i.e., a safety in numbers approach to reproduction, Bone et al. 1995). Additionally, the word "large" is quite subjective and open to a wide range of interpretation.

Fairly Disease-Resistant

Yellow perch are by no means bulletproof with regard to disease, and can suffer from a variety of bacterial, fungal, and parasitic infections. However, they are no more susceptible to disease than other species, according to an aquatic veterinarian with extensive experience in diagnosing and treating diseases of yellow perch and other aquacultured species and other experienced researchers (Sedgwick 1982; Kent,1992). Additionally, production system management plays a very important role in the nature, frequency, and severity of yellow perch disease outbreaks (e.g., M. Kebus, B, Hahle, and J. Malison, personal communications), as it does with all aquacultured species.

Produce Offspring Large Enough To Accept Pelleted Feeds At First Feeding

Developing acceptable first feeds for yellow perch has been challenging and a subject of ongoing research. However, evidence exists of real progress in habituating early-fingerling yellow perch (<15 mm TL) to artificial diets (North Central Regional Aquaculture Center [NCRAC], 1997).

Easily cultured under high rearing densities

Research has shown that yellow perch thrive under rearing densities and flow indexes that compare quite favorably to those tolerated by rainbow trout and salmon (Piper et al., 1982; NCRAC, 1992; NCRAC,1993; Soderberg,1995; NCRAC, 1997), perhaps because in nature they are a "strongly schooling fish" (Becker,1983).

Tolerant Of Poor Water Quality

My own research relative to ammonia and nitrite toxicity in yellow perch (Manci and Quigley,1981) and the research of others relative to oxygen tolerances, especially compared to other fishes (Carlson et al., 1980; Craig,1987; NCRAC, 1992), indicate that yellow perch show excellent tolerance to low water quality. Others concur with my assessment and the scientific literature, and rank yellow perch with a positive or neutral score. Certainly compared to salmonids such as rainbow trout and Atlantic salmon, yellow perch display a high tolerance to ammonia and nitrite (Manci and Quigley, 1981; Piper et al., 1982) and an increased tolerance to low levels of dissolved oxygen (Piper et al., 1982; Sedgwick,1982; Solbe, 1988). Indeed, Becker (1983) stated that "Yellow perch are quite tolerant of low dissolved oxygen levels, and have been known to survive winterkill conditions under which

Aquaculture Magazine Jan/Feb 2001

Volume 27, Number 1

bluegill (*L. macrochirus*), largemouth bass (*M. salmoides*), and walleye (*S. vitreum*) have suffocated." Additionally, Becker (1983) reported a toleration threshold for yellow perch of about 0.3-0.4 mg/L.

Market Value That Exceeds Production Costs

Yellow perch, as an aquacultured species, is still in the process of realizing its full commercial potential. Regardless of their current commercial status, some feel strongly that cultured yellow perch deserve a favorable ranking in this category. The current financial success enjoyed by a significant number of private-sector producers must be seriously considered. For example, during January 2000, the North Central Regional Aquaculture Center sponsored a Yellow Perch Forum attended by over 40 current producers of yellow perch. System scale, size, and design are crucial elements in determining the long-term financial success of yellow perch aquaculture facilities as well (C. Starr, personal communication). What cannot be disputed is that yellow perch have a high market value compared to catfish, trout, and other freshwater species that are successfully aquacultured or that have significant aquaculture potential.

Ideal Culture Characteristics

I view the following five traits as extremely important and worthy of inclusion in a table of ideal culture fish characteristics. Clearly, they address issues of biology and economics that can be critical to the technical and financial success of an aquaculture operation, and the commercial success of any species.

Eggs/Fry Easily Produced From Captive Fish

Yellow perch clearly rank positive for this characteristic (Heidinger and Kayes, 1986; Malison, 1999). Yellow perch will spawn in tanks as well as ponds, or may be hand-stripped of eggs and sperm, producing large quantities of each (Heidinger and Kayes, 1986). Using a variety of spawning methods, fertilization rates may exceed 90%, with hand-stripping methods producing the highest consistent rates of fertilization (Heidinger and Kayes, 1986; Malison, 1999).

High Yield Of Edible Flesh

Bennett (1998) indicated that his company realizes an average yield for all yellow perch of 45%, regardless of their sex or reproductive status, which is significantly higher than that of tilapia or catfish. Most yellow perch processors obtain yields of 43-52% for sexually immature fish and 35-43% for sexually mature fish of both sexes (J. Malison, personal communication). While wild-caught yellow perch routinely go to market, in my view, this is not true or uncertain with regard to aquacultured yellow perch, and should not be used as part of an argument against the culture of yellow perch.

Flesh Freezes And Stores Well

According to those with whom I discussed this issue, there is again positive and unequivocal unanimity that yellow perch flesh freezes and stores well. According to Kayes (1989), "The perch's firm flesh, low fat content and phospholipid content are conducive to products having a long shelf life and resistance to freezer damage."

Tolerant To Wide Range Of Temperature

While optimal temperatures for yellow perch growth fall in the range of 21-24° C (Kitchell et al., 1977), yellow perch routinely survive water temperatures down to or just above freezing (Craig, 1987). The upper limit of their temperature tolerance is reported to be >33 C°(Collette et al. 1977).

Tolerant To Wide Range Of Salinity

The range of yellow perch in the wild extends to, and includes, estuaries such as Chesapeake Bay (Thompson 1985), where salinity is highly variable and can range from 0 ppt to that of full-strength seawater. Physiologically, yellow perch are relatively adaptable (Craig, 1987). As such, an ability to tolerate a wide range of environmental conditions is not surprising.

Other Issues

The true wholesale and retail prices paid for yellow perch are frequently reported (Riepe, 1998). The highest prices that I have seen reported were for fillets sold at the retail level, which in 1986 were US$8.00-17.50/kg (Heidinger and Kayes, 1986) and in 1999 were US$19.84-33.07 (Malison, 1999).

Hoven (1998) developed a model for a 22,727kg/yr water-recirculating yellow perch production system and calculated a break even operating cost of US$5.68/kg for fish in the round (which translates to US$12.62/kg for fillets, assuming a 45% yield). Based on the price ranges listed above, profitable production certainly is not inconceivable and is indeed entirely probable.

Conclusions

Many can agree that yellow perch are not an aquaculture panacea. Gaps in our knowledge about this species, and our capabilities with respect to it, do exist, as they do for other candidate aquaculture species. Successful yellow perch aquaculture requires skill and experience, a thorough understanding of the animal's biology and temperament, and most important, appropriate technical and business management. Indeed, many people who attempted to commercially raise yellow perch have failed. To a large extent, those who failed developed poor business plans, poorly designed systems, or did not adequately prepare themselves or take the time to truly familiarize themselves with the characteristics of the species. In fact, a management team with specific experience in yellow perch production is just as important, if not more so, than a good business plan or well-designed facilities. Often the management components of a system are secondary in the planning process—an error that can ultimately lead to failure. These half-hearted, good-intentioned attempts only tarnished what would otherwise be a good record for yellow perch. Note also that failures by companies with other species (e.g., Simplot with tilapia, Weyerhauser with salmon, Coca-Cola and W. R. Grace with shrimp) did not signal the end of those respective aquaculture industry segments, and indeed those segments are thriving today. Past production failures with yellow perch do not signal an end to yellow perch aquaculture.

I see a bright future for yellow perch aquaculture—a future that demands thoughtfulness and hard work by those who accept the challenges. While the challenges are real, success is attainable and demonstrable, and the rewards, both professional and financial, are real as well.

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See: Issue January/February 2001, page 26