Evaluation of Fish Tags as an Attenuated Rights-Based Management Approach for Gulf of Mexico Recreational Fisheries

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Executive Summary

Introduction

Recreational fishing represents a popular and highly valued use of marine resources, with participation by a large percentage of the U.S. population. Nonetheless, many recreational fisheries, including a number of fisheries in the Gulf of Mexico (GOM) recreational reef fish complex, show trends towards shorter seasons, smaller bag limits and more restrictive size limits. Such trends, particularly when associated with failures to maintain harvest at sustainable levels, can significantly reduce the economic benefits of fishing realized by anglers, and anglers' expenditures (and associated economic impacts) in coastal communities. Catch-and-release activity associated with such restrictions can also imply significant release mortality, further threatening sustainability and long-term benefits. Finally, the tendency to impose homogeneous management methods over large spatial scales, paired with often heterogeneous local and non-local angler populations, can lead to angler dissatisfaction and further loss of economic value.

In response to such problems, and in recognition of the success of rights-based management approaches in commercial fisheries worldwide, there is an increasing interest in the potential application of modern rights-based approaches to recreational fisheries. However, while the principles of rights-based management offer the potential for significant improvements in the management of recreational fisheries such as the GOM reef fish fishery, there are practical complications with programs that assign long-term or *durable* fishing quotas to individual recreational anglers. While perhaps not insurmountable, these complications suggest that alternative rights-based management structures may be preferable and more cost-effective. One such alternative involves the use of harvest tags or stamps, such as those currently used to manage terrestrial game and waterfowl hunting in numerous areas of the US. While still a relatively uncommon means of recreational fishery management, fish tags may offer many of the benefits of rights-based management for recreational fisheries, while avoiding some of the more persistent concerns associated with other rights-based approaches.

The of this report purpose is to explore issues related to the potential adaptation of rights-based harvest tags to the Gulf of Mexico reef fish fishery, with an emphasis on red snapper and shallow-water grouper. This includes analysis of the key management features and characteristics of harvest tag mechanisms, a review of status and trends in Gulf of Mexico recreational reef fish fisheries, and a review of existing harvest tag programs in both recreational hunting and fishing applications in the US and worldwide. Based on this information, the paper discusses both opportunities and challenges associated with the potential application of harvest tags to the recreational reef fish fishery.

Programs Assessed

Conclusions in this paper are drawn from analyses of (1) the attributes, patterns and trends in the GOM recreational reef fish fishery, (2) the performance of existing rights based and non-rights

based approaches towards recreational fishery management worldwide, (3) the attributes and performance of selected nationwide hunting tag programs in various states, and (4) the attributes and performance of selected worldwide applications of harvest tags to recreational fisheries.

The paper summarizes nine state (or state-federal) harvest tag programs for terrestrial hunting or mixed hunting-fishing programs. These include the following: (1) the nationwide state-federal duck stamp program; (2) Oregon; (3) Montana; (4) Nevada; (5) Idaho; (6) Colorado; (7) Wyoming; (8) Florida; and (9) Maine. This does not represent a comprehensive review of all state harvest tag programs—many states have some form of tag-based management, for at least some species. The majority of these programs are quite similar in key management aspects, however, such that a reasonable understanding of nationwide programs may be provided by detailed coverage of a smaller number of representative programs. The review provided in the paper is meant to provide an overview of the range of different programs that exist, in terms of species, locations, objectives, and mechanisms.

The paper also summarizes eight of the better-known and more extensive harvest tag programs for recreational fisheries. This review is meant to provide an overview of the range of different programs that currently exist, in terms of species, locations, and objectives. Specific programs reviewed include: (1) the pink snapper fishery in the Freycinet Estuary of Shark Bay in Western Australia; (2) the recreational paddlefish fishery in the Missouri River below Gavins Point Dam in South Dakota; (3) the salmon and sea trout fishery in Ireland; (4) the recreational food-fish program for cod in Newfoundland; (5) the recreational tarpon fishery in Florida; (6) the recreational billfish fishery in Maryland and North Carolina; (7) the multispecies programs for recreational catch of salmon, steelhead, halibut and sturgeon Oregon, and; (8) the multispecies record card program in Washington State. The paper restricts its purview to programs that cover all recreational catch of the species being managed, and does not review programs that use tags to manage catches outside of slot limits (e.g. red drum in Texas) or allow catches in excess of normal bag limits (e.g. striped bass in New Jersey).

Principal Findings

Based on the above assessments, we draw the following general conclusions regarding the potential for harvest tags in the Gulf of Mexico recreational reef fish fishery.

1. Recent trends in management suggest that current regulatory mechanisms, including bag, size and season limits, have been unable to provide for sustainable fisheries and maximize the potential long-term benefits of the fishery to anglers. Rights-based management mechanisms offer a potential means to reverse such trends.

2. Harvest tags offer a promising mechanism to improve management of Gulf of Mexico recreational reef fish fisheries, based on concepts of attenuated, rights-based management.

3. Given the substantial number of private anglers who do not utilize the services of the for-hire fishery sector, and the unsuitability of individual fishing quotas (IFQs) management for such anglers, it is unlikely that IFQs would be appropriate for the entire recreational

reef fish fishery. Harvest tags offer a viable alternative that, with appropriate design, could be applied to both private anglers and the for-hire sector.

4. Mechanisms and examples currently exist for general types of harvest tag programs that would be most appropriate in the Gulf of Mexico recreational reef fish fishery. There is substantial experience in the US and worldwide with the implementation of harvest tag programs.

5. There are only a small number of programs in which harvest tags are currently used to impose hard harvest limits in recreational fisheries. Those examples and the much larger number of harvest tag programs for hunting, however, suggest that such programs can be successful.

6. Implementation of harvest tags for Gulf of Mexico recreational reef fish fisheries would require a larger number of tags than any other reviewed program that imposes hard harvest limits. The number of tags that would be required is likely not prohibitive to a successful harvest tag program, but would add to administration and implementation costs.

7. Given the likelihood of non-trivial pre- and post-release mortality in Gulf of Mexico recreational fisheries, the prevalence and impacts of this mortality should be a consideration when determining the appropriateness of harvest tags in Gulf of Mexico recreational fisheries, implications for species harvest and mortality, and the number of tags that should be issued.

8. Allocation and distribution issues are likely to be among the most challenging elements in developing harvest tags for the Gulf of Mexico recreational reef fish fishery. Prior experience from hunting and fishing tag programs, however, provides numerous successful programs upon which Gulf of Mexico harvest tags could be modeled. Prior experience also suggests that multi-mode tag allocation mechanisms can address most concerns associated with equitable tag distribution.

9. Any potential Gulf of Mexico harvest tag program must establish rules concerning tag transferability. Most current programs allow limited or no transfer of tags. Transferability, however, can have advantages in terms of maximizing net economic benefits and the integration of recreational management with the commercial sector.

10. Monitoring and enforcement capacity is likely to be improved under harvest tag management, compared to current approaches. However, harvest tag programs should be designed to encourage voluntary angler compliance, and should not allow *ex post* acquisition of tags for harvest that has already occurred.

11. Compared to existing management mechanisms in the Gulf of Mexico recreational reef fish fishery, data collection is likely to be improved under appropriately-designed harvest tag management.

12. There are tradeoffs between effectiveness in obtaining harvest data and perceived reporting burden on anglers that should be considered in program design. Voluntary

harvest reporting is generally associated with low response rates; much higher response rates are associated with mandatory reporting mechanisms.

13. Potential harvest tag programs for the Gulf of Mexico recreational reef fish fishery could be structured so as to provide revenues to offset program administration costs. Whether the net cost (e.g., to taxpayers, after considering tag revenues) of overall fishery management will increase or decrease under a harvest tag program in this fishery is uncertain.

14. Stewardship motives of anglers under harvest tag programs are likely to be at least as significant as those that exist under current management, but may be less significant than those under stronger, more durable rights-based approaches.

15. Integration of the private and for-hire recreational fishery sectors within a harvest tag management program is likely to be one of the more challenging aspects of program design. Nonetheless, such concerns have not prevented the development of successful hunting tag programs, and there are many examples upon which one may model harvest tag programs that address the needs of both groups.

16. There is only one known example of a harvest tag program that in any way integrates the recreational and commercial sectors (tags for salmon in the Republic of Ireland). Given difficulties with this program, it appears unlikely that a near-term harvest tag program could be easily developed to provide rights-based integration of the commercial and recreational sectors in the Gulf of Mexico reef fish fishery. Nonetheless, in the long-term, exploration of potential tag-based integration mechanisms could offer to increase the net economic benefits flowing from combined recreational and commercial resources.

17. Universal angler support is not assured in tag-based management of Gulf of Mexico recreational fisheries. However, the clear hunter and angler support in a large number of existing harvest tag programs suggests that such programs can be designed so as to encourage positive stakeholder reactions.

18. One of the key elements in developing angler support for harvest tag programs is likely to be the success of education and outreach programs.

19. The integration of tag programs with administrative mechanisms already in place for state-level fishing licenses could provide a means to increase efficiency and reduce costs associated with the administration of a Gulf-wide harvest tag program.

20. Given the many variants of tag programs that exist worldwide, any harvest tag program for Gulf of Mexico recreational fisheries should be designed in close collaboration with fishery stakeholders. Variations in harvest tag programs influence such elements as the bundling of tags, the availability of different tag classes, the transferability of tags, and tag allocation and distribution mechanisms.

21. It is likely that successful management would integrate harvest tags with supplementary management mechanisms, perhaps including season and size limits. A particularly

intriguing possibility is the integration of IFQ management of the for-hire sector with harvest tag management of private anglers.

Overall, we conclude that harvest tags represent a promising alternative to the current system of bag, size, and season limits in Gulf of Mexico recreational fisheries. The potential advantages of harvest tags are many, as reflected in existing tag-based hunting and fishing programs. These advantages include, among others: (1) the ability to set hard harvest limits; (2) the potential for longer seasons; (3) the availability of mechanisms to promote equitable tag allocation; (4) the ability to contribute to more effective monitoring and enforcement; (5) the provision of harvest data; (6) the generation of funds to support management; (7) promotion of a stewardship ethic and angler compliance; (8) the ability to integrate with a for-hire fishery sector; (9) the ability to (at least in theory) integrate with the commercial fishery sector, and; (10) a potential ability to garner and encourage angler support. These advantages, however, are not automatic; they require a well conceptualized and implemented plan that addresses the nature of the fisheries involved and the preferences and attributes of anglers.

Given the potential complexity of successful harvest tag programs (although some are simpler than others) and the size of the fisheries in question, implementation of harvest tag programs for Gulf of Mexico recreational reef fish fisheries would likely require significant start-up costs and planning efforts at both the state and federal (Council) level. Managers would have to design a unique program suited to the needs of stakeholders in the recreational reef fish fishery and the biological attributes of Gulf reef fisheries. The design of such a program would require potentially difficult choices and tradeoffs, and would have to account for such factors as the size of the fisheries involved, the quantity of harvest consistent with a sustainable fishery, the heterogeneity of private anglers and for-hire operators, and the need to ensure equitable access to recreational fishing opportunities. The potential complexity of program design notwithstanding, the widespread success of hunting (and some fishing) tag programs worldwide suggests that appropriately designed tag programs can result in sustainable harvest of renewable resources and an increase in economic benefits relative to common recreational fishery management methods.

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I. Introduction

Recreational fishing represents a popular and highly valued use of marine resources, with participation by a large percentage of the U.S. population. For example, the most recently published National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reports that an estimated 34 million anglers[1] (16% of the population) participated in recreational fishing in 2001. Participation averaged 16 fishing days per angler (USFWS 2002; Sutinen and Johnston 2003). Considering saltwater fishing alone, over 9 million anglers are estimated to have participated during the same time period (USFWS 2002; Sutinen and Johnston 2003). Numerous studies demonstrate the often sizable economic benefits that can result from various types of recreational angling nationwide (Johnston *et al*. 2006).

Recent trends suggest either constant or increasing participation in recreational fishing nationwide, placing increasing pressure on fishery resources (e.g., Criddle *et al*. 2003; Finn and Loomis 2001; USFWS 2002; Sutinen and Johnston 2003; National Recreational Fisheries Coordination Council 1995). This pressure can be particularly significant on popular species targeted by both commercial and recreational fisheries, such as red snapper and grouper in the Gulf of Mexico (GMFMC 1999). Although historically recreational fisheries have been perceived as having relatively modest implications for the status of marine fish stocks, a growing number of fishery management authorities are recognizing that weak control of recreational catch can in some cases undermine the sustainability and economic benefits of fisheries (Sutinen and Johnston 2003; Coleman *et al.* 2004; Criddle *et al.* 2003). The sustainability and social value of recreational fisheries are further threatened by recent trends in management (Sutinen and Johnston 2003). For example, common trends towards shorter seasons, smaller bag limits and more restrictive size limits can significantly reduce the economic benefits of fishing realized by anglers, and anglers' expenditures (and associated economic impacts) in coastal communities (cf. Woodward and Griffin 2003). The substantial proportion of catch-and-release activity associated with such restrictions can also imply significant release mortality (e.g., Schirripa and Legault 1999; Millard *et al.* 2003; Woodward and Griffin 2003), further threatening sustainability and long-term benefits.

In addition, the tendency to impose homogeneous management methods over large spatial scales, paired with often heterogeneous local and non-local angler populations, can lead to angler dissatisfaction and further loss of economic value. For example, the recreational season for red snapper in the Gulf of Mexico—which since 2000 has run from April 21 through October 31—applies throughout the Gulf with no regional variation. The dates of the open season, however, may not provide optimal benefits to anglers in all geographic areas (Sutinen and Johnston 2003).

[1] This includes anglers who are at least 16 years of age.

Aside from implications for the sustainability of fisheries and economic benefits realized by anglers, the allocation of directed and incidental harvest among various sectors (e.g., recreational, commercial, by-catch) can represent a persistent challenge for fishery managers (e.g., Berman *et al.* 1997; Criddle *et al.* 2003; NPFMC 2001; Baker *et al.* 1998; GMFMC 2000). Such allocation issues can be further exacerbated by the application of rights-based management approaches, such as IFQs, in one of the competing sectors (Criddle *et al.* 2003). Potential conflicts may also be magnified by the common use of soft TACs and other management mechanisms that do not place a hard limit on recreational harvest (Sutinen and Johnston 2003; Criddle *et al*. 2003). These challenges are exemplified by recent management deliberations in the Alaska halibut fishery (NPFMC 2006; NPFMC and ISER 1997; Criddle *et al*. 2003). Given the increasing interest in rights-based management of commercial fisheries worldwide, such issues represent a looming concern for recreational fisheries targeting species also valued for commercial purposes.

In response to such problems, and in recognition of the success of rights-based management approaches in commercial fisheries worldwide (Newell *et al*. 2002; Sanchirico and Newell 2003; National Research Council 1999; Leal *et al.* 2006), there is an increasing interest in the potential application of modern rights-based approaches to recreational fisheries (Sutinen and Johnston 2003). Examples include the approved but not yet implemented halibut charter IFQ in Alaska (NPFMC 2006) and the concept of angling management organizations proposed by Sutinen and Johnston (2003). However, such solutions, while promising in theory, face often formidable hurdles in practice. For example, recreational IFQs face challenges related to the allocation of quota among heterogeneous recreational anglers (including private anglers and the for-hire sector) and the monitoring and enforcement of harvest levels over large numbers of participants (Sutinen and Johnston 2003). More revolutionary approaches, such as angling management organizations, can face difficulties due to the significant policy changes they would imply (Sutinen and Johnston 2003; Sikes 2004). Moreover, non-attenuated (long-term) rights-based methods, while arguably promoting a greater stewardship motives than time-attenuated (short-term) methods (Leal *et al.* 2006; National Research Council 1999), also face persistent resistance due to the perception that the government is "gifting" or "giving away" public fishery resources to the private sector (Marine Fish Conservation Network 2005; Macinko and Bromley 2002).

In summary, while the principles of rights-based management offer the potential for significant improvements in the management of recreational fisheries such as the Gulf of Mexico (GOM) reef fish fishery, there are practical complications with programs that assign long-term or *durable* fishing quotas to individual recreational anglers. While perhaps not insurmountable, these complications suggest that alternative rights-based management structures may be preferable and more cost-effective. One such alternative involves the use of short-term, or time-attenuated harvest rights (cf. Macinko and Bromley 2002). Such mechanisms may be particularly suitable to recreational fisheries, given distributional, ethical, and practical concerns associated with the allocation of long-term harvest rights in such fisheries. Moreover, there is already limited experience with the application of at least one type of attenuated harvest right in recreational fisheries—the management of recreational harvest using fishing tags or stamps, such as those currently used to manage terrestrial game and waterfowl hunting in numerous areas of the United States. While still a relatively uncommon means of recreational fishery management, fish tags may offer many of the benefits of rights-based management for recreational fisheries,

while avoiding some of the more persistent concerns associated with other rights-based approaches.

This paper addresses the potential adaptation of rights-based harvest tags to the Gulf of Mexico (GOM) reef fish fishery, with an emphasis on red snapper and shallow-water grouper. The paper will explore examples from both fishing and hunting tag programs applied worldwide, discuss the performance and attributes of these programs, and assess implications for the potential application of similar programs to GOM recreational fisheries. This includes discussion of conceptual, theoretical, and practical issues surrounding the application of harvest tags, as well as challenges and opportunities related to the design and implementation of recreational fish tag programs for GOM reef fish.

The paper will proceed as follows. Section II briefly summarizes characteristics and potential benefits of rights-based fisheries management. Section III summarizes the characteristics, status, trends and primary management challenges of GOM fisheries including red snapper and shallow-water grouper (with an emphasis on red and gag grouper), as well as potential complications with the application of long-term recreational harvest rights in these fisheries. Section IV presents general concepts and management features associated with harvest tags in recreational fishery applications, as well as practical challenges. Section V discusses the practical application and attributes of harvest tags applied in terrestrial (mostly hunting) contexts. Section VI summarizes the attributes and performance of selected worldwide fishing applications of harvest tags, with particular emphasis on attributes relevant to the adaptation of similar mechanisms to GOM recreational fisheries. Section VII discusses possibilities for transferring similar tag-based management elements to GOM recreational fisheries, including red snapper and the grouper complex. This section emphasizes both the potential advantages/gains that may be realized through the application of such methods, as well as the disadvantages and/or practical challenges, and is framed in terms of the management features identified in section four. Finally, Section VIII offers concluding recommendations.

II. Rights-Based Fisheries Management

This paper proposes a form of attenuated (or short-duration) rights-based management, based on an application of fishing (or harvest) tags. Prior to discussing the details of tag-based management mechanisms, it may be useful to summarize briefly the concept of rights-based fishery management. As described by Sutinen and Johnston (2003), the term 'rights-based' is often used to denote a management regime that assigns strong property rights to users of fishery resources. The concept of property right used in the fisheries management literature, however, does not necessarily imply a *legal* property right in the strictest sense, in that compensation must be paid if the right is taken or diminished (Macinko and Bromley 2002). Rather, it typically implies a durable, enforceable and transferable harvest permit entitling the holder to a specified quantity of harvest, of a specific species, in a specified time and/or location. The assignment of these rights may be to individuals or to groups. The holder of such a right has three important powers (Scott 2000): (a) the power to use or manage the property, (b) the power to dispose of the property (by sale or grant); and (c) the power to receive the stream of benefits yielded by the property. Rights-based mechanisms need not be used to the exclusion of other methods; they

are often paired with supplementary non-rights based approaches such as specified fishing seasons and gear restrictions.

Sutinen and Johnston (2003), following Scott (1988; 2000), identify four primary characteristics of property rights: (1) *exclusivity*, the extent to which the holder can exclude others from either using or interfering with the holder's use of the property; (2) *transferability*, the extent to which the rights-holder is free to transfer the property; (3) *durability*, the length of time the rights-holder may exercise the powers above; and (4) *security* (or enforceability), the ability of the rights-holder to withstand challenges by other individuals, organizations, or government, to maintain rights to the property.

Examples of rights-based fishery management methods include individual fishing quotas (IFQs) and similar quotas issued to groups (e.g., the community development quota (CDQ) program in Alaska), as well as methods in which spatially defined rights to fish are allocated to individuals or groups (a.k.a. territorial use rights in fisheries, or TURFs). Examples of non-rights based mechanisms include standard fishing licenses, time and area closures, limits on the size, sex and daily number of fish that can be landed, and restrictions on the types and sizes of fishing gear (Sutinen and Johnston 2003).[2] Fishing tags, depending on their attributes, represent a middle-ground between the strong harvest rights conferred by IFQs, TURFs and similar durable rights-based mechanisms, and standard management mechanisms that provide fundamentally incomplete, negligible, or nonexistent rights. However, unlike strong rights-based mechanisms such as IFQs, the more limited property rights conferred by a harvest tag may render tag-based mechanisms more suitable to the characteristics of large-scale recreational fisheries. Details are provided in subsequent sections of this paper.

III. Status and Trends in Gulf of Mexico Recreational Fisheries

Red snapper and shallow-water grouper are important components of the large multi-species reef fish complex in the Gulf of Mexico. This section summarizes the status, trends and primary management challenges facing the recreational red snapper and shallow-water grouper (including red and gag grouper) fisheries in the Gulf of Mexico, as well as potential complications with the application of long-term recreational harvest rights in these fisheries.

Trends in the GOM recreational reef fish fishery show evidence that current management mechanisms are inadequate to maintain harvest at levels consistent with a sustainable fishery and the maximization of net benefits to anglers. Red snapper, for example, is currently classified by NMFS as both overfished and subject to overfishing. Since 1992, recreational landings have often exceeded the quota allocated to the recreational fishery. The Reef Fish Fishery Management Plan was implemented in November 1984 and imposed a minimum size limit of 13

[2] Fishing licenses, for example, provide the holder with the secure right of *access* to a fishery, but the right to the stream of *benefits* is not secure, since it may be diminished or eroded by the fishing behavior of others (i.e., it does not imply a right to a specified quantity of harvest, only the right to access the fishery). For example, the stream of benefits from the fishery may not last if the intense fishing by all license holders drives down the fish stock, and/or results in early closure of the fishery. Nor does a fishing license provide an exclusive right; it does not allow the holder to exclude others, since others have the right to catch the same fish. The other measures (closures, gear and fish size restrictions) similarly provide no strong property rights (Sutinen and Johnston 2003).

inches for red snapper with the provision that anglers could keep a total of five undersized fish and an unlimited number of fish that exceeded 13 inches fork length (GMFMC 1984). Through other regulatory actions since 1984 the daily bag limit has been progressively reduced from seven to four fish, the minimum size limit for retaining fish has been progressively increased from 13 to 16 inches, and the recreational season has decreased from a year-round season to one running from April 21 to October 31 (GMFMC 1997a, 1997b and 2005). In addition, in 2002, a three-year moratorium was imposed on new permits for charter vessels and head-boats in the reef fish fishery (GMFMC 2003).

As with red snapper, progressively more restrictive management measures have been applied to the harvest of groupers, particularly red grouper. The most recent red grouper population assessment (completed in 2007) concluded that the Gulf of Mexico population is neither overfished nor subject to overfishing. This conclusion, however, is at odds with prior findings that the stock is both overfished and subject to overfishing, and is undergoing additional review (NMFS SERO 2007a,b). From an aggregate daily bag limit of five fish of any grouper species, the bag limit for red grouper has been progressively diminished to two fish, with a temporary rule effective August 2005 further reducing this bag limit to one fish (NMFS SERO 2006), and a final rule effective July 17, 2006 that established a permanent one red grouper limit per person per day (NOAA 2006). The minimum size limit for landing fish has also increased from 18 to 20 inches (GMFMC 2005).

Moreover, for many species in the reef fish complex (including red snapper and the shallow-water groupers), recreational harvests comprise a significant proportion of total fishery mortality, implying that effective management of the overall fishery requires control of recreational harvests. A hard recreational TAC, under which all recreational fishing ceases when anglers' catches reach a specified quota, would appear to offer the highest degree of control over recreational fishing mortality. However, if not paired with rights-based or other approaches that effectively limit the harvest of individual anglers, the result can be movement towards ever-shorter recreational seasons—the parallel to derby fishing in the commercial sector. This has already begun to occur in the red snapper fishery.

Management reform to a rights-based regime that incorporates elements such as fish tags in GOM recreational fisheries will face certain challenges due to a number of the fishery's attributes, including: 1) a large number of anglers from a wide geographic region; 2) highly heterogeneous user groups, including local and non-local private anglers and a large for-hire sector; 3) the lack of a small number of easily observed landing points at which the recreational sector—particularly private anglers—lands fish; and 4) anglers habituated to combinations of season, size, and bag limits, but also the ability to fish at any time during the legal season, regardless of prior planning or arrangements other than obtaining a state saltwater license.

The Gulf of Mexico recreational reef fisheries present a number of challenges to fishery managers. These challenges relate to a number of attributes of the fishery, including fishery users and patterns of use. Not all are unique to the Gulf of Mexico or the reef fish complex; many are attributes of recreational fishing more broadly.

(1) Number of Participating Anglers: There are a large number of anglers who fish in the Gulf of Mexico; many of these anglers target fishes in the reef fish complex. MRFSS data for 2002 to

2004 (excluding Texas) indicate that an annual average of 5,976,561 saltwater anglers participated in Gulf of Mexico recreational fishing. The large number of participants presents a challenge to monitoring and enforcement efforts, and further suggests the critical importance of user support and voluntary compliance for the effectiveness of fishery management mechanisms. The large number of participating anglers also presents a clear challenge for distribution and allocation mechanisms that might be used for rights-based management approaches such as harvest tags.

(2) Angler Heterogeneity: Gulf of Mexico anglers are heterogeneous across a number of attributes. These include standard demographic attributes such as age, education, and income, as well as attributes characterizing fishing modes, fishing locations, and other factors relevant to fishery management. For example, Gulf of Mexico reef fish (including red snapper and shallow-water grouper) are harvested from both private boats and various types of for-hire vessels (e.g., rental, charter) (Sutton *et al.* 1999). Anglers are both local (i.e., from states bordering the Gulf) and non-local (tourists), and fish during different times of the year. Fishing frequency also varies across different anglers (Fensom 2004). The heterogeneity of Gulf of Mexico anglers can lead to significant challenges for management, as regulations well suited to some groups may not be well-accepted by others (Sutinen and Johnston 2003).

(3) Variable "Landing" Points: Unlike commercial fisheries, in which vessels often land harvests at a small number of easily-observed facilities, recreational anglers may land harvests at a large number of public and private docks, boat launches, and other facilities (Fensom 2004). The lack of a small number of identifiable landing points complicates monitoring and enforcement efforts, as well as the potential on-site distribution of licenses, harvest tags, and other permits. While such issues may be less of a management concern for the for-hire sector—the boats of which often dock at well-known locations—they can be a significant concern for private vessels.

(4) Recreational Angling Traditions: Increasingly, recreational anglers are becoming accustomed to ever-more restrictive limits on recreational fishing activities, including requirements for various types of licenses and/or fishing permits for different types of fishing, in different areas. Nonetheless, anglers are by-and-large unaccustomed to the type of planning and record-keeping associated with rights-based commercial fisheries. Anglers in the Gulf, for example, are habituated to standard combinations of season, size, and bag limits—but may generally fish (and land fish) at any time during the legal season, regardless of prior planning or arrangements (other than the obtaining of a state saltwater license). Alternative forms of fisheries management—particularly those based on harvest rights—may require greater prior planning, and may also lead to situations in which anglers are unable to land a desired fish due to the lack of a required permit or tag. This would represent a fundamental shift in management approach from those common in current Gulf recreational fisheries.

(5) Limitations in Participation and Harvest Data: Largely due to factors noted above (e.g., large number of anglers, lack of common landing points, and lack of a standard license requirement), data collection and recordkeeping is a persistent challenge in recreational fisheries (Jones 2004). Appropriate management in large-scale recreational fisheries requires accurate assessments of recreational fishing effort and resulting mortality, neither of which is directly observable (Committee on the Review of Recreational Fisheries Survey Methods (CRRFSM)

2006). Moreover, recent assessments have identified significant limitations with current methods of obtaining data for recreational fisheries (CRRFSM 2006). A lack of accurate data can hamper development of appropriate management responses, but also points to the potential value of management mechanisms that provide data on some or all aspects of recreational fishing.

IV. An Overview of Harvest Tags

Harvest tags, while only rarely used to manage catch in recreational fisheries, have been widely used for the management of terrestrial hunting. Hunting tags are documents or physical tags, typically issued by state natural resource agencies, authorizing the hunting or take of a designated species (i.e., deer, moose, elk) at a designated time and place (Baker 2006). Tag programs typically are applied in conjunction with other restrictions on hunting or fishing. For example, most hunting tag programs are combined with a restricted hunting season and sometimes with specific hunting methods (e.g., bowhunting). While some "tags" are simply paper documents allowing the harvest of a particular type and number of species, many are actual physical tags that must be attached to an animal upon harvest.[3] For example, the few existing fish tag programs typically require that tags be attached through the jaw, gill or dorsal fin of the fish as soon as the animal is caught and retained.

Tag mechanisms, like IFQs in fisheries, function through the assignment of a right (or privilege) to a specified quantity and type of harvest during a specified time period. However, unlike some rights-based systems of harvest management, the rights implied by tags are generally time-attenuated, non-renewable, and often of limited transferability. This means that, unlike IFQs whose implied rights are generally renewable or of long duration and may be sold or easily transferred, harvest rights bestowed by tags usually expire at the end of a given hunting or fishing season and are rarely saleable. Moreover, the rights bestowed by tags in many states are limited not only by season, but also by species, sex of the animal, and geographic area.

Typical applications of hunting and fishing tags incorporate some, but not all of the primary characteristics of "strong" property rights characterized by Scott (1988, 2000), and highlighted above. Harvest tags typically convey an *exclusive* right, in that the harvest right conferred by a tag is held exclusively by a single owner (i.e., he or she may exclude others from that right). Rights conveyed by tags are also *secure*, in that they are established and protected by legal authority. *Transferability* of harvest tags, however, varies—with many programs strictly limiting or disallowing transfer. Other programs, however, allow various forms of transfer. Finally, the *durability* of tags is usually clearly limited or attenuated, generally to a single harvest season or year. Hence, while tags clearly capitalize on rights-based mechanisms, the rights conferred by tags are somewhat weaker than those conferred by typical rights-based management mechanisms in commercial fisheries (e.g., IFQs, TURFs).

[3] Many states require a carcass tag to be affixed to the animal upon harvest, even those which do not have tag-based mechanisms as described above. In the cases where individual licenses are issued for one animal at a time, the carcass tag is a part of the license. Some states require that hunters check in their game at designated stations prior to bringing it home or to a processor, and the game wardens inspect the carcass tag at that time.

The specific attributes and distribution mechanisms for hunting (or fishing) tags can vary widely across states and/or species, depending on a variety of factors. These include the scarcity of the species relative to the demand for hunting (and hence the value of a tag), the relative proportion of local versus non-local participants, the purpose of the tag program, other regulations that may be in place (e.g., season length, hunting method), and other factors. Tag programs can either be relatively simple or quite complex, with different classes of tags issued to different types of hunters (e.g., local vs. non-local[4]; hunters using different types of equipment), using different allocation mechanisms (e.g., lottery, direct sales[5], auctions), and with different types of approaches to ensure fairness in distribution (e.g., preference points). The quantity tags issued annually may either be constant or may vary according to stock status.

While most hunting or fishing tag programs are motivated by general concerns over the level and sustainability of harvest, tag programs generally have one or both of two primary stated goals. The first is harvest management; tags may be used to control the harvest of a species to a specified quota limit. The rights implied by possession of a tag also may allow for a longer duration of open seasons. A second common goal of tag programs is the collection of harvest data, allowing for more effective long-term management. The principal distinguishing factor between programs designed primarily to manage harvest and those designed to collect data is the relative availability of permits. Programs for which harvest control is the primary motivating factor often have strict limitations on the number of tags that are issued (e.g., Zumbo 2004; Sandrey *et al.* 1983; Hanback 2005; see also Appendix B). In contrast, programs motivated primarily by a desire to collect data may have few or no controls on the number of tags that may be issued to interested hunters or anglers. Still other states may manage regional hunting effort by controlling the number of tags issued by geographic area. Review of nationwide hunting tag programs suggests that a large number are motivated primarily by a desire to control harvest, particularly for highly sought-after species. In contrast, the majority of (the relatively smaller number of) fish tag programs are motivated primarily by a desire for improved harvest data.

Examples drawn from specific fishing and hunting programs are provided in subsequent sections of this paper and Appendices B and C, along with potential implications for broader recreational fishery applications. Given the emphasis of this paper on the potential application of fish tags to Gulf of Mexico recreational fisheries, for the primary purpose of controlling harvest and improving management, subsequent discussion emphasizes those programs for which harvest control is a primary motive.

Principal Management Features of Tag Programs

Aside from the general attributes summarized above, there are a set of specific management features, or attributes, of existing tag programs which render them promising for recreational fisheries applications on a broader scale. These features include: (1) the ability to set hard limits on harvest; (2) the potential for longer seasons; (3) the availability of mechanisms to promote equitable tag allocation; (4) the ability to contribute to effective monitoring and enforcement, and greater angler compliance; (5) the provision of additional harvest data; (6) the generation of funds to support management; (7) the promotion of a greater awareness of resource scarcity and

[4] Typically, nonresident hunters are allocated a fairly low percentage of total available permits.
[5] Direct sales are used for species that are not in high demand relative to tag availability.

a stewardship ethic; (8) the ability to integrate with a for-hire fishery sector; (9) the ability to (at least in theory) integrate with the commercial fishery sector, and; (10) the potential ability to garner and encourage angler support. These are summarized below, and discussed in much greater detail in section seven, with particular emphasis on Gulf of Mexico recreational reef fish fisheries.

(1) Hard Harvest Limits: Like IFQs in commercial fisheries, harvest tags can be issued to match a harvest limit specified by managers. Unlike typical recreational fishery restrictions such as bag limits, size limits, and seasonal restrictions, such tag mechanisms allow a fixed quantity of harvest. Moreover, this restriction does not require the abbreviation of open seasons or other restrictions on access. Assuming that appropriate monitoring and enforcement ensures adherence to tag-imposed limits, the application of tag-mechanisms could hence ameliorate problems and potential conflicts (e.g., with the commercial sector) related to inadequate harvest control in recreational fisheries.

(2) Longer Seasons: Also like IFQs, hunting or fishing tags generally allow the holder to harvest the indicated target at any time during the legal season. This helps eliminate a race to fish or hunt that may be associated with systems in which harvest shares are not allocated to individuals, and in which early closure may result once overall TACs are exceeded (e.g.,, a fishing derby). For example, one of the goals of the South Dakota paddlefish tag program is to allow for harvest over an open season of longer duration (Sorenson 2006). The ability of rights-based approaches to promote longer open seasons is well established in commercial fisheries (e.g., Casey *et al.* 1995; Newell *et al.* 2002; Leal *et al.* 2006). Similar incentive properties apply to tag programs, and could hence lead to similar lengthening of recreational fishing seasons.

(3) Equitable Allocation: Nationwide hunting tag programs incorporate a range of different mechanisms to encourage the equitable allocation of harvest opportunities. These include: (1) lotteries for high-demand hunting tags; (2) preference points allocated to hunters who fail to obtain tags in past lotteries, increasing the probability of obtaining tags in future lotteries; (3) set-asides of tags for the exclusive use of particular groups (e.g., residents, nonresidents, landowners, outfitters) or hunting methods; (4) limits on the number of tags that may be held by specific individuals. While not all participants universally support the specified allocation of hunting tags (e.g., *Outdoor Life* 2003), tag programs can incorporate a wide array of provisions to encourage the equitable distribution of hunting or fishing opportunities.

(4) Monitoring, Enforcement and Compliance: Monitoring and enforcement is a persistent challenge in many recreational fishing and hunting contexts, given the often large number of participants involved and the general absence of central locations at which participants may be intercepted and observed (unlike commercial fisheries in which catch is often landed at a small number of port facilities). However, the requirement that physical tags be attached to captured animals, together with random checks or established check-points, can facilitate monitoring and enforcement efforts. The attachment of physical tags to harvested animals also can provide somewhat greater certainty regarding the total harvest that is taken—in contrast to mechanisms such as bag limits which provide little certainty regarding total harvest. Voluntary compliance with harvest tag programs will likely depend on the extent to which anglers accept and support tag-based mechanisms and the hard harvest limits they might impose, in contrast to the softer limits associated with current management mechanisms (e.g., daily bag limits, size limits).

(5) Provision of Harvest Data: Unlike common methods of recreational fishery management, which provide minimal data to assist in fishery management, tag mechanisms can provide significant harvest and participation data. For example, tag programs may be paired with requirements that hunters provide data on the date and location of harvest, sometimes using a seasonal, mail-back "report card" format. One of the primary motives for the small number of existing fish tag systems is the collection of harvest data from anglers (see Appendix C), although success in this regard is mixed. Similar motives apply to many hunting tag programs (see Appendix B). In addition, as noted above, tag programs can provide much greater certainty regarding the number of animals harvested, providing data which may be used to improve management efforts.

(6) Funds Generation: Increasingly, successful fishery management efforts worldwide are incorporating some form of cost-recovery to help offset the often significant expenses related to fishery management (Sutinen and Johnston 2003). Like license fees, revenues from the sale or auction of hunting and fishing tags can be used to support management, education, data collection, and other efforts (Sutton *et al*. 2001). Tags are typically distributed (e.g., sold) annually, such that associated revenues may provide continual support for these programs. This stands in contrast to mechanisms such as bag and size limits, which provide no mechanisms for cost-recovery. Revenues provided by tag mechanisms, however, must also be viewed within the context of the sometimes significant cost of implementing such programs.

(7) Conservation Ethic: The requirement that scarce tags must be obtained—sometimes at significant cost and effort—in order to harvest a specified resource can provide clear indications of the scarcity of wildlife resources, and may provide an incentive for hunters (or anglers) to self-police. For example, a hunter who has paid a substantial amount for a prized hunting tag will likely have an incentive to report others who are illegally harvesting the same resource. Moreover, to the extent that tags infer a valued harvest right (albeit a time-attenuated right), they may encourage more of a conservation ethic than traditional fisheries restrictions. Such a conservation ethic may be further encouraged by mechanisms such as preference points, which provide a successively greater likelihood of obtaining valued harvest tags to hunters who fail to obtain tags in prior lotteries. Specifically, hunters may be less likely to take actions that might harm a wildlife resource if they perceive a strong and increasing likelihood that they may obtain a valued tag in future years, and hence realize the benefits of that conservation.

(8) For-Hire Sector Integration: Many major recreational fisheries—including those for red snapper and shallow-water grouper in the Gulf of Mexico—involve both individual anglers who fish from private boats (or other private/public areas) as well as anglers who use the services of the for-hire sector (e.g., charters, head-boats, etc.). Hence, an important aspect of any management mechanism is its ability to integrate both individual anglers and the for-hire sector. In this regard, state hunting tag programs have an extensive history of the integration of tag programs with an active for hire (e.g., hunting guide) sector. Typical strategies for integration include: (1) hunters can first obtain the desired tag, then seek out an appropriate for-hire guide or hunting service, or; (2) guide services can obtain tags on behalf of hunters.[6] In addition, many

[6] Examples of the latter may be found in the literature of numerous guide services nationwide. As of May 2006, examples could be found at http://www.westwindguideservice.com/details.htm, http://www.ks-mo-hunt.org/; http://www.idahowhitetailadventure.com/, http://www.zhuntfish.com/hunting.htm, among many others.

states provide a set-aside allocation of tags for outfitters and guides. Although the details of such arrangements would require specification in any fishing application, there is a record of success in the integration of a for-hire sector with tag-based management mechanisms.

(9) Commercial Sector Integration: Integration of management with the commercial sector can prevent ongoing conflict between the two sectors, as well as repeated and often contentious revisiting of commercial-recreational harvest allocations (Sutinen and Johnston 2003). Hence, there is increasing interest in mechanisms that, at least in theory, allow for rights-based integration of harvest rights in the commercial and recreational sectors, including the potential for transfer of rights between the two sectors. A recent example is the approved but not yet implemented Alaska halibut charter IFQ program, which would allow limited transfers between the charter and commercial sector (Criddle *et al*. 2003). Tag programs also allow the possibility, in theory, for mechanisms that would allow transfer between the recreational and commercial sector. Practical mechanisms for such transfer, however, are not well developed in either hunting or fishing applications; as noted above, most tag programs allow for limited or no transferability of tags.

(10) Angler Support: Given the difficulty in monitoring the behavior of large numbers of individual recreational anglers—particularly those who do not utilize the services of the for-hire sector—voluntary compliance with regulatory measures is critical to management success. Management regimes that are widely rejected by anglers or viewed as inappropriate may result in protest fisheries or lack of compliance. Overall, tag management programs have been well-accepted by hunters and anglers, even in cases where harvest is severely restricted. This support is not universal, however, with some tag programs in fisheries experiencing a lack of universal angler support (Slade 2006; Grant 2006).

Practical Challenges of Fish Tags

Most tag-based management systems are applied to terrestrial hunting; a relatively small number of tag programs have been applied to control harvest in recreational fishing contexts. Hunting and fishing are similar in that individuals pursue a wild public resource for sport and/or as a food source (Baker 2006). Nonetheless, there are non-trivial differences between typical hunting and fishing experiences which can affect the properties and outcomes of harvest tags. As a result, while the principal management features of tag mechanisms offer many potential advantages, there are also practical challenges to their application in many fisheries contexts. This section outlines some of the general differences between hunting and fishing contexts as they influence the potential application of tag-based management mechanisms. Implementation challenges specific to selected Gulf of Mexico recreational fisheries are detailed in later sections.

Fundamental differences between hunting contexts to which tags have been applied and typical recreational fisheries include the expectations of hunters relative to anglers. Unlike hunters in many areas, who may be accustomed to waiting for open seasons and seeking scarce licenses or tags for high-demand species, anglers are typically more accustomed to fishing at will, with fewer restrictions on the take of recreational species (Baker 2006). Moreover, payment of often substantial fees for licenses or tags is well-established in hunting contexts, with hunting tags for valued species often ranging from $100 - $1,000 or higher (cf. Zumbo 2004, also Appendix B). In contrast, recreational anglers are typically unaccustomed to substantial fees; even small

increases in license fees can sometimes cause significant decreases in participation (e.g., Sutton *et al.* 2001). A third difference relates to the ease with which hunters may identify and target specific species, compared to recreational anglers who often have much less control over fish that are landed. While catch-and-release provisions are a common solution, release mortality can be a significant concern in many recreational fisheries (Schirripa and Legault 1999; Millard *et al.* 2003; Woodward and Griffin 2003). Finally, the number of participants and/or quantity of allowable harvest can have an impact on the practicality of hunting or fishing tag management mechanisms. Many hunting tag programs are applied to scarce wildlife resources for which only a small quantity of annual harvest (i.e., number of animals) is permitted. In contrast, recreational fisheries often allow the take of millions of individual fish by thousands or even millions of anglers. The sheer numbers involved can complicate program implementation and render monitoring and enforcement less tenable.

Contrasting Fishing Tags and Recreational IFQs

Individual fishing quotas are the most common rights-based management approach applied to modern commercial fisheries, with well-established advantages (National Research Council 1999). However, as noted by Sutinen and Johnston (2003) there are aspects of IFQs which may render them unsuitable for many recreational fisheries applications, particularly in fisheries characterized by large numbers of individual anglers who do not fish though for-hire operators. These aspects are summarized in Appendix A, along with the comparative attributes of tag-based management programs. In the context of this discussion, it is worth noting that the authors are aware of no applications of IFQ or similar management mechanisms to recreational hunting, notwithstanding the numerous applications of tag programs. The potential combination of tag-based management of individual angler harvest (i.e., those who do not use for-hire services), combined with IFQ management of the for-hire sector, is discussed in section seven of this paper.

V. Tag-Based Management in Terrestrial or Mixed Hunting-Fishing Applications

The concept of a hunting tag differs across states. In many states, a hunting license allows a hunter to pursue only small game; in order to harvest larger animals (e.g., turkey, deer) the hunter must purchase a one-time license, sometimes called a *license tag*. In other states, a hunting license allows harvest up to a seasonal bag limit, however, hunters must still attach a *field tag* to animals for recording purposes only. In yet other states, *hunt tags* are the manifestation of game management quotas and are used to manage harvest directly; tags are allocated for specific areas, seasons, and species, often via a draw or lottery system. Federal (and sometimes state) migratory bird stamps act represent another type of tag-based management mechanism (see summary of the duck stamp program in Appendix B).

Tags serve several purposes in wildlife management and in the allocation of hunting rights. First, the completion of field tags combined with check-in stations enable game management authorities to track harvest. Second, the combination of quotas and license tag requirements can allow game managers to spread hunting effort across different regions and time periods. Third, and most closely tied to the concept of rights-based management, hunting tags grant the right to harvest a specific species, during a particular area in a specific geographic area. In some cases,

these tags (i.e., hunting rights) can be transferred between users.[7] Additionally, revenue from the sale of tags and licenses can help offset costs of conservation and management efforts.

Continuum of Management Intensity and Types of Tag Programs

States vary widely in the types of management applied to various types of hunting. These may be grouped in terms of management intensity—representing the degree and complexity of constraints placed on hunting activities.

- *Low Intensity*: In some states, there is minimal regulatory oversight of hunting activities. For instance, in Alabama and Mississippi, the majority of hunting occurs in private hunt clubs managed by the property owner. Hunters must have a license to hunt on public or private lands, and there are seasonal bag limits to the number of deer that can be taken from public land. However, there is no required tagging or harvest reporting.

- *Moderate Intensity*: In states such as Connecticut and Pennsylvania, regulators set specific harvest quotas for game in different regions. These states typically do not experience excess demand for hunting; in fact, in some areas hunters are hired to cull herds (e.g., of deer). The federal/state migratory game bird management system (duck stamp program) could also be considered a moderately managed hunting program. Hunters must purchase a stamp in order to be able to hunt migratory birds, but seasonal bag limits are not rationed at an individual level.

- *High Intensity*: For species or regions where demand for hunting opportunities exceeds the ability of the environment to recover from the hunt, game management agencies have implemented a variety of systems to manage excess demand. These systems generally involve lottery draws for hunt tags.

Harvest tag applications in Gulf of Mexico recreational fisheries would likely fall somewhere between the moderate and high degree of intensity found in hunting applications. For states and species with moderate to high management intensity, for which tags are used to directly control harvest, a variety of tag mechanisms exist. The most common examples include:

- *Geographic and seasonal quotas (no rationing system):* These are "over the counter" tags that are available in some western states, as well as eastern states such as Pennsylvania, and Connecticut. Licenses are allocated regionally and sold on a first-come, first-served basis until the hunting season is over or until the quota is met.

- *Limited harvest with lottery rationing*: In regions where demand for hunting exceeds the sustainable level of harvest, licenses or tags are often distributed via a lottery draw. Examples include lottery rationing of deer tags or harvest rights in Maine, Idaho, and some of Florida.

[7] Transfer of tags, however, is rarely if ever permitted in cases in which there is substantial excess demand. The concern is that tag transferability in such cases could generate tag prices that would preclude participation by all but the most wealthy hunters.

- *Limited harvest with enhanced lottery rationing:* To enhance the likelihood that repeat applicants will be rewarded with a hard-to-obtain tags—often for big game such as elk or moose—some states have instituted preference point or bonus point systems. Examples of such systems are found in Colorado, Nevada, Oregon, Montana, Maine, and numerous other states. There is some variability in how these systems operate; details are included in Appendix B.

- *Auction of hunting rights*: Some states generate revenue either by auctioning off a limited number of hard-to-obtain tags (i.e. moose in Maine) or by holding a special lottery drawing in which the hunters may purchase an unlimited number of chances to obtain desired tags (but not purchase the tags themselves).

Primary Goals of Hunting Tag Programs

The primary stated goals of hunting tag programs include (1) limiting harvest; (2) ensuring equitable distribution of harvest opportunity; (3) promoting effective monitoring and enforcement, and; (4) providing data to improve management. These are summarized below.

(1) Limiting Harvest: Most if not all limited quota, tag-based management systems are designed to limit harvest. Harvest limitations serve a number of purposes including: (a) preserving valued wildlife populations regionally and statewide; (b) maintaining the quality of hunting within given areas; (c) distributing hunting pressure across geographic regions within a state; (d) maintaining desired herd compositions (e.g., doe-buck ratios).

(2) Ensuring Equitable Distribution: Hunting tag mechanisms are often designed with the explicit goal of ensuring an equitable distribution of the opportunity to hunt and harvest high-demand species. For example, by allocating scarce hunting tags via lottery draws, states can allocate high-demand hunting opportunities at prices that are non-prohibitive for most hunters. Such lottery draw systems can make hunting available to a much broader population than would be the case if permits were sold at market-clearing prices. As noted above, many states also have preference point or bonus point systems that increase the odds of a hunter being selected in a tag draw if that hunter participated (unsuccessfully) in the same draw in preceding years.[8] Finally, some states with preference point systems also set aside a portion of the tags to be distributed via random draw to participants with no points (i.e., to "novice" hunters).

(3) Promoting Monitoring and Enforcement: Requiring field tags and check in for all animals harvested, as well as distributing licenses (tags) one at a time to hunters, allows managers to keep closer track of harvest than is typically possible with alternative management mechanisms (e.g., bag limits).

(4) Providing Data to Improve Management: In addition to promoting monitoring and enforcement (see above), many states with limited hunts require tag holders to complete harvest

[8] If a hunter enters a drawing and is not picked to receive a tag, she earns a point which may either act as an additional chance in the next year's draw (a bonus point), or may put her into a limited pool of applicants for subsequent drawings (a preference point.)

reports. These reports contain information on hunting effort and (sometimes) wildlife observed, and are typically required even if a hunter is not successful in harvesting the species for which a tag is issued. Data collection is also an integral part of the federal duck stamp program; in order to obtain the stamp, hunters must register for the Harvest Information Program (HIP) survey.[9]

Summary of Selected Tag-Based Hunting Programs

Appendix B summarizes nine state (or state-federal) harvest tag programs for terrestrial hunting or mixed hunting-fishing programs. This does not represent a comprehensive review of all state harvest tag programs—many states have some form of tag-based management, for at least some species. The majority of these programs are quite similar in key management aspects, however, such that a reasonable understanding of nationwide hunting tag programs may be provided by detailed coverage of a smaller number of representative programs. The review provided in the Appendix is meant to provide an overview of the range of different programs that exist, in terms of species, locations, objectives, and mechanisms. The Appendix also emphasizes programs for which harvest limitation is a key management objective, in contrast to field tag programs designed solely to provide harvest data.

Appendix B reviews the following hunting tag programs: (1) the nationwide state-federal duck stamp program; (2) Oregon; (3) Montana; (4) Nevada; (5) Idaho; (6) Colorado; (7) Wyoming; (8) Florida; and (9) Maine. A brief summary of the attributes of these harvest tag programs is provided by Table 1.

[9] Data collection opportunities, of course, are not limited to hunt tag programs. In Maryland, for example, bow-hunters are asked to complete an extensive survey of all game animals observed. These annual surveys are an integral part of the state's game management program. Other states conduct telephone surveys of a random selection of all licensed hunters.

Table 1. Characteristics of Selected Harvest Tag Programs for Hunting and Mixed Hunting-Fishing Applications

Program Location	Species	Tag Type (physical tag; catch record card; other)	Allocation Method for Over-subscribed Hunts*	Cost of Tags for Adult Residents	Tags Create Annual Limit on Individual/ Total Harvest	Number of Tags for Selected Species / Tags Over-Subscribed for Some Species (yes/no)	Mandatory Harvest Reporting
Idaho	all big game species	tag	lottery with preference points for over-subscribed hunts	deer: $20 elk: $30	yes/yes	controlled deer (2004) 14,824, general season deer unrestricted, elk (2004) 20,254/ yes	yes
Maine	moose, "any deer", and "bonus deer"	tag	lottery with preference point system for moose permits only	moose: $52 any deer: free bonus deer: $13	yes/yes	"any deer" (2006) 67,725, moose (2006) 2,825/ yes	yes
Montana	all big game species	tag	lottery with bonus point system; bonus points cost $2 for residents	deer: $16 elk: $20	yes/yes	Mule deer (2003) 207,330, elk (2003) 139,914/ yes	no
Nevada	all big game species	tag	lottery with bonus points	deer: $30 elk: $120	yes/yes	mule deer (2005) 10,357; antlered elk (2005) 843 / yes	yes
Oregon	all big game species	tag	lottery with preference points for over-subscribed hunts	deer: $19.50 elk: $34.50	yes/yes	buck deer (2005) 66,852, elk (2005) 48,822 / yes	no
Wyoming	all big game species	tag	lottery with optional preference points for over-subscribed hunts. Preference points cost $50 for elk, $40 for deer	deer: $35 elk: $47	yes/yes	Mule deer (2004) 81,933, elk (2004) 58,852/ yes	no
Colorado	all big game species	tag	lottery with preference points for over-subscribed hunts	deer: $31 elk: $46	yes/yes	Elk (2006) 164,766, deer (2006) 119,593/ yes	no
Florida	deer	other	permits distributed via lottery	varies	no/no	Special deer hunt permits (2004-2005) 118/ yes	no
Federal Duck Stamps	migratory game birds	other	general sales	$15	no/no	1.6 million (2003-2004) / no	no

* Preference and bonus point systems described in main text. Over-subscribed hunts are those for which hunter demand for tags exceeds number available. For hunts that are not oversubscribed, multiple point of sale and direct distribution mechanisms are used in different states.
Source: Johnston *et al*. [20].

VI. A Summary of Current Tag-Based Management Programs in Recreational Fisheries

The use of tags to manage the harvest of recreational fisheries remains relatively rare.[10] The majority of existing harvest tag programs in fisheries exist primarily to improve information on catch and effort; however, several programs do exist for which tags are used at least in part to control or manage harvest. Most of these programs are less than ten years old, although a small number have existed for longer periods.[11] A comparative review of these programs provides insights into how future programs might be structured in the Gulf of Mexico and elsewhere, and some of the challenges they may face.

The motivation for and objectives of harvest tag programs in recreational fisheries vary, as do the operational details of the programs and the types of fisheries in which they have been implemented. Appendix C summarizes eight of the better-known and more extensive harvest tag programs for recreational fisheries. This does not represent a comprehensive review of <u>all</u> worldwide harvest tag programs. For example, some neighboring states maintain similar tag programs for identical species that cross state borders[12]; for such cases Appendix C reviews only one of the programs in detail. However, this review is meant to provide an overview of the range of different programs that exist, in terms of species, locations, and objectives. Specific programs reviewed include: (1) the pink snapper fishery in the Freycinet Estuary of Shark Bay in Western Australia; (2) the recreational paddlefish fishery in the Missouri River below Gavins Point Dam in South Dakota[13]; (3) the salmon and sea trout fishery in Ireland; (4) the recreational food-fish program for cod in Newfoundland; (5) the recreational tarpon fishery in Florida[14]; (6) the recreational billfish fishery in Maryland and North Carolina; (7) the multispecies programs for recreational catch of salmon, steelhead, halibut and sturgeon in Oregon, and; (8) the multispecies record card program in Washington State. In conducting this review, we have restricted our purview to programs that cover *all recreational catch* of the species being managed, and do not review programs that use tags to manage catches outside of slot limits (e.g. red drum in Texas) or allow catches in excess of normal bag limits (e.g. striped bass in New Jersey). More specific details are found in Appendix C, along with the citations from which program details were derived (often personal communications with program managers).

Most of the harvest tag programs distribute physical tags that must be attached through the jaw, gill or dorsal fin of the fish as soon as it is caught and retained. However, as in the hunting applications discussed above, programs vary in terms of the definition and required uses of fishing "tags". For example, the program for billfish in Maryland and North Carolina does not require anglers to possess or affix a tag when the fish it caught, only when it is landed. The Washington catch record card and the Oregon combined harvest tag do not use physical tags at

[10] This use of tags is distinct from the common use of tracking tags on living animals to monitor such things as migratory behavior and mortality.

[11] For example, Washington and Oregon have been implementing harvest tag programs for salmon and steelhead for decades.

[12] An example is the paddlefish tag programs in Nebraska and South Dakota (Mestl 2001; Sorenson 2006).

[13] As noted above, Nebraska has a nearly identical program to manage recreational catches in the same area. Our review concentrated on the South Dakota program but descriptions and conclusions should be applicable to Nebraska's program as well.

[14] There are very similar tag programs for tarpon in Alabama and Texas which we do not review here.

all. Rather they provide a booklet in which anglers must immediately record catches of all fish they retain, along with the location the fish was caught.

Program Objectives

All reviewed programs were motivated in some way by concerns over the level and sustainability of recreational catch. However, only three of the reviewed programs (pink snapper, paddlefish and tarpon) use harvest tags to implement hard caps on the total number of fish that can be taken. These programs allocate a fixed number of tags to anglers and require anglers to use a tag on any fish retained. This creates an upper limit on total retained recreational catch of those species in specific areas, though not necessarily on mortality as fish can be caught and released without using a tag, leading to a certain level of pre- or post-release mortality. In the case of paddlefish, the number of tags allocated is greater than the target total catch, based on an assumption that only about half of the tags will be used to retain a fish. In contrast, although a creel survey suggests that only about half of the pink snapper tags are used to retain fish, the number of tags allocated is maintained at the target catch level (Harrison 2006). Tags for retaining tarpon in Florida are capped at 2500, but only about 300-400 are actually issued each year. Retaining tarpon is discouraged, the cost of tags is high, and retaining catch is not common due to the low food value of the fish (Colvocoresses 2006). In Ireland, the Central and Regional Fisheries Boards set a target total recreational catch of about 15,000 fish, but the total number of tags is not limited since the number of licenses that can be issued is not capped and each license is allocated 20 tags. The number of tags allocated with license can, however, be adjusted to influence total catch and, a halving the license allocation to 10 tags was under consideration in 2006 as is the possibility of limiting the total number of tags issued.

All of the programs except for the Florida tarpon and Maryland and North Carolina billfish programs set limits on the number of fish an individual can land annually. These limits are probably not binding for the majority of anglers, but do constrain catches by some anglers and thereby contribute to limiting total catch. None of the programs reviewed relies solely on harvest tags to manage catch. Size limits and daily bag limits are in place in most cases, and only relatively short fishing seasons are allowed for paddlefish and Newfoundland cod.

The primary objective of the programs that do not set limits on total catch is to improve collection of data on retained catch. Notably, the pink snapper and paddlefish programs that limit the total catch using harvest tags do not require mandatory reporting and rely on creel surveys to estimate the number of tags used. All other programs except the Oregon combined harvest tag program have mandatory reporting requirements, although not all of these incorporate effective mechanisms to ensure compliance with reporting requirements. Fines can be levied for noncompliance with reporting requirements in Ireland and Newfoundland, and anglers in Washington are required to return completed catch cards in order to get a license in subsequent years. Salmon anglers in Ireland are issued tags in batches of five and must demonstrate that they have completed catch record logbooks for utilized tags before receiving more. Tarpon anglers can also be denied the opportunity to purchase additional tags for not reporting, but this has not been enforced. Oregon, in contrast, uses incentives (i.e., lotteries for prizes) to encourage voluntary reporting. Angler compliance with reporting requirements varies across programs.

Allocation of Tags

The reviewed harvest tag programs use a variety of means to allocate and/or ration tags, and to reduce angler demand. The pink snapper tag and paddlefish tag programs, for example, both face excess demand for the limited number of tags available. These programs use lotteries to ration tags. In the case of paddlefish, there are separate lotteries for archery and snagging methods, and for residents and nonresidents. In the case of pink snapper, the purchase of tags is not limited to anglers, and environmental groups have applied for tags for the purpose of preventing the harvest of pink snapper. The tag program for Florida tarpon sets a high price on tags ($51.50) that effectively discourages acquisition, keeping demand for tags well below the maximum available. The Oregon combined harvest tag, in contrast, has a fee beyond the base license that potentially creates some demand reduction, although the reported purpose of those fees is revenue generation rather than demand reduction. None of the programs allows resale of tags, and none but pink snapper allow them to be transferred. Pink snapper tags may be given away. Additional details of allocation and distribution methods are found in Appendix C.

None of the reviewed programs have the explicit goal of generating revenues sufficient to cover costs of running the program, although the license program for Newfoundland cod, which has a fee for licenses but no separate fee for tags, was intended to be revenue-neutral. Those programs for which tags are sold separately from licenses all produce sufficient revenues to cover added administrative costs of the tag programs, but do not fully cover management, monitoring and enforcement costs. In Ireland and Newfoundland, where tags are issued free with licenses, license revenues are estimated to be insufficient to cover the overall costs of the licensing programs themselves.

Performance and Impacts of Fish Tag Programs

In all reviewed cases, managers involved with these programs feel that they have fully or partially met objectives. The pink snapper program has successfully maintained total catch well below target levels and proven that recreational catch can be kept within a specific allocation. The paddlefish program has maintained catch at desired levels, reduced crowding in popular areas and allowed a longer season. The Irish salmon tag program has provided more information on exploitation patterns than was available before its implementation. The Florida tarpon tag program has been successful at reducing retained harvest to negligible amounts, but has proven less effective at estimating harvest rates do to incomplete reporting and the fact that some tags are used for temporary possession of fish (while they are being weighed) that are released live. The Newfoundland cod program has improved management by providing data on catch and effort and by raising public awareness of concerns over conservation of inshore groundfish stocks. The tag program for billfish in Maryland and North Carolina provides information on catches that complement and improve upon survey data. There are no explicit objectives for the Oregon combined harvest tag, however the program does provide substantial revenues for management. The usefulness of information from voluntary reporting, however, is compromised by the low (20%) reporting rate. The Washington catch record card program, in contrast, has mandatory reporting has a reporting rate of around 60%. This enables managers to estimate harvest over wide geographic areas, but the accuracy of estimates may be compromised by non-reporting bias.

Practical Challenges and Solutions

Most of the programs have faced some challenges and educating the public has been a concern in most cases. Managers for some programs (pink snapper, Irish salmon, Newfoundland cod, Oregon and Washington) report some resistance to the programs by anglers based on the cost of tags or licenses or the inconvenience of using them (see Appendix C). However, other programs were generally well received by anglers. As mentioned above, harvest reporting rates were low in Oregon. Even when reporting is mandatory, reporting rates are low (tarpon) to moderate (Irish salmon, Washington). The Irish program has reportedly suffered from budgetary and staffing constraints that have limited the ability of managers to ensure compliance. There were problems with distribution of tags and record keeping for the Florida tarpon program, since the tax collectors who were responsible for sales and record keeping were unfamiliar with required procedures. Newfoundland also experienced difficulties in distributing cod tags in time for the beginning of the season.

Overall, the case studies of harvest tag programs suggest that they can be an effective way to improve information on catch and effort over traditional survey methods if reporting is mandatory. However, penalties for non-reporting in the form of fines or withholding the next year's license may be required to increase reporting. Unless a substantial proportion of catch is by nonresidents, requiring reporting before issuing next year's license and/or tags may be more effective than fines, since agencies may not have the resources or political will to prosecute for non-returns. Programs that have attempted to strictly limit catch have been successful at doing so. However, the two programs that use lotteries for tag allocation (because demand for tags exceeds supply) are relatively small programs in terms of the number of tags issues and the geographic area of the fishery. The tarpon tag program, in contrast, covers a much larger area, but the low food value of the fish and the high cost of tags is apparently a more significant factor in its success at limiting catch than hard limits on tag numbers.

The lotteries used by two of the programs appear to have been an acceptable means of rationing tags in those fisheries; however, lotteries (as will ensuring compliance with requirements to land only tagged fish) may by logistically more difficult for large fisheries such as red snapper and shallow-water grouper in the Gulf of Mexico. For all of the programs, a substantial proportion of the tags (or catch allowed by them) go unused, and allowing resale would likely increase the total catch and would require greater constraints on the number of tags sold or annual limits for individuals. It seems likely that allowing resale would aggravate resistance to the programs from anglers already concerned with the relatively low price of tags.

Summary of Recreational Fish Tag Programs

Table 2 summarizes the attributes of the reviewed recreational fish tag programs. Additional details are provided by Appendix C.

Table 2. Characteristics of Reviewed Harvest Tag Programs for Recreational Fisheries

Program Location	Species	Tag Type (attached vs. catch card)	Allocation Method	Cost of Tags for Adult Residents	Tags Create Limit on Individual/Total Catch	Number of Tags / Tags Over-Subscribed (yes/no)	Mandatory Harvest Reporting
Shark Bay, Western Australia	pink snapper	attach	lottery	AUS$10	yes/yes	1,400 (2006) / yes	no
Missouri River, South Dakota	paddlefish	attach	lottery	US$5	yes/yes	275 archery, 1,400 snagging (2006) / yes	no
Ireland	salmon and sea trout	attach	with license	free with license	yes/no	Not limited, ~25,000 per yr. / no	yes
Newfoundland	cod	attach	with license	free with license	yes/no	Not limited, ~135,000 per yr. / no	yes
Florida	tarpon	attach	purchase	US$51.50	no/yes(but not binding)	Cap of 2,500, 300-400 sold per year / no	yes
North Carolina and Maryland	bluefin tuna, white and blue marlin, sailfish, swordfish	attach (acquired upon landing)	provided at designated landing spots	free	no/no	Not limited, ~2000 – 3000 per year / no	n.a., tag acquired only when used
Washington	salmon, steelhead, halibut, sturgeon, dungeness crab	record on card	purchase in addition to license	first card free with license, US$10 plus dealer fee for additional cards	yes/no	Not limited, ~650,000 per year / no	yes
Oregon	salmon, steelhead, halibut, sturgeon,	record on card	purchase in addition to license	US$21.50	yes/no	Not limited, 208,452 (2005) / no	no

VII. Potential for Fish Tags in Gulf of Mexico Recreational Fisheries

The following section addresses the potential for adaptation of existing harvest tag mechanisms to the Gulf of Mexico reef fish fishery, with particular emphasis on red snapper and the shallow-water grouper complex. The emphasis is on conceptual development and exploration of management mechanisms with the potential for application in these fisheries, considering both biological and socioeconomic fishery attributes. These proposals are offered with the intent of initiating a dialog among all stakeholders towards alternative paths to sustainability, fewer conflicts, and greater social benefits from these valuable fishery resources. The specific details of any harvest tag program should be developed in coordination with the full range of stakeholders and managers involved in the Gulf of Mexico reef fish fishery.

Adaptation of Tag Management Mechanisms to Gulf Recreational Fisheries: Management Features, Opportunities and Challenges

The challenges and opportunities related to the adaptation of harvest tags to the Gulf of Mexico recreational reef fish fishery may be considered within the context of the ten management features identified in Section IV. As described above, these features include: (1) the ability to set hard limits on harvest; (2) the potential for longer seasons; (3) the availability of mechanisms to promote equitable tag allocation; (4) the ability to contribute to effective monitoring and enforcement; (5) the provision of additional harvest data; (6) the generation of funds to support management; (7) promotion of a greater awareness of resource scarcity and a stewardship ethic; (8) the ability to integrate with a for-hire fishery sector; (9) the ability to (at least in theory) integrate with the commercial fishery sector, and; (10) an ability to garner and encourage angler support. For each of these management features, harvest tags offer potential opportunities to improve current management performance. However, for many of these features, there are also challenges that must be addressed. These challenges largely relate to divergences between typical hunting programs in which harvest tags are widely successful, compared to the context of recreational angling in the Gulf of Mexico. These are discussed below and summarized in Table 3.

Table 3. Management Features of Harvest Tags versus Current Management in Gulf of Mexico (GOM) Recreational Fisheries

Issue	Features of Current Management	Features of Harvest Tags
Hard Harvest Limits	• No effective harvest limits imposed; quotas are "soft" or do not exist. • Trends towards more restrictive management.	• Allows hard harvest limits to be imposed. • Would require large number of tags, and complex administration. • Number of tags issued should account for potential release mortality.
Season Length	• Trends towards shorter seasons related to ineffective harvest control.	• Can allow for longer seasons compared to non-rights based management, promoting angler satisfaction.
Rights Allocation	• Harvest open to all anglers subject to license, bag, size, season and other limits. • Rights "allocation" generally not a concern, as management is not rights-based. • Waiting period or pre-planning rarely required to fish.	• Requires establishment of mechanisms for allocation of harvest tags. • Allocation can be complicated by large numbers of anglers; heterogeneous groups; resident vs. non-resident distinctions. • Short-term rights can ameliorate some allocation concerns or controversy associated with durable rights. • Allocation can be controversial; allocation methods for scarce tags include lotteries (with preference and/or bonus points) and auctions. • Examples of various successful allocation modes in existing programs. • May involve money cost, effort, or waiting periods to obtain tags; might require pre-planning to target certain species.
Monitoring, Enforcement and Compliance	• Faces common challenges associated with monitoring, enforcement, and compliance with regulations in large scale recreational fisheries.	• Monitoring and enforcement still a challenge, but ameliorated by attributes of harvest tags (ease of observability at check points, etc.) • Requires mechanisms for monitoring tags and harvest. • Can increase voluntary compliance and self-policing among anglers. • Angler education and information materials often required.
Data Collection	• Recent assessments identify significant limitations with current methods of obtaining data for recreational fisheries, including those in GOM.	• Tags can provide data on some or all aspects of recreational fishing. • Wide array of reporting and data gathering mechanisms in current tag programs provides lessons for developing methods for GOM fisheries. • Reporting compliance varies with incentives provided by program.
Revenue Generation	• Current management mechanisms such as bag and size limits provide no mechanism for cost recovery or revenue generation.	• Revenues from the sale or auction of harvest tags can be used to support management, education, data collection, and other efforts. • Revenues must be viewed within the context of program cost.
Sector Integration	• Private and for-hire sub-sectors face same bag, size and season limits. Regulations rarely suit groups equally. • Commercial and recreational sector not integrated under current management.	• Many models for integration of management for private and for-hire groups using harvest tag programs. • Possibility of rights transfer between recreational and commercial sectors; practical mechanisms for integration are not well developed.

(1) Hard Harvest Limits: One of the persistent challenges in Gulf of Mexico recreational fisheries, including those for red snapper and shallow-water grouper, has been maintaining harvest below specified quotas and/or sustainable levels. As noted above, Gulf reef fisheries are generally managed through a combination of input and output controls, with a target soft TAC that is often exceed in practice. For example, anglers typically exceed the recreational quota for Gulf of Mexico red snapper. Other species, such as many in the shallow-water grouper complex, have no specified quota for harvest (GMFMC 2005). As noted earlier in this paper, the resulting weak control over harvest has led to progressively increasing management restrictions (e.g., smaller bag limits, shorter seasons, larger minimum sizes). As highlighted by Johnston and Sutinen (2003), strong control over fishing mortality from all sources (recreational, commercial, incidental) is a key principle of effective management—a principle that is currently violated in many Gulf of Mexico recreational fisheries.

Harvest tags, combined with existing harvest quotas for many Gulf species, provide a potential mechanism to introduce hard harvest limits into recreational fisheries. Hunting and fishing applications (see Appendices B and C) provide numerous examples in which harvest tags are used successfully to impose sustainable, hard harvest limits. While more common in hunting applications (the majority of fishing applications do not use tags to impose hard caps on harvest), the fundamental mechanism for linking tag-management to hard harvest limits is well-established. These mechanisms function in a manner similar to those applied in alternative rights-based fishery management mechanisms such as IFQs. In the most general case, harvest targets for specific species are established through a process involving policymakers, scientists and sometimes stakeholders. These targets may be established over either small or fairly large geographical regions, depending on management goals and species attributes. Tags are then issued allowing a harvest quantity equal to this established quota. Harvest of the species in question generally requires a tag; mechanisms for allocating and distributing tags vary (see discussion below and Appendices B and C). Tags may also be gear-specific. While possession of a tag does not guarantee harvest, it guarantees the right to harvest a specified animal, during a specified season, in a specified geographical area.

In addition to well-established mechanisms whereby harvest tags could be used to impose hard harvest limits, recreational quotas have already been established for a variety of Gulf reef fishes, including red snapper (currently 4.47 million pounds) and red grouper (currently 1.25 million pounds) (GMFMC 2005). For these species, harvest tags would provide a mechanism to enforce the currently existing harvest quotas. For species with no current harvest quota (e.g., gag grouper), the implementation of harvest tags would require the establishment of enforceable quotas. However, in all cases, one additional step would be the translation of current harvest quotas, specified in pounds, to those suitable for application to harvest tags (which are typically specified in number of animals, or fish). In addition, decisions would have to be made regarding whether tag-quotas would be established for single species (e.g., red snapper, gag grouper) or for species groups (e.g., shallow-water grouper). Although either is feasible, the majority of existing harvest tags convey the right to harvest an animal of a specific species.

One important consideration in terms of the ability of tags to promote hard harvest limits is the way in which tags function to limit harvest, particularly with regard to already-existing

management mechanisms such as bag limits. For example, most tag programs are designed such that tags are required for all animals harvested. However, alternatives exist, as reflected in existing hunting and fishing tag programs. For example, a hunting license in Montana allows the harvest of a single animal of certain species; additional harvest requires tags for special hunts. Similarly, harvest tags could be required for harvest above a specified daily bag limit, but in such cases tags would not impose hard harvest limits.

A second potential consideration in the application of harvest tags to establish hard harvest limits for Gulf of Mexico reef fish is the size of the quota (i.e., number of animals and tags) relative to common hunting and fishing applications. The majority of terrestrial hunting applications of harvest tags involve less than 250,000 issued tags, with the majority of programs issuing far fewer than this number (Appendix B). The majority of existing fish tag programs involve similar numbers of tags (an exception is the Washington State Catch Record Card, for which approximately 650,000 are issued annually). In contrast, tag programs for species such as Gulf of Mexico red snapper would likely require over 1,000,000 tags, assuming one tag per harvested fish. Large numbers of tags would also be required for a variety of shallow-water grouper species. The comparative magnitude of potential tag numbers for Gulf of Mexico reef fish applications (approximately 4x the number of tags as the most common large hunting programs) suggests that implementation of such programs would require a more significant administrative structure than is typical for existing programs. It does not suggest, however, that the number of tags required would be prohibitive to a successful harvest tag program. A more direct concern would be the cost of implementation relative to any revenues that might be generated, although there might be economies of scale in program administration, such that the cost "per tag" might be lower than in contexts in which a smaller number of tags is allocated. Additional issues related to the cost of program implementation are discussed below.

A final important issue relevant to the use of tags to impose hard harvest limits is pre- and post-release mortality (e.g., due to barotraumas). This issue is particularly significant given the multi-species nature of the reef fish fishery. Unlike terrestrial hunting, in which one can identify species (e.g., deer, elk) prior to harvest, anglers in multi-species fisheries have a limited ability to avoid catching untargeted fish. Compliance with fishery regulations often involves the release of fish for which harvest is not permitted. The primary purpose of harvest limits is the reduction of species mortality, and harvest tags would almost certainly require the release of fish caught in excess of the number of possessed tags. This is similar to the current requirement for harvests in excess of daily bag limits for red snapper and grouper in the Gulf reef fish fishery. However, recent research in the Gulf of Mexico and elsewhere suggests that pre- and post-release mortality in recreational fisheries may be higher than was previously assumed (e.g., Schirripa and Legault 1999; Millard *et al*. 2003; Woodward and Griffin 2003). As a result, tag numbers—like harvests allowable under bag limits—may significantly understate mortality. In this regard, tags are little different from current management mechanisms, for which estimated harvest likely understates mortality. As a result, hard harvest limits imposed by tags may be less beneficial in terms of mortality reductions if pre- or post-release mortality is substantial. Given the likelihood of non-trivial post-release mortality in Gulf of Mexico recreational fisheries, the prevalence and impacts of post-release mortality should be a primary consideration when determining the appropriateness of harvest tags in Gulf of Mexico recreational fisheries, implications for species harvest and mortality, and the number of tags that should be issued.

(2) Season Length: Currently, the Gulf of Mexico red snapper season runs from April 15 to October 31, down from a year-round season that was in place until 1996. While the shallow-water grouper season is currently year-round, it is anticipated that there will be a seasonal grouper closure from February 15 to March 15 beginning in 2007 (GMFMC 2005). Such closed seasons often lead to dissatisfaction among anglers and a loss of economic benefits to the for-hire sector. Past trends show little evidence that current management methods will lead to a lengthening of open seasons for these fisheries in the foreseeable future, and if anything portend further reduced seasons in future years. In contrast, harvest tag programs, such as the South Dakota Paddlefish tag program, may be designed so as to disperse fishing effort over a season of longer duration. In this regard, tags function much as IFQs, in terms of the latter mechanism's ability to reduce the race to fish in commercial fisheries. In the case of South Dakota paddlefish, for example, the tag system was designed to allow anglers the freedom to spread their fishing effort over a greater number of days, and thereby relieve the congestion at fishing areas that was occurring under the prior system. All indications are that the program has been successful in this regard. Similarly, the reviewed hunting tag programs reveal success in maintaining harvest limits and sustainable species populations, with no evidence of trends towards reduced season lengths.

Combined evidence from both fishing and hunting applications of harvest tags suggests that such mechanisms are often able to either maintain or increase the duration of hunting or fishing seasons, with little associated difficulty with excess harvest. Presuming angler support and effective monitoring and enforcement (see discussion below), there is no reason to suspect that similar advantages would not apply to harvest tags in the Gulf of Mexico recreational reef fish fishery.

(3) Equitable Allocation: One of the most difficult issues facing rights-based mechanisms in both commercial and recreational fishing applications is the allocation of fishing rights (Sutinen and Johnston 2003; Macinko and Bromley 2002). Such allocation issues can be particularly challenging in cases, such as IFQs, in which rights are long-term or durable (Macinko and Bromley 2002). Allocation for harvest tags may be somewhat less challenging than that for IFQs and other durable rights, because harvest tags generally confer only short-term (e.g., season long), non-renewable rights. Hence, the transfer of long-term wealth or value associated with harvest tags is much less than one might associate with similar long-term rights such as IFQs (cf. Macinko and Bromley 2002). Nonetheless, review of harvest tags in both hunting and fishing applications (see Appendices B and C) suggests that allocation issues represent one of the more significant concerns of stakeholders and managers.

Notwithstanding the potential challenges associated with appropriate allocation of harvest tags, existing hunting and fishing tag programs incorporate a wide array of provisions to encourage equitable distribution of hunting or fishing opportunities. While not always universally popular, these mechanisms are often reported as largely successful in promoting equitable allocation of tags among different angler or hunter groups. As noted above, established allocation mechanisms include: (1) lotteries for high-demand hunting tags; (2) preference points allocated to hunters who fail to obtain tags in past lotteries; (3) set-asides of tags for the exclusive use of particular groups or hunting methods; (4) limits on the number of tags that may be held by specific individuals. In addition, tags for which quantities are somewhat less limited are distributed or sold using a variety of point of sale or other mechanisms, including: (1) on-site

sales at local fishing or hunting supply shops (i.e., point of sale vendors); (2) distribution to individual anglers or hunters via the postal service; (3) distribution at government agency offices; (4) availability of tags directly through for-hire sector operators, such as hunting guides, and (5) availability of tags at hunting or fishing tournaments. Tags may also be distributed as stand-alone documents, or may require the individual to have previously or simultaneously obtained other license documents.

Review of hunting and fishing tag programs also suggests a wide range of complexity of tag allocation mechanisms. Systems range in complexity from relatively simple programs such as that in the Newfoundland Cod Food Fishery (tags are automatically distributed with groundfish licenses) to highly complex systems such as those for the allocation of Colorado deer and elk and Maine moose tags. Programs of modest complexity are most common; examples of moderately complex fishing tag programs are those for Western Australia (Shark Bay) pink snapper and South Dakota paddlefish, both of which rely on lottery allocation mechanisms. In general, more scarce tags (relative to angler demand) are associated with more complex allocation mechanisms (e.g., lotteries, preference points, auctions), while tags that are less scarce (or are unlimited in quantity) are associated with less complex allocation mechanisms (e.g., automatic allocation with licenses, point of sale vendors). The specific tag allocation mechanisms appropriate in any given context must be decided by local policymakers, preferably in coordination with stakeholder groups (e.g., anglers, hunters, conservationists). Given characteristics of Gulf of Mexico reef fisheries, however, it is likely that harvest tag allocations would fall somewhere in the mid-range of existing programs in terms of demand for tags relative to supply. Hence, required complexity of allocation mechanisms would likely fall somewhere in the middle range of current programs.

Among the more controversial of elements associated with tag applications would likely be any rationing mechanism imposed to equilibrate quantity supplied and demanded. Market or price-based rationing (including auctions) can represent an effective means to allocate tags to those with the highest willingness to pay, but can also result in an undesirable disenfranchisement (i.e., elimination of fishing opportunity) for less wealthy hunters or anglers, and would likely face significant resistance from anglers. Lottery systems divorce allocation likelihood from willingness to pay, but provide no mechanism through which preference is given to hunters or anglers for whom tags are particularly high-value.[15] First-come first-served mechanisms can result in a race-for-permits, and the unavailability of permits late in the season. Sale or provision of tags with license purchases offers a simple allocation mechanism which can take advantage of existing systems for license sales. However, it would not ensure hard controls on total harvest unless the number of licenses is limited.

Related to the rationing issue is any waiting period that might be required to obtain a tag. Current regulations in the Gulf of Mexico recreational reef fish fishery allow fishing during any day of the open season, with no extensive prior planning. In contrast, some types of tag distribution mechanisms (with the exception of point of purchase sales) would require some delay or waiting period between when an angler ordered a tag and when harvest could occur. Significant waiting periods could erode angler support for tag management. Distribution of tags

[15] Although preference points are designed to reward hunters who are persistent in lottery applications for high value tags.

through retailers (e.g., of sporting goods, bait, etc.) might alleviate that problem, but this might not be possible if a lottery system is used to ration tags.

Given the heterogeneity of anglers and large number of anglers fishing from both private and for-hire boats in the Gulf of Mexico, multiple-mode allocation may be most suitable. Such multiple-mode allocation is common in hunting tag applications, with tags available through a variety of mechanisms. Examples might include a certain number of tags allocated automatically with saltwater fishing licenses, with additional tags available through point of sale purchase, lottery, auction, or other rationing mechanism. Such mechanisms would match those applied in hunting tag programs such as those in Montana (see Appendix B), although most hunting programs involve more than one mode of permit allocation. Multiple-mode allocation models can ameliorate some of the negative attributes of single allocation methods, particularly when tags are scarce. However, even in such cases, harvest tag programs may face resistance from local anglers who fish frequently, as the rationed tags needed to impose hard harvest limits may reduce the potential harvest of such anglers, relative to that possible under current management.

In addition to allocation methods applicable to individual anglers, one might also wish to develop a mechanism whereby a certain proportion of tags are either sold or otherwise distributed solely to operators in the for-hire sector, in addition to other distribution methods. Such provisions are common in hunting tag programs, including many reviewed in Appendix B (e.g., Oregon, Idaho). A similar mechanism exists in Wyoming, whereby certain nonresident tags may only be used in coordination with a guided hunt (Appendix B). Such mechanisms can help to ameliorate a potentially significant concern among the for-hire sector that insufficient tags would be made available to support anglers wishing to use their services, such that their business would decline relative to prior seasons. In this regard, it is important to recognize that a harvest tag program could be designed so as to allow a similar level of harvest to that which now occurs for various reef fish species. Were this to be the case, there would be less justification for an argument that harvest tags would negatively impact the for-hire sector. Nonetheless, the for-hire tag allocation issue remains salient; any tag allocation program should likely contain provisions to ensure integration with the existing for-hire sector. These issues are discussed in greater detail below.

An additional issue of concern is the availability of tags to residents versus nonresidents. Nearly all state hunting tag programs distinguish between resident and nonresident applicants, with the majority of tags available to residents. However, a significant difference between most hunting tag programs and the Gulf of Mexico recreational reef fish fishery is that hunting occurs within state borders (and most on state or private land), while the majority of harvest in the reef fish fishery occurs in waters of the federal exclusive economic zone (EEZ). Given that most fishing occurs in federal waters, a distinction between Gulf state residents and nonresidents may be less appropriate than in state hunting programs. This conclusion notwithstanding, the allocation of resident versus nonresident tags would be a critical issue in the design of any tag allocation program for Gulf of Mexico recreational fisheries.

A final issue with significant implications for the ultimate allocation of tags are rules governing transferability. Few hunting and fishing tag programs allow for individuals to sell harvest tags; some allow tags to be transferred or swapped contingent upon no money changing hands. For example, Maine, Idaho and Florida, among other states, allow limited transferability of hunting

tags. Transferability has both positive and negative aspects. Based on market principles, transferability would provide a mechanism for tags to reach those for whom harvest is most highly valued, thereby maximizing the net economic benefits of angling. Transferability would also provide a means of integration with both the for-hire sector and the commercial sector for reef fish (see additional discussion on such issues below). However, permit or tag sales could also result in speculation for highly valued tags and a "pricing out" of less wealthy anglers from the permit markets that might result.[16] Given the lack of transferability (particularly in exchange for money) options in most hunting and fishing applications of harvest tags, it appears that the majority of policymakers feel that the negative aspects of transferability outweigh the positive aspects. In contrast, transferability is a critical aspect of most rights-based management programs in commercial fisheries, ensuring that harvest is done by the operators that can realize the greatest net economic benefits. Considering the pros and cons of transferability, this paper draws no firm conclusion with regard to the most promising approaches for the Gulf of Mexico recreational reef fish fishery. We emphasize, however, that such provisions can have critical implications for the outcome of any tag allocation mechanism, as well as for support for harvest tag programs among various stakeholder groups and the potential integration of recreational harvest tags with rights-based approaches in the commercial sector.

Given the above and other concerns, allocation questions that are likely to apply to any application of harvest tags to Gulf of Mexico recreational reef fish fisheries include:

1. How would tags be distributed among Gulf state residents and nonresidents (tourists)?

2. How would tags be allocated among individual anglers and the for-hire sector (see additional discussion of for-hire integration below)?

3. Would tags be available on-site, during the day of fishing at point of sale vendors, or would anglers be required to obtain tags prior to a fishing day?

4. To what extent would rationing of tags be required? What rationing mechanisms would be considered most appropriate by policymakers and stakeholders? Would multiple or single rationing methods be used?

5. To what extent would any tag rationing mechanism promote perceptions of tag shortages or scarcity, and would this influence angler support for harvest tag programs?

6. To what extent would tags be transferable or saleable? What regulations might govern the transfer of tags?

7. Would tags be distributed using a single mechanism, or combined methods?

[16] The result would be similar to that which occurs with highly sought-after concert tickets, in markets where "legal-scalpers" may purchase and resell tickets. The result is that a large proportion of tickets are sold to legal resellers, who then sell the tickets to end-users at much inflated prices. For certain events, the extreme demand for tickets among resellers can make it very difficult for individuals to obtain tickets through normal avenues.

(4) Monitoring, Enforcement and Compliance: As noted in previous sections, monitoring, enforcement and compliance are critical issues in the management of recreational fisheries. Moreover, given the large number of participants involved and the absence of central locations at which all participants may be intercepted and observed, recreational management in the Gulf of Mexico reef fish complex relies heavily on voluntary angler compliance, motivated in some cases by monitoring and enforcement measures. Harvest tag programs do not eliminate concerns with monitoring, enforcement and compliance. However, there are aspects of tag programs which can, at a minimum, ameliorate some of the associated challenges. For example, relative to bag limits, a requirement that physical tags are attached to harvested fish, together with random checks or check-points, can facilitate monitoring and enforcement efforts.[17] Harvest reporting requirements associated with tags (e.g., required in order to obtain additional tags or tags in subsequent years) can also aid in more accurate harvest monitoring. In addition, hunting tag programs nationwide have well-established "spot check" and other mechanisms to assess and encourage compliance (see Appendix B), providing models from which potential Gulf of Mexico harvest tag programs could draw. Overall, it is likely that monitoring and enforcement would be at least as effective, and probably more so, than it is under current management mechanisms. The general success of the reviewed hunting tag programs (Appendix B), as well as the small number of fishing tag programs that establish hard harvest limits (Appendix C), suggests that monitoring and enforcement ability under harvest tags is sufficient to maintain effective harvest management.

Another area in which harvest tags could encourage improved monitoring and enforcement is in the form of self-policing behavior among anglers. As noted earlier in this paper, a requirement that scarce tags must be obtained—sometimes at significant cost and effort—in order to harvest Gulf recreational fishes would likely provide a clear indication of the scarcity of these fishery resources. In addition, an angler who has made a resource outlay (e.g., in money or time) to obtain a fishing tag will likely have a greater incentive to report others who are observed to be harvesting illegally, compared to incentives that might exist under current bag and size limits. Such incentives could aid in publicly-funded monitoring and enforcement efforts.

Voluntary compliance can also be influenced, either positively or negatively, by harvest tag programs. In some instances tags can increase angler satisfaction, as noted in the South Dakota paddlefish tag program (Appendix C), which could be expected to increase voluntary compliance with management measures. However, experience in the small number of existing fish tag programs is not universal in this regard. For example, the Newfoundland Cod Food Fishery has experienced a protest fishery due to anglers dissatisfied with the current tag program—a clear example of noncompliance. Of the reviewed hunting tag programs in Appendix B, none have indications of significant noncompliance.

In addition to developing programs so as to avoid angler protest and resistance, there are other attributes of tag programs that may assist in effective monitoring and enforcement. For example, few of the reviewed hunting or fishing harvest tag programs allow for *ex post* acquisition of tags for harvest that has already occurred. Although some nationwide hunting program do allow tags

[17] For example, the presence of tags on retained fish may be easily and quickly observed at check-points. In contrast, verifying size limits requires measurement of retained fish and verification of bag limits requires counting of the number of fish per angler.

to be obtained *ex post*, in fishing applications it is likely that such opportunities could greatly reduce the effectiveness of monitoring and enforcement efforts, as well as the effectiveness of the program at limiting harvest. For example, noncompliant anglers could fish without tags, and if intercepted (without tags on harvested fish) could argue that the required tags were to be obtained after the harvest. The resulting opportunities for facile noncompliance would likely render a harvest tag program much less effective.

(5) Provision of Harvest Data: Relative to controls such as bag and size limits, tag programs can provide much greater certainty regarding the number of animals harvested, providing data which may be used to improve management efforts. One of the primary motives for both existing hunting and fishing tag systems is the collection of harvest data; this motive is explicit in all reviewed programs in Appendices B and C. Moreover, many programs incorporate specific mechanisms to gather harvest data. Hence, compared to existing management mechanisms in the Gulf of Mexico recreational reef fish fishery, data collection is likely to be improved under appropriately-designed harvest tag management. In addition, the wide array of harvest reporting and data gathering mechanisms incorporated into existing hunting and fishing tag programs—together with the relative successes and failures of these mechanisms—provides information that may be used to develop successful methods for Gulf of Mexico recreational fisheries.

Voluntary compliance with harvest reporting varies across existing harvest tag program. Harvest reporting is excellent for some programs. For example, Nevada reports 90% compliance with its harvest reporting requirements, while compliance with Idaho's reporting requirements averages approximately 80% (Appendix B). Other programs report more significant difficulties with reporting compliance. For example, an average of only (roughly) 20% of anglers return catch record cards in Oregon (Appendix C). Other programs—both hunting and fishing—have no requirement for harvest reporting. As one might expect, compliance with harvest reporting is greater in programs that enforce significant negative consequences for non-compliance. For example, in Idaho, hunters are unable to obtain hunting licenses for the next year unless a harvest report card has been submitted for the current year (Appendix B). In cases where penalties are nonexistent or not enforced, compliance is predictably lower. For example, there has been little or no enforcement of non-reporting penalties in the Florida tarpon tag program. Reporting may also vary across hunter or angler groups, as in Wyoming where compliance with required harvest reporting varies from 60-70% for nonresidents to only 40-50% for residents (Appendix B).

As a generalization, it appears that mechanisms exist to encourage a high proportion of anglers or hunters to comply with harvest reporting, thereby providing data on harvest that is unavailable under current management approaches. However, such mechanisms would likely require penalties for non-reporting, which may reduce program support among anglers. Moreover, reporting may be viewed as more burdensome in fisheries such as the Gulf of Mexico reef fish fishery, in which anglers may fish frequently and obtain significant harvest. In contrast, programs in which high reporting compliance is common often involve species such as deer or elk, for which harvest is small and successful trips less numerous. As with other management features of tag programs, harvest reporting requirements should most likely be designed in cooperation with angler groups, to maximize potential reporting while reducing the perceived burden on anglers.

(6) Revenue Generation: Revenues from the sale or auction of hunting and fishing tags can be used to support management, education, data collection, and other efforts (Sutton *et al.* 2001). In contrast, mechanisms such as bag and size limits provide no mechanisms for cost-recovery. Revenues provided by tag mechanisms, however, must be viewed within the context of the sometimes significant cost of implementing such programs. Many hunting tag programs, and all except the Florida Tarpon Tag program in recreational fisheries, require only nominal payments in order to obtain tags; required payments of $5 - $20 are common for tags allowing one or more animals to be harvested. Where tag rationing occurs, it is typically conducted using lotteries or other non-price based mechanisms. A few notable exceptions exist, such as the auction program through which Maine allocates a small portion of its Moose permits. However, as a generalization, tag prices are relatively low, and as a result program revenues are often insufficient to cover the full cost of fishery management (although sometimes sufficient to cover the direct cost of harvest tag administration). Additional details of program costs and revenues are provided in Appendices B and C.

Given potential angler resistance, it is unlikely that high tag prices would be feasible in the Gulf of Mexico recreational reef fish fishery. Modest tag prices, however, might be acceptable to many anglers; the evidence is mixed in current fishing tag programs as to whether anglers protest tag fees. In some fisheries significant protest has erupted over tag fees (e.g., the Newfoundland cod food fishery tag program). In others, tag fees seem to be accepted with little controversy (e.g., South Dakota paddlefish). A third group of fishery harvest tag program managers indicates limited resistance among anglers to tag fees (e.g., Oregon). Experience from existing programs suggests that associated revenues may be sufficient to cover program administration, but will almost certainly be insufficient to pay for the full range of costs of fishery management in the Gulf of Mexico recreational reef fish fishery. Whether the net cost (e.g., to taxpayers, after considering tag revenues) of fishery management will increase or decrease under a harvest tag program in this fishery is uncertain.

(7) Conservation Ethic: Stewardship motives of anglers under harvest tag programs are likely to be at least as significant as those that exist under current management. The general lack of incentives for conservation and stewardship behaviors provided by standard, non-rights based management in fisheries is well established (National Research Council 1999). It is unclear, however, whether harvest tags would encourage substantial increases in stewardship behaviors, or a conservation ethic, among anglers. Many argue that strong rights-based management in fisheries encourages conservation and stewardship behavior (National Research Council 1999). Some, however, argue that a similar degree of stewardship benefits would be associated with short-term enforceable catch shares (e.g., Macinko and Bromley 2002), such as those granted by harvest tags. As a general consensus, however, many argue that motives for stewardship behavior are strongest in cases where harvest rights are more secure and durable, and in which fishers perceive their own actions as having a notable impact on the fishery (Leal *et al.* 2006). In contrast, harvest tags in the Gulf of Mexico reef fish fishery would confer short-term rights, in which each angler's share of the total fishery harvest would be small. Hence, while the harvest rights conferred by tags might encourage greater stewardship among anglers compared to current management mechanisms, incentives for stewardship are likely to be less pronounced than those observed for durable rights-based programs such as IFQs. In addition to classical stewardship incentives (arguably) provided by rights-based management, additional incentives for self-

policing among anglers—another form of stewardship behavior—are presented above in the discussion of monitoring and enforcement.

(8) For-Hire Sector Integration: The Gulf of Mexico recreational reef fish fishery involves a large number of individual anglers who fish from private boats (or other private/public areas) as well as anglers who use the services of the for-hire sector. Both groups are combined into the larger category of the recreational fishery sector, although the for-hire sub-sector represents a set of commercial enterprises. Currently, both the private and for-hire sub-sectors are managed under the same bag, size, and season limits, although additional restrictions on entry apply to for-hire operations. The for-hire sector is also subject to standard business regulations that do not apply to private anglers.

The significant differences between the for-hire and private recreational sector can lead to difficulties in developing standardized regulatory mechanisms that apply equally to both. These challenges are recently exemplified by the Alaska halibut fishery, in which IFQ management has been proposed for the charter sector only, leaving private anglers under non-rights based management (Criddle *et al.* 2003). Such programs aside, the economic properties (e.g., efficiency) of fisheries are often improved when rights-based management integrates all sectors of a fishery, allowing reallocation of scarce harvest to those sectors with the highest marginal values. Hence, a significant aspect of any rights-based management mechanism for the recreational fishery is its ability to integrate both private anglers and the for-hire recreational sector.

Any potential application of harvest tags to the Gulf of Mexico recreational reef fish fishery would require collaboration with both representatives of private anglers and the for-hire sector to ensure that the details of management were appropriate to both groups. Another alternative would be to pair harvest tag management of private anglers with IFQ management of the for-hire sector—an idea explored in greater detail below. Assuming that harvest tags were applied to both private anglers and for-hire operators, however, there are a great many examples which might be used as models for sub-sector integration. For example, state hunting tag programs have an extensive history of the integration of tag programs with an active for hire (e.g., hunting guide) sector. As noted above, strategies for integration include: (1) hunters can first obtain the desired tag, then seek out an appropriate for-hire guide or hunting service, or; (2) guide services can obtain tags on behalf of hunters.

One of the primary concerns of the recreational for-hire sector is likely to be the availability of sufficient permits to support profitable business operations. Such concerns are not unique to for-hire fishing vessels; they apply similarly to hunting guide and outfitting operations. As a result, many states provide a set-aside allocation of tags for outfitters and guides, or incorporate programs to guarantee for-hire hunting operations a certain guaranteed tag or hunt allocation. Similar models could be adapted for use in the Gulf of Mexico recreational reef fishery. For example, the Outfitter Allocation Controlled Hunt Permit program in Idaho provides a mechanism to guarantee outfitters a certain level of controlled hunt business each year (Appendix B). Other states provide for certain types or quantities of tags that are only available through guides or outfitters, and in some states (e.g., Wyoming) nonresidents can only hunt in certain areas if accompanied by a guide (or resident companion). Still other programs allow for tags to be purchased or otherwise obtained through guides or outfitters.

In summary, integration of the private and for-hire recreational fishery sectors within a harvest tag management program is likely to be one of the more challenging aspects of program design. Nonetheless, such concerns have not prevented the development of successful hunting tag programs, and there are many examples upon which one may model harvest tag programs that address the needs of both groups in the Gulf of Mexico recreational reef fish fishery.

(9) Commercial Sector Integration: As noted above, there is increasing interest in mechanisms that allow for integration of harvest rights in the commercial and recreational sectors in rights-based management systems. A recent example is the approved but not yet implemented Alaska halibut charter IFQ program, which would allow limited transfers between the charter and commercial sector (Criddle *et al.* 2003). Tag programs also allow the possibility of harvest right transfer between recreational and commercial sectors. Practical mechanisms for such integration, however, are not well developed in either hunting or fishing applications of harvest tags. One notable exception is the Irish salmon tag program, which integrates the both commercial and recreational fishers under the same program, although transfer of tags between commercial and recreational users is not allowed (Appendix C). However, this fishery is not typical, and has experienced a lack of stakeholder support due at least in part to concerns over the implications of fishery integration for the commercial sector. Most tag programs allow for limited or no transferability of tags between any entity, recreational or commercial. Where transferability is allowed, the transfer of money in exchange is rarely permitted.

Any possible tag-based integration of the commercial and recreational fishery sectors would require development of novel management mechanisms. Complications of rights-transfer would likely include differences between durable, strong-rights common in rights-based commercial fisheries (e.g., IFQs) and the short-term rights granted by harvest tags. Integration might be facilitated, in contrast, were the commercial sector to be managed using short-term harvest rights, such as those proposed by Bromley and Macinko (2002). However, the performance of such short-term rights in commercial fisheries has yet to be established, in contrast to significant experience with commercial applications of IFQs (Newell *et al.* 2002). In summary, given the lack of experience in the rights-based integration of commercial and recreational fishery sectors, it is unlikely that a harvest tag program could be easily developed to accomplish such goals in the near-term. Nonetheless, in the long-term, exploration of potential tag-based integration mechanisms could offer to increase the net economic benefits flowing from Gulf of Mexico fishery resources.

(10) Angler Support: Given the cost of detecting non-compliance among recreational anglers, voluntary compliance can be critical to the success of recreational fishery management (Sutinen 1993), rights-based or otherwise. Intuition and past experiences suggest that voluntary compliance, in turn, is likely to be increased in fisheries where there is substantial angler support for management mechanisms; management rejected by anglers may result in widespread lack of compliance. Overall, tag management programs have been well-accepted by hunters and anglers, even in cases where harvest is severely restricted. While reviewed hunting programs indicate some concerns among hunters—many concerning the availability of scarce permits—most report general support of hunting tag programs (Appendix B). Many fishing tag programs report similar angler support (Appendix C). This support is not universal, however, with at least a small number of fishing tag programs experiencing a noted lack of universal angler support (Slade 2006; Grant 2006). For example, in the Newfoundland recreational cod

food fishery, anglers have resisted paying for licenses and tags, given that no such payments or licenses are required in other areas of Atlantic Canada. The result has been a recently-emerged protest fishery. The salmon tag program in Ireland has also experienced lack of stakeholder support due to a variety of concerns, including the associated constraints on harvest and potential effects on commercial fisheries (Grant 2006). However, other fish tag programs have been noted for widespread angler support and satisfaction, including the South Dakota paddlefish program (Appendix C).

Given the range of experiences in angler and hunter support for harvest tag programs, managers should not assume that angler support and satisfaction would be assured in tag-based management of Gulf of Mexico recreational fisheries. Tag programs should likely be developed carefully, in coordination with stakeholder groups, to promote angler support and buy-in. However, the clear hunter and angler support in a large number of existing harvest tag programs suggests that such programs can be designed so as to encourage positive stakeholder reactions.

One of the key elements in developing angler support for harvest tag programs is likely to be the success of angler education and outreach programs. Existing harvest tag programs in recreational fisheries, including the Washington Catch Record Card program, have indicated that angler education is one of the most significant challenges in implementing harvest tag programs. Moreover, intuition suggests that anglers are less likely to support programs that they find confusing or burdensome, or for which they have little accurate information. One might expect angler reactions to be particularly negative if they are surprised by new, unforeseen regulations that prevent them from fishing during a particular occasion or trip—for example if anglers fail to obtain required tags in advance of a planned fishing trip, and tags are not available on-site. Hence, it is incumbent upon policymakers to ensure that any potential harvest tag program incorporates sufficient mechanisms to educate anglers regarding the details of program implementation and administration. Existing hunting tags incorporate various mechanisms for hunter or angler education regarding hunting and fishing regulations. For example, Colorado provides a "planning (hunting) tips for nonresidents" page on its web site, with links to regulations for hunting in the state. Similar web sites are available in other states, with the purpose of educating residents and nonresidents regarding hunting tag and license programs, among other regulations.

Coordination of State and Federal Programs

Aside from opportunities and challenges related to the management features of harvest tags noted above, the implementation of harvest tag management in Gulf of Mexico recreational fisheries would require significant effort to develop infrastructure and operations for program administration. Unlike bag, size, and season limits—which require little administrative infrastructure other than that required for monitoring and enforcement activity—harvest tags typically require significant operational structure to manage distribution, collection and other aspects required for a successful program. While significant management infrastructure exists at the federal level through the NMFS council system (in this case the Gulf of Mexico Fisheries Management Council) and at the state level through various state fish and wildlife agencies, there is no established mechanism for Gulf-wide administration of recreational fishery harvest tags. While this can serve as an impediment to implementation of harvest tags, it is likely that

such impediments could be minimized through appropriate leveraging and coordination of already existing state and federal administrative and management structures.

Despite recent proposals, there is no currently-required federal saltwater angling license, nor any federal fishery management program that currently enables individualized communication with recreational anglers. Harvest tag management, in contrast, would require at least some degree of interaction with large numbers of individual anglers, if only to distribute tags and collect associated harvest data. Establishment of such a system at the federal level could involve significant cost. This cost could be reduced, however, by coordination with state level license programs. All Gulf states require some type of saltwater fishing license, with rules and restrictions that vary by state. However, as a general rule, licenses are required for all saltwater anglers, with a very small number of exceptions.[18] These licenses are typically annual[19], and hence require yearly, individualized contact with all (or the vast majority of) resident and nonresident anglers who fish in state waters. The infrastructure and mechanisms for this state-level individualized angler contact provides a potential mechanism whereby tags and/or associated information could be distributed. For example, tags for certain species could be distributed along with state fishing licenses, or could be purchased with licenses for an additional cost. Tags could be made available through any state channel whereby licenses could also be obtained, with states administering the program according to guidelines established at the federal council level.

The capitalization of state-level fishing license infrastructure and distribution channels for a federal harvest tag program would require coordination between the GMFMC and state agencies charged with fishing license distribution and administration. While certainly requiring start-up costs and negotiation between state and federal entities, this integration could reduce the need for a separate, parallel federal mechanism for tag distribution and administration in the Gulf of Mexico region. Such integration would require agreement on many details, including the source of funds to cover new costs associated with harvest tag programs that might be administered directly by state agencies, and the extent to which GMFMC oversight would be desirable or required. However, the integration of state and federal agencies has precedent in the long-established Duck Stamp program (Appendix B). While this program does not establish hard harvest limits, it illustrates an example of a successful federal-state partnership to administer a harvest tag program. Examples as the Duck Stamp program and state-level fishing license programs provide models for administrative structures that might be leveraged to increase the efficiency, and reduce the costs, associated with a Gulf-wide harvest tag program. In addition, the administration of the program at the state level might increase angler support and buy-in, relative to programs viewed as being imposed at the federal level.

Variants of Tag Programs

As suggested by the many different types of tag programs for the harvest of terrestrial, aquatic and avian species summarized in Appendices B and C, harvest tags may be adapted to many different hunting and fishing contexts, and may be designed to meet a wide array of different

[18] For example, some states do not require licenses for minors or senior citizens.
[19] An exception is the Lifetime License in Florida, which is offered as a substitute for annual licenses for those anglers desiring a longer-term license.

management goals. Some programs, including many of reviewed fishing tag programs, are designed primarily for data collection purposes. Others are designed to reduce harvest, impose hard harvest limits, allow for increased harvest seasons, allocate harvest opportunity among different user groups, and generate revenues, among other goals. Given the myriad potential goals of harvest tag programs and the different contexts in which they are applied, the reviewed hunting and fishing tag programs incorporate a wide variety of management elements. Some of these elements are suited primarily to hunting applications, and have little relevance to potential harvest tags in the Gulf of Mexico recreational reef fish fishery. However, other elements could be incorporated in harvest tags applied to Gulf reef fishes, including red snapper and shallow-water grouper. This section reviews some of the more promising and/or common of these elements.

One of the more common elements of many tag programs is the either *mandatory or voluntary bundling* of tags for various species. Examples of voluntary bundling include the Oregon "Sports Pac," available only to residents, which includes a combination angling/hunting license and several tags including a combined angling/harvest tag, a deer tag, an elk tag, a bear tag, a cougar tag, a spring turkey tag, and validation for upland birds and waterfowl (Appendix B). The similar Idaho "sportsman package" includes tags for deer, elk, bear, mountain lion, turkey, salmon and steelhead. Similar voluntary bundling is found in other programs nationwide. An example of mandatory bundling is the Oregon Combined Angling Harvest Tag, which may be purchased alone or as part of a Sports Pac. This tag allows the angler to catch and keep 20 salmon and steelhead, five sturgeon and six halibut; tags for these fish may not be obtained separately (Appendix C).

Advantages of tag bundling include ease of administration; a single tag-bundle is distributed for a group of species, rather than individually for each species. This can reduce administrative costs and burden, particularly for tags that are only sold as a bundle. Another advantage is that tag-bundles can provide anglers with the ability to retain fish for which harvest had not been anticipated. For example, a tag bundle allowing the harvest of a specified number of red grouper and gag grouper would allow an angler targeting red grouper to catch and keep gag grouper that might be caught, even though red grouper was the primary target. This would not be possible if the angler had only obtained a red grouper tag.

Disadvantages of bundling (particularly mandatory) could include problems with tag availability and/or scarcity, if different groups of anglers target different species. For example, if tags for red snapper harvest were only available bundled with grouper tags, then grouper tags could be essentially "sold out" through bundled purchase by red snapper anglers, even though these anglers no intention of harvesting grouper. This might leave few tags available for those targeting grouper—even though many grouper tags would ultimately go unused. Unless tags were transferable, obvious allocation inefficiencies could result. Anglers might also resist paying for unwanted tags that were bundled with desired tags. Such dissatisfaction has been associated with the mandatory Oregon bundling program (Appendix C). Specifically, anglers have expressed dissatisfaction at the need to purchase a combined angling tag when they do not intend to fish for all species on the tag. As a result, some anglers feel that they are forced to spend money on unwanted tags.

Another issue of tag bundling that is relevant to fisheries applications is the potential for single tags that may be used to harvest fish of different species. For example, one might purchase a "grouper tag" that would allow the harvest of any one of a specified set of species in the shallow water grouper complex. Similar approaches apply to current bag limits in the shallow water grouper complex that, with the exception of red grouper, allow for up to five grouper per day of a variety of species. A combined grouper tag might reduce administration cost and effort, and maximize the utility gained from a single tag. However, it would also reduce the ability of policymakers to set hard harvest limits for specific species. More specifically, tradeoffs associated with such bundling would involve a reduction in administrative cost and perhaps an increase in angler satisfaction, but a decrease in the ability of managers to exert specific control over species harvest.

A second variant of tag programs with potential applicability to Gulf of Mexico recreational fisheries is the use of various *classes of tags*, for different angler groups or types of fishing. For example, hunting programs often offer distinct tags for different hunting modes, such as bow-hunting, or for different groups of hunters (e.g., residents versus nonresidents). In fisheries applications, for example, the South Dakota paddlefish tag program allows different tags for fish harvested through archery and snagging. Tag classes can be used to address a wide variety of equity and distributional issues, including the concern that sufficient tags be made available to particular groups. For example, a certain subset of tags might be classified for use only with for-hire vessels, or only for use with private vessels. One might also distinguish between transferable versus non-transferable tags, or resident and nonresident tags. In general, although allowing for different tag classes would increase program complexity, it could also allow the flexibility to address potential problems associated with a single type or class of tags.

A third element across which tag programs can vary is the *transferability of tags*, discussed briefly above. Most tags either cannot be transferred, or transfers are highly limited. None of the programs reviewed in Appendix B or C allow for the sale of tags. It is also uncommon for tags to be exchangeable, although some programs do allow for the exchange of certain types of tags. For example, in Oregon, a controlled season hunt tag may be exchanged for a general season tag before the opening of the season, but controlled season and antlerless tags may not be exchanged (Appendix B). Similarly, programs rarely allow for the "money back" return of tags, even though only a percentage of tags are used to harvest animals. One could, however, allow for unused tags to be exchanged for tags good in future years, or for preference points that would increase the likelihood of obtaining tags available through lottery drawings. Here, the tradeoff might be the ability of tags to raise revenues (which, for a given number of tags sold, would be increased if tags were not returnable) versus the ability of tags to garner angler support (which might be increased if tags were to be returnable or exchangeable). Ability to return tags with some form of compensation might also reduce the incidence of discarding due to insufficient prior tag purchases (i.e., anglers would be more willing to purchase additional tags, knowing they could be returned if unused). It might generally increase demand and thereby offset revenue losses associated with tag refunds. Similarly, as noted above, decisions to allow tag transferability may involve tradeoffs between economic efficiency (i.e., tags going to those with the highest value) and perceived equity or fairness (e.g., an equal opportunity to obtain a tag regardless of ability to pay large sums).

A final element that varies considerably across programs is the *means of allocating, obtaining and distributing tags*, as discussed in detail above. As noted above, allocation mechanisms include point of purchase sales, lotteries, auctions, and other mechanisms. Non-rationed tags may be available through a variety of channels including mail order, internet sales, or in-person sales at a variety of locations. Tags may also be available directly from for-hire operations. As noted above, allocation and distribution mechanisms can have critical implications for the outcomes of harvest tag management. Critical elements that are likely to determine suitable tag allocation and distribution mechanisms in Gulf of Mexico recreational reef fish fisheries would likely include the large number of tags that would be involved, the large number of anglers who would wish to obtain tags, the significant number of both private anglers and for-hire operations, a desire of stakeholders and policymakers to ensure equity and availability of tags to a wide range of user groups, a desire to reduce the burden imposed on users and administrators, and the desire to obtain stakeholder support for any new management program.

As one of the most potentially controversial and variable elements of harvest tag implementation, allocation and distribution mechanisms should most likely be designed in close coordination with stakeholders in Gulf of Mexico recreational fisheries. Like most aspects of harvest tags, there are existing models for such coordination. For example, Colorado recently convened a License Allocation Work Group (LAWG) to explore potential changes to their nonresident hunting tag programs. The LAWG was comprised of representatives of sportsmen, landowners, outfitters, and community members. Similar bodies could be convened for deliberations regarding any potential harvest tag program for Gulf of Mexico recreational fisheries.

Integration with Alternative Management Mechanisms

Appropriately designed rights-based management mechanisms can act as "stand-alone" regulations, replacing alternative types of regulations. Nonetheless, most are supplemented by other regulatory mechanisms. For example, most hunting and fishing tag programs are paired with limits on seasons and allowable gear, among other supplementary regulations. Even in the presence of a well-functioning harvest tag program for Gulf of Mexico recreational reef fish fisheries, it would likely be necessary (or at least beneficial) to retain some non-rights based regulations. Hence, harvest tag programs would have to be designed to integrate with supplementary measures.

For example, an August 1999 regulatory amendment to the Gulf of Mexico Reef Fish Fishery Management Plan established two marine reserves that cover 219 square nautical miles off West Central Florida on areas suitable for gag and other reef fish spawning aggregations. Given the vulnerability of fish to over-harvest during spawning aggregations, it would likely be inadvisable to remove these regulatory measures, even in the presence of an appropriate harvest tag program. Similarly, regulators might with to retain size limits for biological reasons, apart from gross harvest limits that might be imposed by harvest tags. Moreover, while harvest tags might allow for an increase in season length for species such as red snapper, most fishing and hunting tag programs incorporate some degree of season limits; it is unlikely in the near-term that recreational red snapper fishing would be allowed year-round, even in the presence of harvest tags. Other means of integration could be used to increase angler support for harvest tags, as noted above. For example, one might require tags for harvest in addition to a specified (and low) bag limit, or for fish that exceed a certain size.

One might also consider integration of other rights-based management mechanisms with harvest tags. For example, one might design an IFQ program for the for-hire recreational reef fishery sector, following the example of the proposed Alaska halibut charter IFQ program. (As noted by Sutinen and Johnston (2003), IFQ programs may be much more suitable to the for-hire sector than to individual, private anglers.) Such a for-hire IFQ program could be paired with harvest tag management of private anglers who do not utilize the services of the for-hire sector. Such hybridized systems would be more complex than any one rights-based system used alone, but could offer significant advantages. Among these advantages would be capitalization of the full range of benefits of IFQ management for the charter sector, while managing individual anglers using harvest tag programs long proven to be successful in such contexts. The potentially intricate details of IFQ-harvest tag integration are beyond the scope of the current manuscript, although it is hoped that future research may address such promising integrations in recreational fisheries.

VIII. Implications and Conclusions

This paper explores issues related to the potential application of harvest tags to the Gulf of Mexico recreational reef fish fishery, with particular emphasis on red snapper and shallow-water grouper. This includes analysis of the key management features and characteristics of harvest tag mechanisms, a review of status and trends in Gulf of Mexico recreational reef fish fisheries and a review of existing harvest tag programs in both recreational hunting and fishing applications in the United States and worldwide. Based on this information, the paper discusses both opportunities and challenges associated with the potential application of harvest tags to the recreational reef fish fishery.

Based on the analysis and information presented above, we draw the following general conclusions regarding the potential for harvest tags in the Gulf of Mexico recreational reef fish fishery.

1. Recent trends in management suggest that current regulatory mechanisms, including bag, size and season limits, have been unable to provide for sustainable fisheries and maximize the potential long-term benefits of the fishery to anglers. Rights-based management mechanisms offer a potential means to reverse such trends.

2. Harvest tags offer a promising mechanism to improve management of Gulf of Mexico recreational reef fish fisheries, based on concepts of attenuated, rights-based management.

3. Given the substantial number of private anglers who do not utilize the services of the for-hire fishery sector, and the unsuitability of IFQ management for such anglers, it is unlikely that IFQs would be appropriate for the entire recreational reef fish fishery. Harvest tags offer a viable alternative that, with appropriate design, could be applied to both private anglers and the for-hire sector.

4. Mechanisms and examples currently exist for general types of harvest tag programs that would be most appropriate in the Gulf of Mexico recreational reef fish fishery. There is

substantial experience in the US and worldwide with the implementation of harvest tag programs.

5. There are only a small number of programs in which harvest tags are currently used to impose hard harvest limits in recreational fisheries. Those examples and the much larger number of hunting applications, however, suggest that such programs can be successful.

6. Implementation of harvest tags for Gulf of Mexico recreational reef fish fisheries would require a larger number of tags than any other reviewed program that imposes hard harvest limits. The number of tags that would be required is likely not prohibitive to a successful harvest tag program, but would add to administration and implementation costs.

7. Given the likelihood of non-trivial pre- and post-release mortality in Gulf of Mexico recreational fisheries, the prevalence and impacts of this mortality should be a consideration when determining the appropriateness of harvest tags in Gulf of Mexico recreational fisheries, implications for species harvest and mortality, and the number of tags that should be issued.

8. Allocation and distribution issues are likely to be among the most challenging elements in developing harvest tags for the Gulf of Mexico recreational reef fish fishery. Prior experience from hunting and fishing tag programs, however, provides numerous successful programs upon which Gulf of Mexico harvest tags could be modeled. Prior experience also suggests that multi-mode tag allocation mechanisms can address most concerns associated with equitable tag distribution.

9. Any potential Gulf of Mexico harvest tag program must establish rules concerning tag transferability. Most current programs allow limited or no transfer of tags. Transferability, however, can have advantages in terms of maximizing net economic benefits and the integration of recreational management with the commercial sector.

10. Monitoring and enforcement capacity is likely to be improved under harvest tag management, compared to current approaches. However, harvest tag programs should be designed to encourage voluntary angler compliance, and should not allow *ex post* acquisition of tags for harvest that has already occurred.

11. Compared to existing management mechanisms in the Gulf of Mexico recreational reef fish fishery, data collection is likely to be improved under appropriately-designed harvest tag management.

12. There are tradeoffs between effectiveness in obtaining harvest data and perceived reporting burden on anglers that should be considered in program design. Voluntary harvest reporting is generally associated with low response rates; much higher response rates are associated with mandatory reporting mechanisms.

13. Potential harvest tag programs for the Gulf of Mexico recreational reef fish fishery could be structured so as to provide revenues to offset program administration costs. Whether the net cost (e.g., to taxpayers, after considering tag revenues) of overall fishery

management will increase or decrease under a harvest tag program in this fishery is uncertain.

14. Stewardship motives of anglers under harvest tag programs are likely to be at least as significant as those that exist under current management, but may be less significant than those under stronger, more durable rights-based approaches.

15. Integration of the private and for-hire recreational fishery sectors within a harvest tag management program is likely to be one of the more challenging aspects of program design. Nonetheless, such concerns have not prevented the development of successful hunting tag programs, and there are many examples upon which one may model harvest tag programs that address the needs of both groups.

16. There is only one known example of a harvest tag program that in any way integrates the recreational and commercial sectors (Irish salmon tags). Given difficulties with this program, it appears unlikely that a near-term harvest tag program could be easily developed to provide rights-based integration of the commercial and recreational sectors in the Gulf of Mexico reef fish fishery. Nonetheless, in the long-term, exploration of potential tag-based integration mechanisms could offer to increase the net economic benefits flowing from combined recreational and commercial resources.

17. Universal angler support is not assured in tag-based management of Gulf of Mexico recreational fisheries. However, the clear hunter and angler support in a large number of existing harvest tag programs suggests that such programs can be designed so as to encourage positive stakeholder reactions.

18. One of the key elements in developing angler support for harvest tag programs is likely to be the success of education and outreach programs.

19. The integration of tag programs with administrative mechanisms already in place for state-level fishing licenses could provide a means to increase efficiency and reduce costs associated with the administration of a Gulf-wide harvest tag program.

20. Given the many variants of tag programs that exist worldwide, any harvest tag program for Gulf of Mexico recreational fisheries should be designed in close collaboration with fishery stakeholders. Variations in harvest tag programs influence such elements as the bundling of tags, the availability of different tag classes, the transferability of tags, and tag allocation and distribution mechanisms.

21. It is likely that successful management would integrate harvest tags with supplementary management mechanisms, perhaps including season and size limits. A particularly intriguing possibility is the integration of IFQ management of the for-hire sector with harvest tag management of private anglers.

Overall, harvest tag mechanisms represent a promising alternative to the current system of bag, size, and season limits in Gulf of Mexico recreational fisheries. The potential advantages of harvest tags are many, as reflected in existing tag-based hunting and fishing programs. These advantages include, among others: (1) the ability to set hard harvest limits; (2) the potential for

longer seasons; (3) the availability of mechanisms to promote equitable tag allocation; (4) the ability to contribute to more effective monitoring and enforcement; (5) the provision of harvest data; (6) the generation of funds to support management; (7) promotion of a stewardship ethic and angler compliance; (8) the ability to integrate with a for-hire fishery sector; (9) the ability to (at least in theory) integrate with the commercial fishery sector, and (10) a potential ability to garner and encourage angler support. These advantages, however, are not automatic; they require a well conceptualized and implemented plan that addresses the nature of the fisheries involved and the preferences and attributes of anglers.

Given the potential complexity of successful harvest tag programs (although some are simpler than others) and the size of the fisheries in question, implementation of harvest tag programs for Gulf of Mexico recreational reef fish fisheries would likely require significant start-up costs and planning efforts at both the state and federal (Council) level. As there is no simple "off the shelf" harvest tag program that could be easily implemented in the Gulf, managers would have to design a unique program suited to the needs of stakeholders in the recreational reef fish fishery and the biological attributes of Gulf reef fisheries. The design of such a program would require potentially difficult choices and tradeoffs, and would have to account for such factors as the size of the fisheries involved, the quantity of harvest consistent with a sustainable fishery, the heterogeneity of private anglers and for-hire operators, and the need to ensure equitable access to recreational fishing opportunities. The potential complexity of program design notwithstanding, the widespread success of hunting (and some fishing) tag programs worldwide suggests that appropriately designed tag programs can result in sustainable harvest of renewable resources and an increase in economic benefits relative to common recreational fishery management methods.

Appendix A

Primary Differences Between Recreational Fishing Tags and IFQs

(1) Duration: IFQs generally represent long-term or indefinite harvest rights or privileges, with often substantial capitalized value. While well-suited to commercial fisheries in which access limitations are already commonplace and expected, application of indefinite harvest rights to *recreational* fisheries could raise concerns related to fisheries access and equity—particularly when applied to individual (not for-hire) anglers. Moreover, even in commercial fisheries, the duration of rights or privileges bestowed by IFQs—and the associated wealth implications for quota holders—is a concern to some (Macinko and Bromley 2002; Marine Fish Conservation Network 2005).

(2) Allocation: As noted by Sutinen and Johnston (2003), the allocation of IFQ shares in recreational fisheries can represent a significant barrier to implementation. Again, this becomes more of an issue in fisheries with significant number of individual anglers who do not utilize for-hire vessel services. As noted by Sutinen and Johnston (2003, p. 485), "Since catch histories are nonexistent for most if not all recreational anglers, the most common basis for initial quota allocation cannot be used. While other means of initial allocation may be acceptable, this remains a fundamental challenge." Unlike IFQs, hunting or fishing tags are allocated each year using direct sales, lotteries, auctions, or other mechanisms. As noted above, tag allocation mechanisms in recreational hunting contexts are well-established, and similar mechanisms are likely applicable to many recreational fishing contexts.

(3) Enforcement: Detecting non-compliance among recreational anglers is typically much more difficult and costly than similar detection in commercial fisheries (Sutinen 1993). As noted by Sutinen and Johnston (2003, p. 485), "Individual recreational quotas can only aggravate these problems, since thousands of individuals' catches would have to be monitored." This would likely render enforcement ineffective, and effectiveness would rely primarily on voluntary compliance. Tag-mechanisms do not eliminate enforcement concerns. Nonetheless, the simplicity of monitoring a physical tag (that must be attached to an animal upon harvest) offers to at least partially ameliorate enforcement difficulties. Moreover, the relative simplicity of most tag-based programs may encourage voluntary compliance, compared to more complex mechanisms that may encourage angler frustration and noncompliance.

(4) Recordkeeping: IFQs require commercial vessels to maintain careful harvest records to compliance with quota levels and other applicable rules. While such recordkeeping may represent a small burden to commercial operators, it could represent a substantial imposition to recreational anglers—particularly those who fish infrequently. Hunting and fishing tags, in contrast, typically require minimal recordkeeping. At most, some require that the hunter or angler record the location and date than an animal is harvested. Moreover, where paperwork is required to obtain a tag or maintain records, for-hire guide services often assist hunters in such matters.[20] Such minimal recordkeeping requirements are generally more suitable to recreational

[20] For example, see guide service promotional literature at http://www.westwindguideservice.com/details.htm, http://www.ks-mo-hunt.org/; http://www.idahowhitetailadventure.com/, http://www.zhuntfish.com/hunting.htm, among many others.

fisheries, in which anglers "are out there precisely because they want to feel more like hunters than businessmen" (Economist 1994, p. 85).

(5) Education: IFQs can require significant education among participants to understand mechanisms for purchase, recordkeeping, enforcement, and other issues. For commercial businesses such education may be viewed as a reasonable requirement—and do not seem to have presented a significant barrier to the implementation and success of commercial IFQs. However, mastery of an unfamiliar and perhaps complex management system can represent a greater burden to recreational anglers. In contrast, tag systems are usually more simple—and might be considered even more straightforward than existing methods of recreational fishery management (e.g., bag limits, size limits, gear restrictions, etc.), which may be complex and are often used in combination (Woodward and Griffin 2003). While education of anglers would nonetheless be required—particularly upon the introduction of tags to new fisheries—the widespread success and acceptance of tag mechanisms in hunting contexts suggests that the required education of participants would not be an insurmountable barrier.

As noted by Sutinen and Johnston (2003), the above noted difficulties with IFQ management in recreational fisheries are most applicable to *individual* anglers. For fisheries dominated by the for-hire sector, IFQ methods may be appropriate and practical (cf. NPFMC 1998). Alternatively, one might combine tag-based management of individual anglers with IFQ management within the for-hire sector, as approved for the Alaska halibut fishery (Criddle *et al.* 2003). However, as a single management mechanism applicable to an *entire* recreational fishery (with both individual anglers and for-hire vessels), the above concerns suggest that tag-based mechanisms may be more practical than IFQs.

Appendix B

Details of Selected U.S. Hunting Tag Programs

(1) Duck stamps: (Source: U.S. Fish and Wildlife Service (USFWS), Federal Duck Stamp Program. http://www.fws.gov/duckstamps/)

Hunting of migratory birds such as ducks and geese is managed cooperatively by state fish and wildlife agencies and the U.S. Fish and Wildlife Service (USFWS). According to the USFWS the primary objectives of the duck stamp program are species management and conservation funding (USFWS, *undated a*). In order to hunt migratory bird species, a hunter requires a state hunting license, a federal duck stamp, and sometimes a state version of a game bird stamp as well. The federal stamp acts as a hunting license, similarly to the way that species-specific tags operate in big game species hunting. Duck stamps are not rationed and simply act as a license to hunt migratory waterfowl.

Open seasons for the various game species are set at the state level. With the exception of some large and rare bird species (e.g., swans in Montana) and wild turkey (which is generally managed similarly to big game animals), game birds do not have seasonal harvest limits. However, some states set daily bag limits and possession limits. The price of a Federal duck stamp is currently $15. In 2003-2004, more than 1.6 million duck stamps were sold, generating $24,241,395 in revenue (USFWS, *undated d*). Not all duck stamps are sold to hunters, however. The stamps also act as entrance passes to wildlife refuges, so some portion of the stamps are sold to birdwatchers and others who wish to access these refuges. Stamp collectors also purchase duck stamps. In order for a federal duck stamp to be valid for hunting, the user must sign the back of it, and the stamp is not transferable (USFWS, *undated b*). Federal Duck Stamps can be purchased at U.S. Post Offices, at some sporting goods stores, and via the internet.

Harvest reporting is a key element of the duck stamp program. In order to obtain a (state) license to hunt migratory birds, a hunter must sign up for the Harvest Information Program (HIP), and must carry proof of his participation in HIP whenever he or she hunts migratory birds. Signing up for HIP requires the identification of bird species pursued in the previous year's hunt. A random selection of HIP-certified hunters are contacted each year and asked to keep a record of the number of migratory birds harvested during the current season (USFWS, *undated c*). Participation in the survey, however, is voluntary.

(2) Oregon Hunting Tags and Sports Pac: *(Source: Oregon Department of Fish and Wildlife. http://www.dfw.state.or.us; Oregon Department of Fish and Wildlife (ODFW) 2005)*

This section describes tag programs applied to game hunting only; the *Oregon Combined Angling Harvest Tag Program* is described in Appendix C. Game hunting is popular in Oregon, with over 280,000 sportsmen hunting for sheep, bear, cougar, deer, elk, antelope, and goat in 2004 (Upton 2006). Approximately 92% of participating individuals are Oregon residents, representing 7.3% of the population. In 2004, 62,815 big game animals (not including antelope and bear) were harvested. All big game hunters must possess a hunting license and a non-transferable tag valid for the area, dates and species being hunted. For bear, deer, cougar and

elk, there is an unrestricted number of general season tags available. However, general season tags are restricted by dates, hunting area, and weapon for each species (Baker 2006).

Oregon requires tags for both unrestricted general season hunts and controlled hunts. Upon harvest of an animal, hunters must attach a valid tag to the animal. All tags are specific to a geographic area and a set of dates, but general season tags are not over-subscribed and therefore are not rationed. The Department will, however, close specific areas if too many animals are harvested in those areas during the general season. Bear, cougar, elk and deer hunts are offered under both the general season and controlled hunt programs. Pronghorn, mountain goat, and bighorn sheep are only available in controlled hunts.

For controlled hunts, the demand for tags exceeds supply. Hence, the number of hunters is limited and tags are awarded through a public drawing. Controlled hunts and associated lotteries require more intensive management than other Oregon hunting programs (ODFW 2005; Baker 2006). The drawing incorporates a preference point system, whereby hunters who do not obtain their first choice of hunt in one year are given a preference point to be used for a subsequent year's drawing. Preference points accumulate for each year that a hunter does not draw their first choice controlled hunt. The drawing allocates 75% of first choice available tags for a hunt to applicants with existing preference points. The remaining 25% are drawn randomly from a pool of all applicants; this ensures that all applicants have some chance of drawing a tag each year they apply. Tags are assigned to first choice applicants until all tags are assigned, or all first choices are filled. Tags are only assigned to second choice applicants after all first choices have been filled. Once a hunter is selected for a controlled hunt (i.e., chosen to receive a tag), all accrued preference points are cancelled (ODFW 2005).

Tags for both general season and controlled hunts are purchased either at a license agent or by mail/fax. In order to obtain the tag associated with a successful draw, the hunter can either show her license and notification postcard to the license agent or provide her hunting license number (and a check) via mail to the agency. The application fee for a controlled hunt draw is $4.50 for up to four choices within one hunt series (i.e. one application.) Prices of tags themselves vary by species and residency status, with prices for nonresidents exceeding those for residents. For example, the price of a resident deer tag is $19.50; nonresident deer tags are $264. The price of a resident elk tag is $34.50; a nonresident elk tag is $361.50. A controlled season hunt tag may be exchanged for a general season tag before the opening of the season, but controlled season and antlerless tags may not be exchanged (ODFW 2005).

Tag availability is also determined by a hunter's residency status. State legislation dictates the percentage of nonresidents in general and controlled hunts (Baker 2006). For example, a maximum of 3% of tags for pronghorn antelope and black bear hunts, and a maximum 5% of tags for controlled deer and elk hunts can be issued to nonresidents (Thornton 2006). The Guides and Outfitters Program provides guides and outfitters with the opportunity to market nonresident tags. A number of tags equal to one-half the nonresident tags drawn in the previous year are available through this program. Certified guides submit applications and compete for the right to market these tags.

Resident hunters may also obtain a "Sports Pac" through the state wildlife agency—an option not available to nonresidents. The cost of a Sports Pac is $130, and includes a combination

angling/hunting license and several tags including a combined angling harvest tag, a deer tag, an elk tag, a bear tag, a cougar tag, a spring turkey tag, and validation for upland birds and waterfowl (ODFW 2006; Baker 2006). Quantities of Sports Pacs are not limited. Additional details of the Sports Pac, as applied to angling, are detailed in subsequent sections of this report.

The number of tags issued varies by species and by year, depending on a variety of factors including the biological status of species. For example, the total number of buck deer tags drawn in 2005 was 66,852 (with 114,000 resident and 8,000 nonresident applications). The total number of elk tags drawn in 2005 was 48,822 (with 110,000 resident and 9,000 nonresident applications).[21] Success rates for tag holders typically vary between 10 to 60% depending on species; for the many species the majority of tags are unused, in that the hunter is unsuccessful in taking the species in question.

To verify compliance with tag requirements, random field checks are carried out by wildlife department staff and a special branch of the Oregon Police Department. Minor infractions are classified as violations or misdemeanors, with fines ranging from $90 to $6,250 and up to a year in jail. More serious infractions may be charged as felonies with potential fines of up to $375,000 and 20 years in prison (Markee 2006; Baker 2006). Overall, tag mechanisms are considered by the state to be an effective, well-organized, and equitable means to monitor harvest and sustain big game populations (Thornton 2006a).

(3) Montana : *(Source: http://fwp.mt.gov/hunting/default.html)*

Hunting in Montana is managed by the Montana Fish, Wildlife, and Parks Department. Big game species include deer, elk, antelope, and black bear, as well as mountain lion (cougar), bighorn sheep, mountain goat, bison, and moose. This section emphasizes regulations and statistics for deer and elk, the two most popular big game species. In 2003, the state estimates that 153,108 hunters harvested 140,725 deer in Montana, which represents a 68% success rate. This success rate incorporates the fact that successful hunters averaged 1.35 deer per hunter. Of those hunting, 128,292 were Montana residents and 24,963 were nonresident hunters (MDOW 2004a). Elk hunters in Montana numbered 115,476, of whom 98,262 were residents and 17,211 were nonresidents. Elk hunters harvested 28,916 animals, representing a 25% success rate *(*MDOW 2004b).

In order to hunt in Montana, residents and nonresidents must possess a conservation license as a prerequisite for all other licenses. Hunters must also purchase specific licenses (tags) for the geographic area and species they wish to hunt. Hunting licenses are grouped by license type (general, special, second antelerless elk, etc.) and by whether the licenses are available for purchase from license providers or via the special purpose drawings (MDOW 2006). Each license entitles the user to harvest one animal as specified by the license. Upon harvest of an animal, hunters must validate the tag and attach it to the animal.

General licenses for deer and elk allow hunting in specific areas during the general season. Residents may purchase a general licenses over the counter from any license dealer. Montana

[21] Source: http://www.dfw.state.or.us/resources/hunting/big_game/controlledhunts/reports/hunt_summary/2005.pdf

residents must hold a general license before applying for or using a special license. General licenses for Montana residents include general deer ($16) and general elk ($20). Residents may also purchase a Sportsman's License ($85), which includes the conservation license, a general deer and a general elk license, as well as small game, bear, and fishing licenses. Nonresident license options are discussed below. The remainder of hunting tags (including limited deer and elk licenses) are allocated via a special drawing. A special license typically allows the hunter to harvest an additional animal over and above the one he may harvest with a general license. The department's description of the drawing process is as follows:

> "Drawings are conducted species by species, hunting district by hunting district. For example, when conducting the drawing for elk permits, the computer starts with the first elk hunting district: 100-00. If the quota is 10, the computer starts selecting applicants who applied for this district as their first choice. If there are at least 10 first choice applicants, the drawing does not consider second choice applicants. When that district quota has been filled, the computer goes to the next hunting district and completes the same process until all district quotas are filled with first choice applicants. If there are not enough first choice applicants to fill a quota, the computer starts selecting second choice applicants, and so forth." (MDOW 2006, p. 10)

Montana uses a voluntary bonus point system in the big game hunt draws. Applicants accumulate one bonus point for each unsuccessful year. Each bonus point essentially becomes an extra chance in future drawings; bonus points are accumulated independently for each species, and apply only to the hunter's first choice of districts. Once a hunter successfully draws a tag, he loses all bonus points for that species (MDOW 2006). The cost to participate in the bonus point system is $2 for residents and $20 for nonresidents. Bonus points are non-transferable.

Licensing requirements for nonresidents are somewhat different than those for Montana residents. Nonresidents must hold a Big Game Elk/Deer or Deer Combination License in order to hunt deer or elk in Montana, and they have a choice of whether to purchase the license directly or via an outfitter. The price for over-the-counter (general) nonresident licenses is lower than for outfitter-sponsored licenses, but the number of over-the-counter nonresident licenses is capped at 11,500 (MDOW 2006); these are allocated via a lottery drawing. In addition, nonresidents must hold a Big Game Elk/Deer or Deer Combination License as a prerequisite to apply for a special deer or elk license (MDOW 2006). The price for a nonresident general elk/deer combination license is $643 and for an outfitter-sponsored elk/deer combination license is $995; the prices for special hunt licenses (tags) are $80 for a deer tag and $275 for elk. Nonresidents are limited to no more than 10% of the license and/or permit quota in the draws.

Beginning in 2006, resident and nonresident hunters may purchase an unlimited number of $5 chances to win a Montana hunting license (SuperTag) for moose, bighorn sheep, mountain goat, deer and elk. Each SuperTag license allows an individual to hunt in any Montana hunting district valid for that species, including special license areas. Five of these SuperTags will be made available in 2006.

For purposes of monitoring and enforcement, all hunters and anglers must stop at all designated check stations on their way to and from hunting and fishing areas, even if they have no game or

fish to be checked. In addition, Montana FWP conducts an annual telephone survey to gather hunting and harvest information from Montana hunters.

(4) Nevada: *(Source: Nevada Department of Wildlife http://www.ndow.org/hunt/; Nevada Department of Wildlife (NDOW) 2006)*

Hunting in Nevada is managed by the state Department of Wildlife. Like other mountainous Western states, Nevada has a variety of big game species available for hunting. All big game hunts are managed via a tag program, even those hunts for which there is no excess demand. Resident and nonresident hunting tags are issued for mule deer, pronghorn antelope, Rocky Mountain elk, desert (Nelson) bighorn sheep and California bighorn sheep. Only Nevada residents may obtain tags for Rocky Mountain Bighorn Sheep and Rocky Mountain Goat. This section emphasizes attributes of tag programs for deer and elk.

In 2005, NDOW issued 9,205 resident and 1,152 nonresident tags for mule deer; 3,918 residents and 593 nonresidents harvested a deer, representing 43 and 51% success rates, respectively (NDOW 2006a). Also in 2005, NDOW issued 729 resident and 114 nonresident antlered elk tags. Resident hunters harvested 461 elk while nonresident hunters harvested 85 elk, representing 63 and 75% success rates, respectively (NDOW 2006b). Licenses may be purchased at authorized dealers or at NDOW offices.

In order to hunt in Nevada, an individual must possess a hunting license and a hunt tag specific to the species, area, and season to be hunted. All of Nevada's elk and deer hunts are conducted by a random draw, which occurs in three stages. The first drawing occurs in May, a second drawing is conducted for remaining tags in June, and any remaining tags after that draw can be applied for on a first-come, first-served basis. When applying for a big game tag, hunters specify their top five choices from among several hundred options, representing permutations of different species, areas and seasons (NDOW undated a).

Residents and nonresident tag applicants receive bonus points when they are unsuccessful in drawing a tag. Hunters may purchase a bonus point without applying for a tag, allowing hunters to accrue bonus points without necessarily drawing a tag or hunting (NDOW 2005). Bonus points are awarded by specific species categories, with each encompassing all weapons hunts available in that category. That is, if a hunter applies for an "any legal weapon" antlered deer tag and was unsuccessful, and then applied for an archery antlered deer tag, and was unsuccessful, she would still only accrue one point because these are both in the antlered deer category. However, if she applied for an "any legal weapon" antlered deer tag, and was unsuccessful, and then applied for a doe tag, and was unsuccessful, he would receive a bonus point for each because they are in two different categories—antlered deer and antlerless deer (NDOW undated b). Bonus points cannot be transferred to another person or into another species category. A hunter's bonus points revert to zero in a particular species category when she is successful in obtaining a tag or fails to apply for two consecutive years.

Application fees for the big game draws are $15 for elk and $10 for all other big game species, plus $5 per application in additional fees. The price to purchase a bonus point alone is $10. The

odds of obtaining a deer tag are 3 to 1 for residents and 8 to 1 for nonresidents, while the odds of obtaining an antlered elk tag are 16 to 1 for residents and 34 to 1 for nonresidents (NDOW 2006a, NDOW 2006b). Tag fees for nonresidents are substantially higher than those for Nevada residents. For example, a deer tag for a resident is $30; nonresident deer tags are $240. The price of a resident elk tag is $120; a nonresident elk tag is $1200.

The questionnaire issued as part of a tag must be properly completed and received by the 15th weekday following the close of the season to which the tag applies. The state reports the percentage of tags returned in its harvest report; the return rate exceeds 90% (NDOW 2006a, NDOW 2006b).

(5) Idaho: (Source: Idaho Department of Fish and Game, http://fishandgame.idaho.gov/)

Hunting in Idaho is managed by the state Department of Fish and Game (IFG). Deer (white tail and mule deer), elk, antelope, and black bear can be hunted in both general season and controlled hunts; moose, goat, and sheep are only hunted in controlled seasons, and mountain lion (cougar) has a strictly open season. This section emphasizes tag programs for deer and elk. In 2003, nearly 200,000 hunters harvested 32,690 deer, representing a 16% success rate for white tail deer and 18% success rate for mule deer (IFG 2004a, IFG 2004b). Elk hunters in 2003 numbered 49,000, harvesting 8,144 elk which represented a 17% success rate (IFG 2004c).

In order to hunt in Idaho, both nonresidents and residents must obtain a hunting license. Nonresidents have a choice of a hunting-only license or a combined hunting and fishing license; residents have the additional option of purchasing a "sportsman package". The sportsman package includes tags for deer, elk, bear, mountain lion, turkey, salmon and steelhead. In addition to the license, a hunter must have in possession a valid tag for the species, dates, and area being hunted (IFG 2006c). For the most part, each hunter is limited to one deer (elk) tag, allowing harvest of one deer (elk) per year (IFG 2006c).

Tags are available for both *general season* (unrestricted) hunts and *controlled* hunts. All of the tags are specific to an area and a set of dates, but the general season tags are not over-subscribed and therefore not rationed. Deer hunters can choose either a regular deer tag or a white tail deer tag. Details of the deer program are reported below. Generally, a hunter may only harvest one individual of each game species per season; that is, if she draws a controlled hunt tag she may not participate in the general hunt for that species (IFG 2006c). Controlled hunt tags, although more difficult to obtain, provide a higher likelihood of a kill than the overall success rates for hunters. For example, in 2004, there were 14,824 permits issued for controlled deer hunts, generating a total harvest of 7,934 deer (IFG 2005b).

Permits for controlled hunts for both deer and elk are allocated by a drawing. Group or individual applications are accepted. In the event that some controlled hunt permits are left over or unclaimed, a second drawing is held. Any permits remaining after the second drawing are then sold on a first-come, first-served basis. Nonresident participation in controlled hunts is limited to 10%, or less, of the available permits (IFG 2006c). A hunter successful in a controlled hunt permit draw for antlered deer cannot participate in the draw for the next season (IFG

2006c). To further increase the future chances of unsuccessful entrants, Idaho will be implementing a bonus point system in 2007 (Compton, 2005). In addition, there are special controlled hunts for hunters with pre-existing written agreements with outfitters licensed in the hunt area. These Outfitter Allocation Controlled Hunt Permits provide a mechanism to guarantee some outfitters some controlled hunt business each year. In 2005, only 86 of these permits were available (Compton 2005; IFG 2006c). Otherwise, the outfitters' participation in controlled hunts is limited to requests by hunters selected in the draws.

There is a cap on the percentage of deer and elk tags allocated to nonresidents, and the cost of hunting licenses and hunt tags is substantially higher. A resident combination license costs $33.50, while a nonresident combination license is $199.75. An elk tag for a resident is about $30, and a deer or turkey tag is $20; for a non resident, an elk tag costs $372 and a deer tag is $258 (IFG, 2006c). The IFG administers a system for transferring nonresident hunting tags. If the tag buyer has not hunted, he may designate another nonresident hunter to receive an additional tag; or if the buyer has retained an outfitter or guide, the guide may designate a new hunter to receive the tag (IFG 2006c). Also, hunters may exchange general season elk and deer season tags for use in another zone.

In Idaho, there are two species of deer: mule deer and whitetail deer. Idaho's mule deer numbers are estimated to be half what they were in the 1960s. Currently, Idaho is working to increase the number of mule deer in certain areas, through predator control, minimizing competition with other species, improving habitat, and controlling hunting pressure (IFG 2006b). Meanwhile, whitetail deer populations are expanding and management has focused on controlling them in areas where agriculture or mule deer have been affected. In 2005, two different general season deer tags were established. Hunters must choose between a regular deer tag or a whitetail-deer-only tag. With the regular tag, hunters may harvest either a mule or whitetail deer, but the hunting season is generally shorter than the whitetail-only season. With the whitetail-only tag, the hunting season is extended into the rutting season, when opportunities for harvesting a trophy animal are increased. The incentive created by allowing hunting during the whitetail rut may encourage some hunters to voluntarily shift their hunting focus from mule deer (IFG 2006c; Compton 2005).

Idaho has required hunters to submit a harvest report card since 1998. The compliance rate has historically been about 80% (Compton, 2005). Hunters are required to submit a harvest report within 10 days of harvesting an animal, and unsuccessful hunters must submit a harvest report within 10 days of the end of the hunting season. Hunters are unable to obtain hunting licenses for the next year unless a harvest report card has been submitted (IFG 2006c).

Brad Compton, Idaho's Big Game Manager, expresses a general satisfaction with the functioning of the deer management scheme in Idaho. Because the rules are revised each year, the system can be fine-tuned as management problems arise. For example, it is likely that additional controlled hunts for buck mule deer will be established, due to demand from hunters. The main issue or problem surrounding deer hunting in Idaho is dissatisfaction among hunters that are not successful in securing their desired controlled hunt tag. Although for some controlled hunts the chance of a successful draw is high, for others the chance is quite low (Compton, 2005). The planned bonus point system may help resolve this situation.

(6) Colorado Deer and Elk Tags: (CDOW) (Source: http://www.wildlife.state.co.us/)

Hunting in Colorado is managed by the Wildlife Division of the state Department of Natural Resources (CDOW). Popular big game species include elk, deer, pronghorn, and moose. The state also provides smaller hunts for bighorn sheep, mountain goats, bear, and mountain lion (cougar). Excess hunting demand from both resident and nonresident hunters is managed through a system of site-specific licenses, preference points, and resident/ nonresident allocations. This section will focus on deer and elk hunting.

In order to hunt in Colorado, an individual must complete a hunter safety course and present the associated card when applying for a license; the hunter must carry the hunter safety card with her at all times while hunting. Hunting licenses are issued for a specific animal, season, and area. In 2005, a total of 91,757 hunters harvested 41,665 deer, for a 45% success rate (CDOW 2006d). Also in 2005, 246,521 hunters harvested 56,462 elk, for a 23% success rate.(CDOW 2006e). A validated license, or carcass tag, must be attached to the animal after a kill. Colorado hunting licenses are non-transferable (CDOW 2006a, Slater 2006).

CDOW sets quotas by season, species, and area. In areas where there is greater demand for hunting licenses than the number of animals in the quota, licenses are allocated via computerized draw. There are separate drawings for each species, and most drawings are held during the month of May. A hunter may only submit one license application per species (CDOW 2006a). The application fee is $3.00. Draw licenses are automatically mailed to successful applicants after the drawing (Slater 2006); over the counter licenses can be picked up at license vendors or at Division offices.

Unsuccessful applicants for the big game draws are awarded a preference point for their first choice hunt, which is used in subsequent drawings. Preference points accumulate until the hunter draws a first-choice license. Until recently, hunters have been able to obtain a preference point simply by submitting an application (for $3), even if they did not plan to hunt in a particular year (CDOW 2005). In response to stakeholders' concerns, the CDOW instituted a new "pay or play" requirement in 2006, in order to ensure that all potential hunters support Colorado wildlife in some way (Slater 2006). As of 2006, a hunter must either purchase a license (for a second-or-lower choice big game hunt, or a small game license), or pay a $25 preference point fee if he does not purchase a hunting license (Slater 2006, CDOW 2005, CDOW 2006a). Even if an applicant does not draw for his second or third choice hunt, a system is also in place to assure unsuccessful applicants the opportunity to hunt in another area. Unsuccessful applicants can be notified of leftover licenses, (i.e., those draws that had fewer applicants than the quota); they can apply for those licenses before the licenses are made available to the public (CDOW 2006a).

Nonresident hunters are very important to the economy in Colorado, contributing $332 million, or 42% of the statewide trip and equipment expenditures for hunting and fishing (Pickton 2004). In order to serve this large market segment, CDOW provides a "planning tips for nonresidents" page on its web site, with links to regulations for hunting in the state. Nonresident licenses for desirable game are priced many times higher than those for residents. For instance, a resident

bull elk license costs $46, and a nonresident bull elk license is $496. Resident deer and pronghorn licenses are $31; nonresident deer and pronghorn licenses are $296 (CDOW 2006b, CDOW 2006c).

Until 2006, 40% of hunting licenses were available to nonresidents. This allocation was reduced to 15% in the eastern portion of the state and between 25 and 33% in the west, based on the amount of preference points needed to draw a license:

> "Nonresident allocations are determined by the average number of preference points a Colorado resident needed to draw a specific license over a three-year period that ended with the 2005 limited license drawing. For hunt codes that required a minimum of 5 or more preference points for a Colorado resident to draw an elk or deer license, 80% of the licenses are allocated to residents and up to 20% to nonresidents… For hunt codes where the minimum was fewer than 5 preference points for a Colorado resident to draw an elk or deer license, 65% of licenses are allocated to residents and up to 35 to nonresidents" (CDOW 2006a, p. 6).

The changes to the preference point system and to the nonresident allocations were instituted based on the recommendations of the License Allocation Work Group (LAWG). The LAWG was comprised of representatives of sportsmen, landowners, outfitters, and community members. In a series of meetings held in 2005, the group developed a package of recommendations for changes in the big game hunt management system. It is worth noting that one of the issues discussed, but not changed, was the question of the economic impact of issuing licenses via the Internet. Sporting goods store owners and hunting community residents expressed concern that not requiring hunters to pick up their licenses in person would take business away from local establishments (CDOW 2005).

Compliance with hunting regulations is monitored via random field checks during the hunting seasons (Slater 2006). There is no requirement for deer or elk hunters to check in their kills; a random sample of hunters is surveyed for annual harvest reports.

Erik Slater of the Limited License Division expresses a general satisfaction with the management of big game hunting in Colorado. He does note, however, that Colorado's system is among the most complicated in the country. It becomes somewhat cumbersome for customers to keep up with changing requirements, even though the flexibility to make changes in response to customer requests is considered a positive aspect of the program (Slater, 2006).

(7) Wyoming Deer and Elk Hunting Programs: (Source: Wyoming Department of Game and Fish. http://gf.state.wy.us/)

Big game hunting in Wyoming is managed by the Department of Game and Fish (WGF). The most popular species for hunting are deer (mule deer and white-tailed deer) and elk. Other species available for hunting include antelope, moose, mountain goat, and sheep. This section emphasizes deer and elk programs. In 2004, nearly 85,000 hunters harvested over 47,000 deer, and 52,000 elk hunters harvested over 21,000 elk (WGF 2005a).

The state of Wyoming does not require a general hunting license. In order to harvest a deer or elk, the hunter must possess a conservation stamp and a license that is specific to the species, area, and season being hunted. Deer and elk hunting in Wyoming is managed very closely; the state is divided into over 100 different hunt areas, each of which has its own seasons and quotas for the species that can be hunted. The number of licenses per hunt area ranges from 25 to several hundred (WGF 2005b). Licenses are also specific to the type of animal; antlered deer and elk tags are sold at "full price" (and are generally harder to come by), while antlerless deer and elk tags are sold at a "reduced price" (WGF 2006a, WGF 2006b). Big game licenses carry a non-refundable application fee of $4 for residents and $12 for nonresidents. Each hunter may only apply for or receive one full-price license for each species per year, but may purchase additional reduced-price licenses during the same year. Hunting for both deer and elk is available in both general season (unrestricted) and limited quota hunts, with both general season and quota hunts sometimes occurring at different times within the same hunt area (WGF 2005b). Wyoming regulation prohibits the transfer of licenses from one individual to another.

The quota hunt licenses are distributed by a random draw. The draw odds are reported on the Department's web site by area, and vary widely from 100% to less than 2%, depending on the area and whether the applicant is a resident or nonresident.[22] Quota hunts for resident hunters are often under-subscribed, so that excess licenses from the resident draw are frequently available and are distributed in a second drawing to nonresident applicants (Eldridge, 2006). In addition, an optional preference point system for nonresident hunters has been instituted as of 2006. Fees to participate in the preference point system are $50 for elk and $40 for deer. In order to ensure that there is some chance of drawing for first-time applicants and for those who do not wish to participate in the preference point system, 25% of the quota is reserved for all applicants regardless of their preference point status. Nonresidents may purchase preference points even if they do not wish to hunt in a given year. When a nonresident wins her first choice draw within the preference point system, she loses all his accumulated points and may not reapply for that species for 5 years (WGF 2006b).

Wyoming's preference point system for elk and deer was modeled after the state's preexisting system of preference points for sheep and goats. The state had previously attempted to manage excess demand for elk and deer via a two-tier system of nonresident applications and draws, whereby nonresidents could opt to pay a higher fee to participate in a more limited draw for licenses. Eventually, however, that system became less useful as a rationing tool, as more and more people opted in to the higher priced draw. The preference point system was the one that nonresident hunters supported most strongly in a survey administered by the Department (Eldridge 2006).

Wyoming has a separate hunting program for nonresidents that differs from the resident program in many respects. First, nonresidents must have a licensed guide or resident companion to hunt big or trophy game in national forest wilderness areas. Secondly, as described above, nonresidents are slotted into particular areas more specifically than residents. In addition, there are limitations on the regions in which nonresidents are permitted to hunt. For example, "There are more than 160 deer areas which have been divided into 11 separate nonresident deer regions.

[22] Source: http://gf.state.wy.us/wildlife /hunting/stats/demand/index.asp?yr=2005

Each region has a nonresident quota based on the deer population in that area. Nonresidents may apply for a general license for a specific region and can hunt any general areas within that region, but cannot go to other regions. Even though the resident general license is good for any general area in the state, we know that the average citizen of Wyoming prefers to hunt deer in areas close to home. With nonresidents, however, it's another matter. Many come a thousand miles or more to hunt deer, and driving another few hundred miles is of little consequence. Without nonresident deer regions, the likelihood would exist that a disproportionate number of license holders would choose to hunt whatever was the "hot" region for that year, possibly creating excessive pressure in some areas. The G&F [WGF] has discussed the region concept for residents, as well as a regional concept for elk, but at this time has not found it necessary."[23]

As is the case for other states, nonresident licenses are priced significantly higher than those for residents. A full-price elk license costs $47 for a resident and $493 for a nonresident, while a reduced price elk license is $40 for a resident and $252 for a nonresident. A full-price deer license is $35 for a resident and $273 for a nonresident, and a reduced price deer license is $23 for a resident and $41 for a nonresident (WGF 2006a, WGF 2006b). Harvest questionnaires are mailed to a random sample of license holders at the close of the fall hunting season (WGF 2005c). The state achieves a high response rate for their surveys; 60-70% of nonresidents and 40-50% of residents return the surveys. Respondents are entered in a raffle to win prizes donated by local outdoor businesses and the WGF (WGF 2005c),

(8) Florida Deer Hunting Programs: (Source: Florida Fish and Wildlife Conservation Commission. http://www.myfwc.com/hunting/)

Hunting in Florida is managed by the state Fish and Wildlife Commission (FWC). Game species hunted include deer, wild hogs, and turkey and other game birds. Deer and turkey are the most popular species hunted in Florida, and the ones with the most active management and hunting pressure. This section will focus on deer hunting.

The total number of hunters in Florida in 2005 was 226,000, although the total number of hunting licenses issued in was substantially less than this—below 150,000 (Haddad, 2005). The state does not record the number of deer harvested (Crowley, 2005, Young, 2006). Licensed Hunters make up 0.8% of Florida's population, and hunting participation has declined significantly from over 250,000 in the 1980's to its present level (Duda, 2005).

In 2005, the FWC hosted a summit on the future of hunting in Florida. In preparation, the agency surveyed hunters about usage patterns, attitudes, and their predictions for the future of hunting in the State. The survey found that 32% of hunters have hunted exclusively on private lands, 24% hunted exclusively on public lands (WMA and other) and 44% hunted on both private and public lands. The survey also found that hunters feel generally pessimistic about the future of hunting in Florida, in part because of excessive regulation and over-involvement from animal rights supporters (VAI 2005).

[23] Source: from the web site's FAQ's: http://gf.state.wy.us/support/faq/index

In order to hunt in a Wildlife Management Area (WMA) in Florida, the hunter needs a license and a WMA permit. Hunting-only licenses for a Florida resident cost $12.50, and Sportsman's Licenses cost $67.50 (Hunting and Freshwater Fishing licenses; and Wildlife Management Area, Archery, Muzzleloading Gun, Turkey and Florida Waterfowl permits), or $83.50 (all of the preceding, plus Snook and Crawfish Permits) (FWC 2005). There are no specific licenses or tags for hunting deer. Licenses and permit sales raise about $5 million in revenue for the FWC (Haddad 2005).

A deer hunter in Florida can choose from several different types of hunting experiences, depending on the price she is willing to pay. Private hunting clubs will virtually guarantee that their members bag a deer or turkey for a price ranging from $600 to $1,200 per season (Young 2006). Special opportunity hunts, administered by the state, also severely curtail hunting competition, for a fee ranging from $50 to $200. Moving down the cost continuum, the first nine days of hunting season are rationed via a quota system, after which an open season begins (FWC 2005). Duda (2005, p. 49) reports that the majority of hunters in Florida feel that the prices charged for hunting privileges are "just the right price."

Florida's quota hunt program helps prevent overcrowding and controls harvest on WMAs, providing hunters with higher quality hunting experiences (FWC 2005). Quotas or maximum numbers of hunters permitted on WMAs are based on areas' size, habitat, game populations and area rules. Hunters wanting to use WMAs during quota hunt periods must submit an application. The quota permits are distributed by a drawing, held at specific times for each season and game species. Each hunter may only submit one quota hunt application for each hunt (Young, 2006).

Special opportunity hunting permits are also rationed via drawings; these cost $5.00 for each submission into the lottery (hunters may submit more than one application) and successful applicants must pay the permit fee to participate in the hunt. Hunters sometimes submit as many as 500 applications per hunt, virtually guaranteeing that they will be drawn (Young, 2006). Special-opportunity hunt permits are transferable by simply giving the permit to another person (FWC 2005). If a hunter is drawn for the special opportunity hunt, a permit invoice is mailed to him. The hunter then takes the invoice to any license vendor or the local tax collector's office, pays, and obtains the permit. This transaction can also be accomplished via the internet. Unredeemed permits are re-submitted for another draw (Young, 2006).

Nonresident hunters in Florida pay $151 for an annual hunting license and $46.50 for a ten-day license. Nonresidents do not have the option of purchasing a Sportsman's license. Also, nonresidents are only allowed to purchase one chance in the special opportunity hunt draws (Young 2006).

(9) Maine Deer and Moose Hunting Programs (Source: http://www.state.me.us/ifw/)

Hunting in Maine is managed by the Department of Inland Fisheries and Wildlife. Big game species available are deer, bear, and moose; turkey hunting is also managed as a big game species. This section will focus on deer and moose hunting. In 2003, 223,110 license holders harvested 30,313 deer in Maine (IFW Undated b). Assuming that 15% of big game license holders do not hunt for deer, this figure represents an 18% success rate. The moose hunt is much

more restricted; only 3,000 moose permits were issued in 2000; 2,552 moose were harvested for an 85% success rate (Vashon, *undated*).

A hunter in Maine must carry a big game license, which costs $21 for Maine residents. Nonresident pricing is addressed below. This entitles the hunter to harvest one antlered deer, bear during the deer season, and raccoon and other small game. Any-deer, "bonus deer" (an extra antlered deer from a district where there are more permits available than applications received), and moose permits are distributed via lottery draws. For the any-deer draw, both the lottery application and the any-deer permits are free, and the bonus deer permits cost $13 (IFW *undated b*). Overall, 89,219 people applied for any-deer permits during 2003, and 72,600 permits were issued. As the likelihood of success in the permit application is high, no bonus point or preference point system is used (Bolduc 2006).

The "Superpack license" (available only to residents, and new for 2006) includes fishing, hunting, archery, and muzzle loading licenses as well as migratory waterfowl, pheasant, fall turkey, spring turkey, bear, and coyote night hunt permits. The fee for the Superpack license is $200. A customer who purchases the Superpack license is entitled to six free chances in the moose lottery for that year. Superpack license holders are also eligible for entry into a special category in the annual Any-Deer Permit Lottery. In order to qualify for the special category the customer must apply in a Wildlife Management District (WMD) for which at least 5,000 permits allocated (IFW *undated a*).

The moose lottery is more oversubscribed than the any-deer lottery, and excess demand is managed by a bonus point system implemented in 1998. One point is awarded for each consecutive year the applicant applies and is not selected for a moose permit. Each bonus point accumulated gives the individual an additional chance in subsequent years' drawings. Hunters may purchase multiple chances in the lottery; in fact, the state offers a "multiple choice option" for hunters who wish to increase their chances of drawing a moose permit. Residents may purchase a maximum of 6 chances in the lottery, and nonresidents may purchase as many packs of 10 chances as they wish (IFW *undated c*, Bolduc 2006). In 2005, there were 49,000 resident and 19,000 nonresident applicants for about 3,000 moose permits (Bolduc 2006). Once a hunter has drawn a permit for a moose, he cannot apply in the lottery for two subsequent years. Moose permits may be swapped between permit holders, but no money can change hands (IFW *undated c*, Bolduc 2006). Moose permits cost $52 for Maine residents (IFW 2005 b). In addition, a small number of moose permits are auctioned off annually. The winning bids for moose permits in 2005 ranged from $10,150 to $10,880[24].

The state allocates approximately 11.5% of deer permits and 10% of moose permits to nonresidents and aliens (percentages are based on the average resident and nonresident applicants for antlerless deer permits over the last 3 years) (IFW, 2005b). If there are insufficient applications from either group to fill a district's permit allocation, unused permits are allocated to

[24] Source: http://www.maine.gov/ifw/hunttrap/moosehunting/index.htm#auction

the other group. Maine big game hunting licenses cost $88 for nonresidents and $127 for non-citizens of the U.S. (IFW 2005 b). A moose permit costs $477 for nonresidents.

All moose and deer harvested must be presented at a registration station immediately after the kill (Bolduc 2006). Moose hunters are also required to complete a questionnaire about their hunt, including information about other game species sighted. Wendy Bolduc of the Office of Public Information reports that the deer and moose hunting programs in the state of Maine are generally seen as successful, and there are no major changes anticipated at this time.

Appendix C

Details of Selected Tag Management Program in Fisheries

(1) Western Australia (Shark Bay) Pink Snapper (source: Harrison 2006)

The Western Australia Department of Fisheries manages both recreational and commercial catch of pink snapper (Pagrus auratus) in the Freycinet Estuary of Shark Bay in Western Australia (a world heritage area) using a harvest tag program. The program was first implemented in 2004 and will continue until 2009 at which time the condition of the stocks will be evaluated to determine whether other management arrangements may be appropriate. The primary motivation for the program is sustainable management of the fishery, and managers feel the program has been effective in achieving this purpose by limiting total catch. The program implements a strict limit of pink snapper catch by requiring both recreational and commercial fishers to hold tags to fish for pink snapper and to affix a tag immediately to any legal size pink snapper caught and retained in this area. Only fishers in possession of these "snapper tags" are allowed to take, land or be in possession of pink snapper in Freycinet Estuary or within 50m of then high water mark of the Estuary. Anyone who catches a pink snapper in this area and does not have a tag must release it immediately.

Anglers acquire tags through a lottery, and tags are only valid in the year in which they are issued. Applicants are notified if they have been successful or unsuccessful and given two weeks to collect tags which cost AUS $10. Anglers cannot obtain a refund on unused tags. An individual can receive up to two tags per year. There is also a bag limit of one pink snapper per day in addition to the tagging requirement. In A total of 1,400 tags are available for 2006 with 1,050 allocated to recreational fishers through a registered lottery. The remaining 350 are distributed to commercial fishers, who are not charged for the tags. In 2006 there were approximately 1,600 recreational tag applications for the 1,050 tags available. Some environmental groups have also applied for tags for the specific purpose of preventing the harvest of a specified quantity of pink snapper. Tags may not be resold, but can be given away. The revenues from sale of tags help cover administrative costs of the program but do not the cover the cost of the compliance and research programs associated with the fishery.

There is no mandatory reporting requirement for recreational harvest. Boat ramp creel surveys are used to determine overall catch. The creel survey indicates that only around 50% of the tags are used.[25] Under this program, the catch of pink snapper in this area has been reduced from around 19 tons in 2002 to about 1.5 tons currently. The program has been successful at maintaining recreational catch below a specific allocation (in fact, apparently well below the allocation), such that snapper stocks are now rebuilding.

(2) South Dakota Paddlefish (sources: Mestl 2001; Sorenson 2006; Stone et al. 2002)

The South Dakota Department of Game, Fish & Parks manages harvest of paddlefish (*Polyodon spathula*) in the Missouri River below Gavins Point Dam downstream to the mouth of the Big Sioux River using a harvest tag program. A similar program in used by the bordering state

[25] Additional tags over and above the sustainable harvest level are not issued based on assumptions that a portion will not be used. Tag numbers are determined assuming that all could be used.

Nebraska for the same species and areas; however our review is focused on the South Dakota program. The ongoing program was first implemented in 1997. All catch of paddlefish in these areas is managed by this program. In addition to the requirement use of tags for each landed paddlefish, the fishing seasons are limited with separate seasons for the two different fishing modes. For example, in 2005, the archery season ran from July 8th to August 6th, while the snagging season ran for 30 days starting October 1. The tagging program replaced a 1,600 paddlefish harvest quota that had been used for eight years prior to 1997. There is also a slot limit for snagging which requires anglers to release any fish between 35-45 inches.[26]

Tags are allocated via lottery drawing among anglers who apply. There are separate lotteries for archery and snagging tags, and for resident and nonresident applicants. The cost of a tag is $5 for residents and $10 for nonresidents. For both archery and snagging tags, individuals may possess no more than two tags, but the second cannot be obtained until a second drawing. The Department of Game, Fish and Parks issues 275 archery tags (255 resident and 20 nonresident) and 1,400 snagging tags (1,350 resident and 50 nonresident). This has increased from the initial year of the program when only 1,000 resident snagging tags and 200 resident archery tags were sold. Nearly all applicants for archery tags receive a tag while approximately 55% of snagging applicants receive a tag. Tags may not be resold. Nebraska sells a similar number of tags (approximately 1,500). There is an expectation that only about half these tags will be used for a target total catch of around 1,600 fish for both states combined.

Reporting on catch is not mandatory. Creel data are obtained through a combination of an annual angler survey and a mail in "season report card." Estimated total archery harvest in South Dakota has ranged from a low of 39 fish in 1997 to a high of 46 fish in 1998. Estimated total snagging harvest in South Dakota has ranged from a low of 415 fish in 1997 to a high of 611 fish in 1999. The primary objectives for implementing the tag program were to control harvest of an easily over-exploited population and to reduce crowding and competition for access. The tag system was designed to allow a similar level of catch to the quota system that preceded it, while guaranteeing a specific season length that would allow anglers the freedom to spread their fishing effort out over more days and relieve the congestion that was occurring under the prior system. The program has been successful at achieving these objectives. Most anglers are satisfied with the program as evidenced by comments made on response cards (Stone and Sorenson 2002). The comments indicated that reduced crowding in popular fishing areas (tailwater) has resulted in higher angler satisfaction.

(3) Irish Salmon (source: Grant 2006)

The Central and Regional Fisheries Boards of Ireland manage both commercial and recreational catch of salmon and sea trout using a harvest tag system. The program covers the species *Salmo salar* and *Salmo trutta* in all inshore areas, rivers and lakes for recreational catch and six miles out to sea for commercial harvest. The program was first implemented in 2001 and is expected to continue in the medium- to long-term as wild salmon stocks in Ireland and in the North Atlantic remain below their conservation limits.

[26] This is the opposite of typical slot limits that establishes minimum and maximum sizes.

Recreational anglers are provided with gill tags and a logbook with each salmon fishing license. Annual license holders are allocated tags in batches of five. When these are used and an individual has demonstrated to license distributors that they have filled in their catch record (logbook) they can obtain an additional allocation of five tags up to an annual maximum of 20 tags. Legislation is being considered that may reduce this maximum to ten tags. There is no additional cost for tags. One day license holders (3,899 licenses in 2004) only receive one tag per day up until June and three tags per day from June to September. Tags are not transferable. Mandatory reporting of catches is required in the form of 20,000 recreational and 1,500 commercial logbooks returned each year to regional boards. Fines may be imposed for lack of reporting compliance.

There are approximately 30,000 recreational licenses sold each year, and, although only a very small minority of anglers catch 20 salmon, there must be sufficient tags for each license holder. The total number of tags issued is not limited, although this policy is currently under assessment and may change. The recreational catch of salmon is approximately 25,000 each year (± 2500) but the number of tags issued always exceeds this number by a substantial margin. The system does not allow managers to limit the catch to a specific total, other than through bag limits and limiting the number of fish that can be caught per day for different parts of the season (mandatory catch & release will be introduced in 8 districts in September 2006, as certain salmon stocks are below their conservation limits). For 2006, the fisheries boards have provided for a commercial fishery of 91,000 salmon and by reducing the bag limits to ten fish per angler, they hope that the rod catch will not exceed 15,000 (in line with scientific advice that the total catch of salmon by all methods should not exceed 106,000 salmon). There are some moves in Northern Ireland to levy fees for tags so that revenues generated could be used to buy-out commercial fishermen exploiting the same stocks. This is being considered in Ireland as well.

The primary motivation for the program is conservation, though the primary concern is with commercial catch. The principal aims are to provide a means of collecting accurate nominal catch statistics and estimates of salmon and sea trout stock exploitation, to develop best management strategies and to ensure these species are exploited in a manner consistent with their long term sustainability on a Regional, Fishery District and river basis. The program is also intended to identify illegally caught salmon, eliminate sales outlets for such fish and to introduce traceability into the distribution chain. The program is not universally popular. There are many detractors of the program in terms of the ability of the Boards to police and ensure compliance (for both recreational and commercial fisheries), and enforcement does appear to be a potential problem. Staffing is difficult given budgetary constraints. The program has however, provided more information on the patterns of exploitation than was available before. The most significant impacts of the program are reductions in the commercial fishery catch from over 200,000 in 2001 to 91,000 in 2005. Recreational catches have remained stable at approximately 25,000 fish.

The most significant problem encountered in implementing the program was resistance from stakeholders to the limiting of catches and the perception that commercial fishermen (often in coastal communities with little alternative employment) would be forced off the water so that recreational fishermen (often of a different socio-economic background) would benefit financially. There has also been resistance to this program by anglers because of restrictions on catches, the introduction of mandatory catch and release, and individuals' dislike of government monitoring. Although many anglers comply with the regulations, there are certainly some anglers

who catch in excess of their bag limits (possibly on a part-commercial time basis, although by law they are not entitled to sell a rod-caught salmon).

(4) Newfoundland Cod Food Fishery (source: Slade 2006)

The Department of Fisheries & Oceans (DFO), Newfoundland & Labrador Region manages a tag system that allows a limited non-commercial food fishery for cod (*Gadus morhua*) in Newfoundland. The discussion below refers to the program in Newfoundland in NAFO area 3P. The program also manages recreational catch of other groundfish, but the primary target is cod and tags are only required for cod. The program was first implemented in 2001. It is expected to continue, but changes to the program are expected in 2006. The tags are distributed with the Recreational Groundfish License. Canada Post is the vendor for sale and distribution of the licensing program. The cost for the Groundfish License is $10, which includes cod tags at no additional charge.

Tags must be immediately affixed to all Atlantic cod caught through the gills and mouth. Tags must be properly sealed such that they cannot be reopened or removed. Groundfish other than Atlantic cod need not be tagged; however, all groundfish retained count towards the daily bag limit of ten fish. Only rod and reel fishing and handlines with a maximum of six hooks per line are permitted. There is a seasonal limit of fifteen tags per individual license, down from 30 tags issued in 2001. Tagged fish cannot be sold. The program allowed the recreational fishing season to be extended from two weekends per year to eight weeks, thus increasing the safety of participants who are now able to fish according to suitable weather and sea conditions.

Average license sales for the past three years in NAFO area 3P are approximately 9,000, with fifteen tags per license (135,000 tags). There are no limits on the number of licenses. Both residents and nonresidents are eligible to purchase licenses. Licenses and tags are not transferable nor can they be bought or sold. Recreational users are required to maintain a daily log of catch and effort. This is a mandatory license requirement, and anglers must return the log no later than 30 days following the closure of the fishery. Recreational anglers can be fined for not returning logbooks. However, only about 30% of logs are returned on average. Based on these returns scientists, estimate approximately 150 tonnes were taken in the recreational cod fishery in 3Pn in the past three years. In the past two years, revenues from licenses did not cover the cost of administrating the program.

The objectives of the program were to improve the management of the cod fishery by acquiring information on catch and effort, and improve DFO'S ability to assess inshore groundfish stocks. An initial intention of the program was to be cost neutral, however this has not been achieved during the past two years. While the program has not achieved all its objectives, it has resulted in an improved management of the inshore cod fishery by providing data on catch and effort which has assisted DFO in inshore stock assessment. It has also increased public awareness of the conservation concerns for inshore groundfish stocks. The biggest problem encountered in implementing the program occurred in (2001/02) where availability and distribution of licenses by Canada Post in the first few days of the season inadequate. Although license sales were high in the first year of the program, there has been on ongoing resistance by anglers to pay for a license and tags where in other areas of Atlantic Canada there is no groundfish licensing program. There was an illegal protest fishery in 2005 for this reason.

(5) Oregon Combined Angling Harvest Tag Program (sources: Messmer 2006; Upton 2006)

The Oregon Department of Fish and Wildlife manages recreational catches of various species of salmon and steelhead, pacific halibut and sturgeon using a combined angling harvest tag. The program covers the entire state and Pacific Ocean off the Oregon Coast within three miles of shore. A combined angling tag which includes all the species above was created by the Oregon Legislature and first implemented in 2001. It is expected to continue indefinitely. However, salmon and steelhead tags have been used on Oregon for several decades. Before they were combined, salmon/steelhead and halibut were separate tags. The program does not use actual physical tags. Rather, the "tag" is a booklet in which the individual must record the catch of any fish that is not released. Reporting is not mandatory but anglers are advised and encouraged (prizes awarded to winners of a tag drawing) to turn in their booklets.

Anglers may purchase tags at point-of-sale vendors or ODFW Offices. Anglers must have a fishing license and pay an additional fee for the tags. The fee for the adult harvest tag is $21.50, and a juvenile harvest tag costs $6.50 (for anglers less than 18 years of age). The tag allows the angler to catch and keep 20 salmon and steelhead, five Sturgeon and six halibut. Additional tags for ten hatchery salmon and steelhead are available for $12.00 and can only be used on hatchery fish with adipose fins clipped. Individuals can purchase only one combined angling tag per year but may purchase any number of hatchery harvest tags. Tags are not transferable.

Anyone who is willing to pay may purchase a tag and about 47% of licensed anglers purchased one in 2005. In 2001, 211,382 combined adult harvest tags were sold. In 2005, sports package license sales that include the harvest tag (24,748) plus combined angling harvest tags (183,704) implied that a total of 208,452 combined angling harvest tags were sold. In addition, 22,834 juvenile harvest tags were sold. In addition, short-term licenses (one, two, three, four and seven days) include tags. In 2005, 155,545 one-day, 22,832 two-day, 14,754 three-day, 3,761 four-day and 10,713 seven-day licenses were sold.

The program does not have specifically stated objectives beyond furthering ODFW's mission of managing Oregon's fish populations by regulating methods and amount of harvest. The program has the capacity to meet many of ODFW's fish management objectives but currently requires additional funding for some specific tasks. A persistent problem is the low rate of tag returns. Currently it is estimated that around 20% of angler's return their completed tags (catch records) and there may be some response bias. The last adjustment that was made for this bias was done in the 1960's and is not valid today due to the change in tag structure (combined angling tag instead of a salmon/steelhead tag). The only resistance to the program expressed by anglers relates to the cost (generally when there is an increase) and the need to purchase a combined angling tag when they do not intend to fish for all species on the tag (e.g. someone who only fishes for steelhead and salmon has to pay for a combined tag that includes halibut and sturgeon). Because of this, some anglers feel that they are paying too much for their tag (e.g., "wasting money" on sturgeon and halibut tags).

(6) Washington State Catch Record Cards (source: Markey 2006).

Washington Department of Fish & Wildlife manages recreational catches of various species of salmon and steelhead, sturgeon, halibut, and dungeness crab using catch record cards. The cards

are required for angling in all waters of Washington, with the exception of salmon caught in land-locked lakes. Dungeness crab reporting commenced in 2000. Requirements for other species began earlier; the salmon program began in the 1960s and steelhead in the 1950s. The program is expected to continue indefinitely. It does not require physical tags to be attached to fish. Rather, individuals receive a booklet in which they must record the catch of any fish that is not released. State regulations require anglers to return completed catch record cards at the end of the year, whether or not any fish were recorded. Response rate is around 60% and estimates, for some areas and species, have been field verified.

Anglers obtain catch record cards from sports license vendors when they purchase a license. The first card is free and allows for 30 fish (of any of the regulated species) to be recorded. Anglers may also order a catch record card via phone or the internet, in which case the card is mailed to them. The first catch record card is free. Subsequent cards or replacement cards cost $10 plus dealer fees. Cards are not transferable. No angler is allowed to take more than 30 steelhead or five sturgeon per year. Approximately 650,000 cards are issued annually. There are no limits on the total number of cards issued. Revenues from card sales (which are only for cards additional to the first which comes with the license) are not sufficient to cover program costs.

The motivation for the program is to estimate sport harvest of the targeted species groups. The cards are also used as a tool to enforce annual catch limits for some species. The steelhead annual limit is 30, so there are 30 spaces on the card for recording fish. After that, the angler cannot get a card for use with steelhead. The same is true for sturgeon, except the annual limit is five. However, this does not effectively limit total catch since the number of licenses is not limited. Moreover, limiting catches could be considered a secondary objective of the program. The most significant problem encountered in implementing this program was angler education. There was some resistance to the program related to the inconvenience of recording harvest while fishing, and the inconvenience of returning cards to the agency. The most significant impact of the program overall was to provide an estimate of sport harvest over a wide geographic area.

(7) Florida Tarpon Tag Program (source: Colvocoresses 2006)

The Florida Fish & Wildlife Conservation Commission manages statewide recreational landed catches of tarpon (*Megalops atlanticus*) with a harvest tag program. The recreational fishery is almost completely a catch-and-release fishery, as tarpon are not generally considered a food fish. The tag program was implemented in 1989 to allow for very limited landings of trophy fish in what would otherwise be only a catch-and-release fishery. The tag program is expected to run indefinitely.

Anglers can purchase tags (good for one year) for $51.50 from the county tax collector's office. There are no limits on the number of tags that can be purchased. Tags are not transferable. Only 300-400 tags have been sold each year. There is a cap of 2,500 total tags that may be sold per year. Only about 10% of purchased tags are reported used. The used tags do not necessarily imply a killed tarpon as many tournaments in recent years require the use of possession tags if fish are removed from the water (as mandated by state law) but the fish are often released alive after being weighed. Reporting is nominally mandatory through the return of a questionnaire postcard to be returned when a tag is used or expires. Denial of future tag issuances may result

from non-compliance, but this has never been enforced. Revenues in all likelihood exceed costs of administering the program itself (though not overall management costs).

The primary reason for introducing this program was to discourage harvest and provide harvest mortality estimates. The program has been very successful at reducing harvest to negligible amounts and has been well received by anglers. It has resulted in almost complete elimination of deliberate harvest and promotion of a conservation ethic. It has proven less effective for estimating harvest rates due to incomplete reporting and the fact that some tags are used for possession of fish that are later released. One problem with the program has been that, because of the very low volume of tag sales, tax collection agents tasked with selling the tags are often unfamiliar with correct sales and record keeping procedures, resulting in failure to provide purchasers with reporting forms and a resulting loss of, or incomplete, purchase data.

(8) HMS Catch Card Census for billfish in Maryland and North Carolina (sources: Salz 2006; Dunn 2006)

Since 1992, the National Marine Fisheries Service (NMFS) has conducted the Large Pelagic Survey (LPS) to collect fishing effort and catch data for the hand-gear fishery directed at "large pelagic species" (e.g., tunas, billfishes, swordfish, sharks, wahoo, dolphin, and amberjack) in the offshore marine waters of the Northeast Region (Maine through Virginia). However, for certain large pelagic species the estimates of harvest produced using the LPS are still less precise than desired. In addition, LPS was designed to produce reasonably precise estimates at the regional and sub-regional level, not at the state level of analysis.

The Catch Card Census (CCC) program is intended to improve upon some of the shortcomings of the LPS and generate better data with which to manage important large pelagic recreational species. The CCC should have the added benefit of promoting angler awareness, participation and "buy-in" into the management of large pelagic species. Large pelagics catch card programs are currently being conducted by state marine resource agencies in North Carolina and Maryland, with funding and technical support provide by NMFS to Maryland's Department of Natural Resources and North Carolina's Division of Marine Fisheries. The programs cover catches of bluefin tuna, white marlin, blue marlin, sailfish and swordfish for fish landed in Maryland and North Carolina. The program was first implemented in North Carolina in 1998 and in Maryland in 1999. Both programs are expected to run indefinitely. The program does not require anglers to acquire tags before fishing. Rather, the fish must be landed in designated locations, and the angler must acquire a tag when they land, and before they can bring the fish ashore. Anyone who lands one of the designated species can receive a tag in exchange for filling out a catch card.

Anglers acquire tags from designated reporting stations established at bait and tackle shops and marinas. In some cases state employees are on the docks handing out tags and catch cards. There is no cost for tags beyond the cost of a standard saltwater fishing license, and no individual limits on tags. Maryland has distributed between 2,000 and 3,000 cards per year while North Carolina usually distributes less than 100 per year.

The primary objective for starting this program was to obtain data on recreational landings of these species. The program has been successful at generating additional catch information. Initially there was some problem informing captains and anglers of the program. Estimating non-

compliance and improving compliance is an important focus for the future. In general, anglers have been receptive to this program.

In 2004, there was some pressure from various stakeholders to implement a harvest tag system to manage US recreational landings of while marlin, with a focus of ensuring compliance with ICCAT Recommendation 00-13 (the 250 recreationally landed marlin limit) (Dunn 2006). However there was also significant concern by many stakeholders regarding the impacts of a tagging program based on potential tag distribution schemes (e.g. if all tags went to permit holders, how would a kill tournament be able to operate?). NMFS identified a number of potential hurdles to implementing a tag program, including, but not limited to, a lack of funds to implement and operate such a program, lack of staff to operate/manage such a program, the limited (2 year) duration of the 250 marlin landing limit, fair and equitable system for distribution of the tags, and the potential for significant political and legal resistance. A number of tagging concepts were discussed including: purchasing tags, a random draw of 250 among all eligible permit holders, allocation according to landings history, send everyone who has a permit a tag good for one fishing year and then close the fishery after 250 were mailed back in, give all the tags to tournaments, divide the tags between tournaments and anglers, etc. Ultimately, NMFS decided that other means of tracking domestic Atlantic recreational marlin landings were sufficient for meeting U.S. international obligations.

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