Limited Entry in Recreational Fisheries—Has Its Time Come?

Richard W. Luebke, *Texas Parks and Wildlife Department, HC 07, Box 62, Ingram, TX 78025*

Robert K. Betsill, *Texas Parks and Wildlife Department, HC 07, Box 62, Ingram, TX 78025*

Abstract: The relation between catch and effort is examined in the context of recreational fisheries. The concept of limited entry as a means of increasing angler catch rates is developed, empirical data demonstrating the catch-effort relationship are presented and ramifications of limited entry in fisheries management are discussed. Limited entry may have a place in the future of freshwater fisheries management.

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The idea of limiting the number of individuals allowed to participate in a fishery (limited entry) is not new. In North America, one of the earliest examples was a restriction on the number of vessels allowed to harvest eastern oysters *(Crassostrea virginica)* in New York in 1679 (McHugh 1978). A similar restriction was placed on the number of fishing boats allowed on the Fraser River, British Columbia, in 1889 (Frazer 1978). During the 1960s and 1970s, numerous entry limitation programs were implemented throughout North America for such species as American lobster *(Homarus americanus)* and salmon (*Oncorhynchus* spp.) (Rettig 1984). Recently, limited entry programs, particularly in marine systems, cover an increasing number of fisheries. For example, in Texas, limited entry has been implemented for management of inshore stocks of penaeid shrimp (*Penaeus* spp.) and blue crabs *(Callinectes sapidus)*, while the Gulf of Mexico Fishery Management Council has implemented limited entry for snappers (*Lutjanus* spp.) and is considering limited entry proposals for mackerels (*Scomberomorus* spp.) (R. K. Riechers, Texas Parks and Wildl. Dep., pers. commun.). The goal of limited entry in these fisheries has been to prevent overharvest.

Use of limited entry as a management tool for public freshwater recreational fisheries is virtually nonexistent. As Griffith (1989) reported, entry limitation in freshwater sport fisheries is still in the conceptual stage with undeveloped goals and objectives. In Ohio, however, small numbers of recreational fisheries are managed with a combination of size limits, harvest quotas, and control over angling effort (Goedde 1991). In Georgia, selected small public fisheries are open to angling only 3 days/week, thus indirectly limiting angler participation (K. Primmer, Ga. Dep. Nat. Resour., pers. commun.). And just recently, Hydrilla Lake on Florida's Tenoroc Fish Management Area has been managed with severely limited entry to maintain high catch rates of largemouth bass *(Micropterus salmoides)* (D. J. Moxley, Fla. Game and Fresh Water Fish Comm., pers. commun.). However, an informal survey of many fish and game agencies revealed limited entry programs generally do not exist at present for most recreational freshwater fisheries.

The purpose of this paper is to examine limited entry as a tool for managing recreational freshwater fisheries and to investigate the potential for limited entry to substantially increase angler catch rates in these systems.

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Importance of Catch

Though motivations for angling are many, perhaps it is intuitively obvious that catching fish is important to many anglers. Fisheries managers have long recognized the importance of catch. Studies by Bennett et al. (1978) and Miranda and Frese (1991) found most fisheries managers ranked catch-oriented goals as more important than non-catch-oriented goals. Likewise, surveys of anglers themselves have shown the importance of catching fish. For example, Costello and Betsill (1996) found the number of target fish caught was the most important factor for fishing success ratings of largemouth bass and white bass *(Morone chrysops)* anglers in Texas. Thus, management tools with the capacity to increase angler catch should be of interest to fishery managers.

Catch-Effort Relationship

Ricker (1975) graphically demonstrated the relationship between catch and effort using a chinook salmon *(O. tshawytscha)* troll fishery as an example (Fig. 1, Line A). As effort increases, so does total catch. However, the relationship is not linear. Instead, as effort increases, total catch increases more and more slowly. Inherent in Ricker's function is that catch rate (CPUE) declines with increasing effort. Although Ricker's model was developed for a commercial fishery, this same relationship should hold true for recreational fisheries.

To more easily visualize the catch-effort relationship in terms of catch rate, a parameter commonly measured for recreational fisheries, Ricker's (1975) model can be expressed with catch rate as a function of effort (Fig. 1, Line B). The exact relationship will surely vary among different recreational fisheries, but the overall characteristics should prevail. Salient features include a precipitous decline in catch rate as fishing effort increases, followed by a gradual leveling off of catch rate as effort continues to increase.

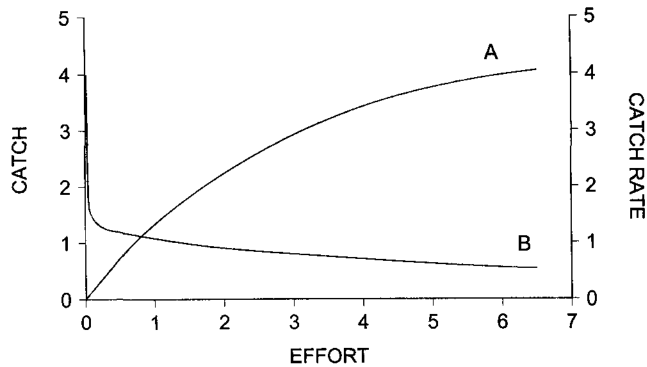

Figure 1. Graphic presentation of the relation between catch and effort. Line A shows catch (in thousands of fish) as a function of fishing effort (in hundreds of lines) for a chinook salmon commercial fishery (after Ricker 1975). Line B is a plot of the same data with catch rate as a function of fishing effort.

Empirical Evidence for Catch Rate-Effort Relation

Though data could be presented for a variety of species to support and discuss the catch rate-effort relationship, we have chosen information for largemouth bass, an important sport fish.

What is the maximum angler catch rate that could be expected for largemouth bass? According to the theoretical relationship presented in Figure 1, as effort becomes very small, catch rate approaches infinity. We submit that catching a fish every time a bait is introduced into the water represents the maximum catch rate from a practical perspective. Accounting for individual differences in size of fish, angling techniques, playing time, etc., the maximum practical catch rate is probably somewhere near 15–20 fish/hour.

Because it is expected that angling effort can negatively influence catch rate, data from unexploited fisheries would be best to validate maximum catch rates. In pond experiments in Texas, when a population of largemouth bass was first exposed to angling, through the first hour (effort = 15 hours/ha) the catch rate was 15.3 fish/hour (TPWD, unpubl. data). This likely represents a best-case scenario because largemouth bass density in the pond was 543 fish/ha. In contrast, creel data from Gibbons Creek Reservoir, Texas, following opening to public angling, showed catch rate of largemouth bass the first day was 0.40 fish/hour (Kurzawski and Durocher 1993). However, this catch rate was reduced because bass densities were likely much lower than in the pond study previously described. In addition, this catch rate represented an average for the whole day, not just the first hour of angling as in the pond study. Furthermore, though not quantified, the largemouth bass population at Gibbons Creek Reservoir had been exposed to some angling prior to the general public opening (Kurzawski and Durocher 1993), which would be expected to negatively impact catch rates.

Literature supports the sharp decline in catch rate that results from increased angling effort. Studies of opening day effects are particularly revealing. Redmond (1972) reported 19%–55% of adult largemouth bass in 5 Missouri lakes were removed by anglers during the first day of angling. Similarly, Hoey and Redmond (1972) reported anglers at Binder Lake, Missouri, removed 39% of the estimated population of legal-size largemouth bass during the first 2 days of angling. Goedde and Coble (1981), studying the effects of opening a previously unfished lake in Wisconsin, found most fish were harvested within the first 2 days after angling began. Bowers and Martin (1957), in 3 Kentucky lakes, found 70% of largemouth bass caught in the first week of angling were taken in the first 30 hours; after only 4 days, catch rates had dropped about 50%. Kurzawski and Durocher (1993) also reported about a 50% reduction in catch rates within 4 days after opening day at Gibbons Creek Reservoir, Texas.

Creel data from Texas were examined to see if they supported the catch rate-effort relationship previously described. Data for largemouth bass angling from 19 reservoirs from 1986 through 1993 were used. Directed effort ranged from 1.9 to 237.0 hours/ha/year and catch rate ranged from 0.07 to 1.11 fish/hour. The reservoirs included a wide range of characteristics in terms of geography, largemouth bass population density, regulations, and angling effort. It is likely the exact form of the catch rate-effort relation would vary among reservoirs. This would be expected because the reservoirs differ in such important factors as largemouth bass density, angler experience levels, etc. However, we would expect the Texas data to display some of the characteristics of our expression of Ricker's (1975) curve, namely an initial steep decline in catch rate as effort increases followed by a leveling off of the relation as effort continues to increase. A model in which angler catch rates decrease proportionally to the inverse of directed effort was used to mimic this. Because catch rates are derived from effort, we were limited in our ability to test for significant fit of the model. However, superimposing the function on the Texas data (Fig. 2) appears to provide a

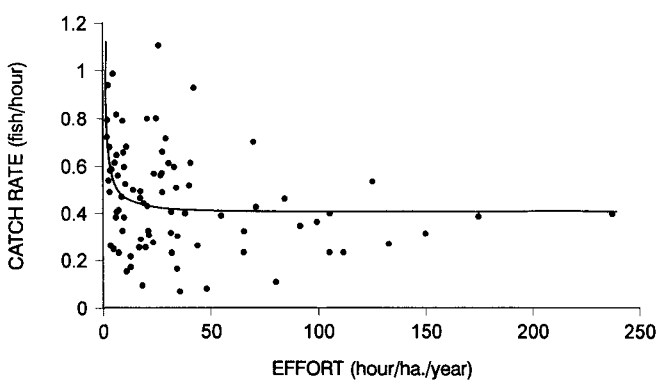

Figure 2. Catch rate and angling effort for anglers seeking largemouth bass from 19 Texas reservoirs, 1986–1993. The curve represents a model where catch rate decreases proportionally to the inverse of effort.

reasonable approximation of the relation between catch rate and effort for this amalgam of Texas reservoirs. Two features of the relationship bear mentioning. First, all of the highest catch rates (>0.75 fish/hour) occurred when effort was <50 hours/ha/year. Second, catch rates differed very little when effort exceeded about 50 hours/ha/year, even when it increased fourfold. Clearly, the data demonstrate the potential for increasing catch rates by reducing angling effort and that reductions to achieve measurable increases in catch rate may have to be substantial for some fisheries.

Are We Ready for Limited Entry?

Fishery managers can increase angler catch rates through a variety of measures. Commonly used techniques such as harvest restrictions or habitat/productivity enhancement are ultimately aimed at maintaining or increasing the density of fish in the population. Logic suggests higher fish densities could sustain higher angler catch rates. It also seems logical that there is an upper limit to which managers can increase fish densities. Even at the highest densities, we would expect the negative relation between catch rate and angling effort to hold. Thus, limited entry could further increase catch rates beyond that which managers could achieve solely through increasing fish density. Indeed, limited entry is probably necessary to sustain largemouth bass average catch rates >1 fish/hour under most circumstances in Texas.

Apparently managers are reluctant to apply measures designed to restrict the number of anglers in public fisheries. Is this because anglers do not want limited entry, or because managers do not want it? Griffith (1989) felt it was clear that interest in limited entry in trout fisheries was arising from anglers, not managers. It is not difficult to imagine anglers wanting less competition from other anglers in their favorite fisheries; angler opinion surveys could help resolve questions in this regard. Likewise, it is not difficult to imagine managers not wanting to propose limited entry, much less decide who gets to participate and who does not. As Rettig (1984) stated, limited entry will lead toward objectives only through sacrifice, and when confronted with sacrifice, careful attention by fisheries managers to equity is required.

Managers interested in limited entry can assure equity in implementation. A simply lottery system would give all interested participants an equal opportunity. This practice is common for public hunting administration; it could be similarly incorporated into public fisheries. Such an approach would allow all anglers to have an equal chance for both making the sacrifice and reaping the rewards.

Limited entry could be used to increase angler catch rates above those currently experienced by anglers on public fisheries. This would expand the spectrum of recreational opportunities (Driver et al. 1987), creating a whole new level of fishing quality for anglers who consider catch rate important. Greatly elevated catch rates could be particularly effective for attracting novice anglers and increasing the likelihood of successfully catching fish. This, in turn, could encourage such anglers to pursue sport fishing as a life-long hobby.

Because the catch rate-effort relationship shows angling effort must be dramatically reduced to realize substantial gains in catch rate, limited entry is probably something managers would want to ease into slowly. New management approaches, especially those involving severe restrictions, should be implemented with caution. They are generally implemented on a limited scale and evaluated in terms of effectiveness and public acceptance. As Rettig (1984) stated, fisheries management has, in common with other forms of public policy, a tendency to evolve by incremental changes.

A potential benefit of greatly elevated catch rates resulting from limited entry is revenue generation. It stands to reason that as the level of satisfaction rises, economic value of an experience likewise increases. Fee fishing operators would not make much money if their clients did not experience high enough catch rates. For example, a fee-fishing operation in Texas maintains angler catch rates of 5–10 largemouth bass/hour in ponds containing mostly 0.5- to 0.9-kg fish. Anglers are charged $305/day for this level of angling quality (R. Kerr, Danbury Fish Farms, pers. commun.). Some public fishery managers may have fisheries where they would be willing to give up some level of access in exchange for increased revenues.

Increased revenue generation through limited entry may not be achieved using a simple lottery system, as the level of revenue generation would be a function of anglers' desire and willingness to pay. This could be perceived by some angler groups as biased toward the affluent. A possible solution to this potential conflict would be to design a program whereby a portion of the overall participants pay for the privilege, while the remainder, those unwilling or unable to pay, are randomly chosen. This approach would give the manager latitude to weigh the tradeoffs involved.

An obviously negative aspect of limited entry is that while it provides fishing opportunities for those allowed to participate, it reduces the number of opportunities available to those who are excluded. However, the number of individuals excluded could be minimized by reducing the length of time anglers are allowed to fish. The public's acceptance of limited entry likely would be affected by the availability of alternative fishing sites and a perception of equity in the allocation of opportunities. Without angler acceptance, fishing license sales would likely be reduced.

Fisheries managers seldom use a single tool. Instead they use an integrated approach involving a variety of techniques. The amount of entry limitation needed to achieve a target catch rate will be dependent on a variety of other characteristics of the fishery. Managers desiring higher angler catch rates but unwilling to drastically reduce angling effort may be able to implement other compatible measures (e.g., catch and release, supplemental stocking, fertilization, etc.) to mitigate the need for more severe entry limitations. Because limited entry has generally not been used in freshwater recreational fisheries, the level of entry limitation as it relates to desired outcomes and other factors represents a research need.

Anglers seeking the highest catch rates of fish frequently go to private waters or travel to some exotic location. They consider fishing in public water only if it is a remote location where angling pressure is negligible. What this does, in effect, is establish the public fishery manager as someone whose best is not as good as that of others. Limited entry could serve to demonstrate public fishery managers can provide the "best." This in turn could elevate public perception of managers as consummate authorities, something that could improve managers' effectiveness in dealing with their constituents regarding other resource management issues.

Limited entry, like any other new management technique, carries with it a need for angler education. Just as sure as the rationale behind a new length limit must be thoroughly explained to the public before it will be accepted by them, so it should for limited entry. The obvious tradeoffs associated with limited entry are so stark they would provide an excellent example of the difficult task managers have to satisfy all user groups.

Is it time for limited entry to find a place in public freshwater recreational fisheries management, or will the words of Griffith (1989) prevail? He said, "So, although they may realize that limited entry could provide another level of quality angling, it is unlikely that fishery managers will be in the forefront of any movement to limit entry . . ." We submit they should at least consider it.

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