Scoping Paper on

Mortality Rates used in Regional Fishery Management Council Fisheries Management Plans for Angler-Caught and Released Fish Focusing on Barotrauma Related Mortality

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Introduction

The mortality of fish that are caught and released by recreational anglers can be significant enough to hinder fisheries management objectives. All fish suffer some degree of mortality – some more than others – that must be incorporated into stock assessments, the establishment of harvest goals, and other aspects of fisheries management.

The purpose of this document is to provide basic background information related to the role of released fish mortality in marine recreational fisheries management, focusing on fisheries where barotrauma-related mortality makes a significant impact. Specifically, this document is intended to:

- Evaluate catch and release mortality used in Regional Fishery Management Council fisheries management plans (FMPs)
- Evaluate other release mortalities for species targeted in U.S. marine recreational fisheries.

A companion report will focus on evaluating outreach materials on fishing techniques and practices to facilitate survival of angler caught and released fish

Recreational release mortality has been the subject of numerous workshops, symposia, publications, and scientific deliberations. Perhaps the most definitive compilation of information on this topic was compiled in a 1999 symposium, and later publication, addressing "Catch and Release in Marine Recreational Fisheries" (Lucy and Studholme 2002). As a result of this symposium a number of research projects, and even a national program to reduce the mortality of angler caught and released fish in Australia, were launched. Among the plethora of other symposia and conferences related to release mortality are the Atlantic States Marine Fisheries Commission (ASMFC) Circle Hook workshop which compiled comparisons of various circle hook mortality versus "J" hook mortality (ASMFC 2003) and a 2001 workshop on regulatory discards (which focused on commercial fisheries but did contain some material pertinent to recreational) (ASMFC 2001). Barotrauma specific mortality was the subject of a 2008 symposium at the American Fisheries Society annual meeting.

This document does not seek to provide a comprehensive literature review of barotrauma science/mortality or catch and release mortality. Rather, it is a fresh and comprehensive look at how release mortality information is currently being applied in the U.S. marine fisheries management process. The findings are intended to facilitate the development of the *FishSmart* communication program. To that end, information has been collated and presented around the following objectives:

- Identifying information for application in a comprehensive communication program to promote best practices in catch and release marine recreational fisheries.
- Secondarily, what information gaps can be identified for researchers to fill in the future.

Catch and Release Mortality Used in Regional Fishery Management Council FMPs

An important initial step in the *FishSmart* process is to evaluate catch and release mortality estimates currently incorporated in fishery management plans and other peer-reviewed release mortalities for species targeted in U.S. marine recreational fisheries. Many fishery management plans (and their underlying models) for saltwater recreational fisheries incorporate an estimate of catch-and-release mortality.

Through the auspices of the Atlantic States Marine Fisheries Commission, the eight Regional Fishery Management Councils were asked specifically to identify FMPs that utilize release mortality rates for recreationally caught and released species (voluntary or regulatory) and if those rates are based on empirical data or are assigned through some other mechanism. For those based on studies or reports, the citation of the report was requested (Appendix A).

Caribbean Fishery Management Council (CFMC)

None of the CFMC's Fishery Management Plans utilize release mortality rates for recreationally caught and released species. The CFMC has addressed the issue of barotrauma in discussing size limits for fish and concluded that for most grouper and snapper species there would be increased release mortality if implemented.

Regulations on seasonal and area closures apply equally to both commercial and recreational fisheries. These are established to protect groupers and snappers during spawning. Section 6 of the 2005 SFA Comprehensive Amendment touches on barotrauma in the discussion of the establishment of seasonal closures (see Appendix B, Excerpt of Section 6 of the 2005 SFA Comprehensive Amendment addressing barotrauma).

Gulf of Mexico Fishery Management Council (GOMFMC)

(See Appendix C for GOMFMC full response)

The Gulf of Mexico Fishery management Council manages 69 species within seven fishery management plans. No Gulf of Mexico fisheries are managed as catch and release fisheries. However, many of the regulations implemented under these FMPs result in regulatory discards. The regulations that most often result in regulatory discards include minimum size limits, closed seasons, closed areas, and recreational bag limits.

The release mortality rates used in the assessment generally come from two sources. They may be estimated based on studies conducted by NOAA Fisheries and other researchers, and often published in the peer reviewed literature. Also, in some fisheries, primarily commercial or headboat fisheries, NOAA Fisheries is able to place observers on a portion of the vessels. This allows direct observations of immediate survival of released fish. Delayed mortality, however, remains unknown and is often a subject of debate. Where sufficient data exists for catch-at-depth, variable release mortality by depth is used in the stock assessments. In addition, release mortality estimates are made separately for each sector and gear type (e.g., commercial longline, commercial handline, headboat, charter boat, and private recreational vessel.

Red Snapper – differential release mortality is applied to red snapper recreational releases based on geographic zones and average depth fished. For red snapper, east of the Mississippi River, most recreational red snapper fishing occurs at depths of 20-40 meters, and an average release mortality of 15% is used. West of the Mississippi, the average depth is 40 meters or greater, and an average release mortality of 40% is used. These estimates are based on numerous studies of red snapper release mortality (Steve Atran, personal communication).

Summary of depths fished by fishery and by region in the Gulf of Mexico, and the estimate of release mortality assigned for red snapper. Release mortality is expressed as the percent of discarded fish that were assumed to suffer mortality (excerpted from Cass-Calay et al, 2004)

Recreational Fishery	Depth	Release Mortality
Western Gulf	20-40m	15%
Western Gulf	40 m	40%
Gulf Wide (1981-96)		27.5%
Gulf Wide (1997-2002)		21%

Vermillion Snapper –Little information is available on release mortality, but anecdotal information indicates a range of 6% - 27%. SEDAR 9 (2006) states: “The only directed study (Burns et al. 2002) concluded that vermilion snapper are more susceptible to release mortality than red snapper, gag, and red grouper, but a mortality rate was not provided.” In the stock assessment, a sensitivity analysis was run for the following ranges: Private recreational: 10-40%; Headboat: 40-60% Commercial hand-line: 40-75%.

Gag Grouper – Gag grouper are fished primarily off Florida and Alabama. Release mortality rates are zoned into the Florida Panhandle (including Alabama) and Florida Peninsula. They are further divided into inshore and offshore regions. Depending upon the region and depth, the release mortality ranges from 11% to 42% based on a series of studies (Steve Atran, personal communication).

Assigned average depth (m) and corresponding percent discard mortality for gag grouper for each of the regions of the Gulf of Mexico. (excerpted from SEDAR 10)

Region	Zone	Average Depth (m)	Release Mortality
Panhandle	Inshore	10	11%
Panhandle	Ocean<10	20	18%
Panhandle	Ocean>10	40	42%
Peninsula/Keys	Inshore & Ocean<10	10	11%
Peninsula/Keys	Ocean>10	30	29%

Red Grouper - a 10% release mortality is applied to recreational fisheries regardless of geographic location, estimated from Wilson and Burns 1996.

Greater Amberjack-data is scarce but a release mortality rate of 20% is assumed based on limited observations. A sensitivity analysis ranging from 0% to 40% was conducted (SEDAR 9, 2006).

Mid Atlantic Fishery Management Council (MAFMC)

(See Appendix D for full response)

The Mid-Atlantic Council currently manages a number of species which have recreational fishery components including summer flounder, scup, black sea bass, bluefish, Atlantic mackerel, spiny dogfish, and tilefish. The MAFMC currently utilizes release mortality rates for recreationally caught fish in either the stock assessment or in the calculation of total allowable catch for all of these species, with the exception of Atlantic mackerel and tilefish. For tilefish, the recreational component of the total catch is so small that it is ignored in the stock assessment. In the case of Atlantic mackerel, recreational landings are incorporated in the catch-at-age matrix of the stock assessment model but the estimate of the discarded portion of the recreational catch is small and is not included. Therefore, no assumptions are required relative to the fraction of dead recreational mackerel discards. A summary of the post release mortality rate assumptions utilized by the MAFMC for fish taken in the recreational fisheries by species (and associated citations) are given below.

Summer Flounder[1] - Lucy and Holton (1998) used field trials and tank experiments to investigate the release mortality rate for summer flounder in Virginia, and found rates ranging from 6% (field trials) to 11% (tank experiments). Malchoff and Lucy (1998) used field cages to hold fish angled in New York and Virginia during 1997 and 1998, and found a mean short term mortality rate of 14% across all trials. Given the results of these release mortality studies conducted specifically for summer flounder, a 10% release mortality rate was adopted in the Terceiro (1999) stock assessment and has been retained in all subsequent assessments.

Overall Summer Flounder mortality measured in various studies (Malchoff et al.2001).				
	NY	VA	NC	All
Mortality	14.7	6.9	5.3	9.9
95% C.I.	.0-21.7	1.6-14.0	0.0-12.1	7.4-11.9
Sample Size	N=247	N=189	N=187	=623

Black Sea Bass – A recreational discard mortality estimate of 5% (Bugley and Shepherd 1991) was derived based on cage experiments conducted in relatively shallow water. Based on the Delphi method, an estimate of 25% was considered to be more representative of expected conditions, including deeper water; therefore 25% has been used in recent stock assessments.

[1] Source of Excerpted Text: Northeast Fisheries Science Center. 2008. 47th Northeast Regional Stock Assessment Workshop (47th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-12a; 335 p

Scup –recreational discard mortality for scup has been estimated between 0-15% (Howell and Simpson 185 as cited in Terceiro 2011) and 0-14% (Williams, unpublished work as cited in Terceiro 2011). The management plan utilizes a 15% discard mortality rate.

Bluefish -A discard mortality rate of 15% is applied to the number of fish that are reported by anglers as "released alive" in the Marine Recreational Statistics Survey (MRFSS). This is based on Malchoff (1995) and as modified by the ASMFC Bluefish Technical Committee.

Spiny Dogfish - a discard mortality rate of 25% is assumed for recreationally caught and released dogfish based on assumed rates for other "hook" gear types and incorporated into the stock assessment models. No published studies are referenced (Northeast Fisheries Science Center 2006).

New England Fishery Management Council (NEFMC)

The NEFMC provided information on a number of species and noted that citations of estimates of discard mortality usually are estimated in stock assessments prior to the development of FMP measures; nevertheless, information was provided pertaining to recreational stocks/species that have size or possession limits and perhaps could help in a literature search. (Appendix E, NEFMC response).

Of the species that are managed by the NEFMC, cod, haddock, pollock and winter flounder are the only fisheries that are targeted or caught in any substantial quantity in the recreational fishery.

Cod and Haddock – stock assessments assume that 100 percent of the fish that are reported by anglers as "released alive" in the MRFSS survive.

Winter Flounder – in the stock assessment, recreational discards are assumed to have a discard mortality rate of 15% based on Durso and Iswanowicz 1982 (as cited in Howell et al. 1992).

Pollock - 100% mortality is assumed for all pollock released in the recreational fishery According to the stock assessment, a tagging study (Clay et al. 1989) estimated 16% total mortality from a hook fishery in a three-month period, 11% of which was attributed to tagging of fish. That study suggested that neither 100% mortality nor 100% survival would be an obviously justifiable assumption for recreational discard mortality of pollock. In the absence of more information, the working group chose to assume 100% mortality of discarded recreational catch (B2). This assumption is also consistent with the 100% discard mortality assumed for commercial discards. Furthermore, because recreational catch is a minor component of the total catch, assuming 100% mortality was not expected to contribute undue influence on model results (Chris Kellogg , personal communication).

South Atlantic Fishery Management Council (SAFMC)

Release mortalities for recreational species are incorporated into stock assessments and modeling phases of the fishery management process of the SAFMC. Most of the mortality rates are based on empirical data; others on inference from research on similar species, and a few such as goliath grouper are based primarily on anecdotal information. The following information was obtained from the Southeast Data, Assessment, and Review (SEDAR) website (http://www.sefsc.noaa.gov/sedar/) for the following species:

Black Sea Bass-The SEDAR 02 (2003) stock assessment utilizes a15% mortality based on a compilation of studies including Collins et al 1999, Low1981, and Vaughn et al.1995.

Red Snapper- differential release mortalities are used for various segments of the fishery. For-hire recreational trips are assessed at 41% release mortality, private recreational trips at 39% mortality, and commercial lines at 48% mortality (SEDAR 24 2010). These are based on the fact that release mortality was higher in several studies (including Burns et al. 2004) than what had been used in previous red snapper models (SEDAR 15 2008).

Vermillion Snapper– a release mortality of 25% is assumed for the recreational fishery based on unpublished data (SEDAR 2 2003).

Mutton Snapper – a 15% release mortality rate for the inshore recreational fisheries is applied, based on studies of “similar species” mainly relying on red snapper studies.

Goliath Grouper-release mortality rate is incorporated as part of overall mortality for modeling purposes and not reported separately (SEDAR 23 2011).

Red Grouper – a release mortality estimate of 20% is assumed based on several studies including Wilson and Burns 1996 and Burns et al. 2002.

Black Grouper - the stock assessment incorporates an assumed release mortality of 20% but concern was expressed about the lack of empirical data to support this (SEFDAR 19 2010).

Gag Grouper - For the recreational fisheries (MRFSS and Headboat Surveys), release mortality is established at 25% based on data from Rudershausen et al. 2005, Burns et al. 2002, Overton and Zabawski 2003, McGovern et al.2005, and Wilson and Burns 1996.

Red Drum – an 8% release mortality is assumed based on a range of studies, including Murphy 2005, Vecchio & Wenner 2007, Anguilar et al 2002, and Gearhart 2002. A sensitivity analysis for southern (10%) and northern (25%) stocks were incorporated into the stock assessment.

Spanish Mackerel-no estimates were developed for the recreational fisheries surveyed by the MRFSS releases due to low numbers released in the recreational fishery (SEDAR 17 2008).

King Mackerel – in the stock assessment, release mortality is assessed at 33% for live releases in the headboat fishery and 20% for live releases (B2) in the MRFSS survey. These estimates are based on observer headboat data and also match an estimate in Edwards 1996.

Greater Amberjack-data are scarce, but a release mortality rate of 20% is assumed based on limited observations. A sensitivity analysis ranging from 10% to 30% was conducted. The release mortality rate of 20% is the same as used in the Gulf of Mexico greater amberjack assessment (SEDAR 15-2 2008).

Red Porgy – an 8% release mortality is assumed based on Collins 1996.

North Pacific Fishery Management Council (NPFMC)

None of the NPFMC FMPs directly address post release mortality of recreational fish. However, the International Pacific Halibut Commission and the Alaska Department of Fish and Game have addressed the issue in the Halibut and Rockfish fisheries.

Demersel Shelf Rockfish - the only marine fishery that incorporates estimates of recreational discard mortality is the demersal shelf rockfish fishery in Southeast Alaska. Survival rate for fish released in the sport fishery is assumed to be zero (100% release mortality) (Brylinsky et al. 2009). However, research documents successful resubmergence of rockfish (Hannah et al. (2008) and survival may be 20% or higher for some species. The Alaska Department of Fish & Game has recently completed a research project estimating: (1) the survival rate of yelloweye rockfish released in the wild using a deepwater release device, and (2) submergence success of yelloweye and quillback rockfish released at the surface. A manuscript is in preparation (Scott Meyer personal communication).

Pacific Halibut - The International Pacific Halibut Commission staff has addressed this issue in the past and Alaska Department of Game & Fish staff has investigated discard mortality for sport caught halibut, (Meyer 2007).[2] Release mortality for halibut caught on circle hooks is assumed to be 3.5% and on “J” hooks 10%. The circle hook mortality rate was based on available data from a study of halibut caught on longline gear and released in “excellent condition” (Meyer acknowledges the significant differences between commercial longline and recreational rod and reel caught halibut). The mortality for halibut caught on “J” hooks and other hooks was assumed based on a review of hooking mortality studies for other marine species (excluding salmonids) which ranged from1.7% to 33.5%, with that for most temperate water species below 10%.

[2] ADF&G discussion paper on halibut discard mortality is found at: http://www.fakr.noaa.gov/npfmc/current_issues/halibut_issues/HalibutDiscards907.pdf

Pacific Fishery Management Council (PFMC)

Pacific Groundfish - Species-specific recreational fishing release mortality for Pacific groundfish is developed based on best available literature and is a combination of three elements of release mortality[3]:

- surface mortality observable when a fish is brought to the surface, handled on deck, and thrown back.
- short-term, below-surface mortality that has been documented in research trials to a limited extent using underwater cameras or divers.
- longer-term, below-surface mortality that is essentially unobservable in the field and for which there is little, if any, information available in the literature. Generally, this was an additional 5% mortality for each 10 fm of depth of capture.

[3] For a full description of how these mortality rates were derived, go to www.pcouncil.org/bb/2008/0608/F4a_SUP_ATT2_0608.pdf and go to Section 4.5.1.6, pages 77 through 91.

Estimated discard mortality rates for recreationally important Pacific groundfish species.				
Species	**Depth from where caught**			
	0-10 fm	**11-20 fm**	**21-30 fm**	**>30 fm**
Black Rockfish	11%	20%	29%	63%
Black and Yellow Rockfish	13%	24%	37%	100%
Blue Rockfish	18%	30%	43%	100%
Bocaccio	19%	32%	46%	100%
Brown Rockfish	12%	22%	33%	100%
Calico Rockfish	24%	43%	60%	100%
Canary Rockfish	21%	37%	53%	100%
China Rockfish	13%	24%	37%	100%
Copper Rockfish	19%	33%	48%	100%
Gopher Rockfish	19%	34%	49%	100%
Grass Rockfish	23%	45%	63%	100%
Kelp Rockfish	11%	19%	29%	100%
Olive Rockfish	34%	45%	57%	100%
Quillback Rockfish	21%	35%	52%	100%
Tiger Rockfish	20%	35%	51%	100%
Treefish	14%	25%	39%	100%
Vermilion Rockfish	20%	34%	50%	100%
Widow Rockfish	21%	36%	52%	100%
Yelloweye Rockfish	22%	39%	56%	100%
Yellowtail Rockfish	10%	17%	25%	50%
Other Species				
Cabezon	7%	7%	7%	7%
California scorpionfish	7%	7%	7%	7%
Kelp Greenling	7%	7%	7%	7%
Lingcod	7%	7%	7%	7%
Pacific Cod	5%	32%	53%	97%
Flatfish	7%	7%	7%	7%
Sharks and Skates	7%	7%	7%	7%
Dogfish	7%	7%	7%	7%

Western Pacific Fishery Management Council (WPFMC)

No response was received from the WPFMC. This section will be further developed in future versions.

Other Fisheries

Striped Bass (Atlantic Coast) – the ASMFC fishery management plan for striped bass assumes an 8% release mortality for recreationally caught and released fish, based on a number of studies, primarily Diodati and Richards (1996).

Red drum – The ASMFC management plan for red drum incorporates a 5% post release mortality estimate for red drum into the stock assessment (Murphy 2005[4]).

Tautog – discard mortality rate of 2.5% is applied to the total released numbers from the Marine Recreational Fisheries Statistics Survey (B2 catch) characterized by length by state and is summed within regions to account for release mortality (Simpson and Gates 1999[5]).

Weakfish – a discard mortality rate of 10% is incorporated into the stock assessments. Hook-and-release experiments for weakfish and spotted seatrout (*Cynoscion nebulosis*) produced results ranging from 3% to 15%. (Murphy et al 1995, Malchoff and Heins 1997, Swihart et al 2000, Duffy 2002, Gearhart 2002)[6]

Atlantic Croaker – the ASMFC stock assessment for Atlantic croaker assumes that 10% of all fish released alive (MRFSS B2) die as a result of being caught. This is not based on any empircal study (ASMFC 2010).

[4] as cited in: SEDAR18-DW09 Recreational harvest estimates and estimated catch-at-age for the recreational fishery in Florida during 1982-2007

[5] as cited in: Stock Assessment Report No. 06-02 (Supplement) of the Atlantic States Marine Fisheries Commission Tautog Stock Assessment Report for Peer Review, January 2006.

[6] as cited in : Report of the 48th Northeast Regional Stock Assessment Workshop 48th Northeast Regional Stock Assessment Workshop (48th SAW) Assessment Summary Report. Northeast Fisheries Science Center Reference Document 09-10, July 2009.

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Appendix A. Letter from Vince O'Shea to the Regional Fishery Management Councils

As you are aware, the growing employment of voluntary catch-and-release in marine recreational fisheries coupled with the explosion of management measures that mandate live release has resulted in post release mortality rates that must be addressed and minimized. In some fisheries, it is reaching crisis levels.

To address this, the Atlantic States Marine Fisheries Commission is working with the National Marine Fisheries Service on a program termed FishSmart. FishSmart is a proactive approach to reducing the mortality of fish stocks while enhancing the recreational fishing experience. FishSmart will address these issues through two basic approaches: 1) developing fishing techniques and management approaches that reduce the catch of unwanted species or sizes, and; 2) improving the survival of released fish. At its essence, FishSmart is an outreach program to introduce stewardship to new anglers and to improve and reinforce the stewardship of current anglers.

An important initial step in the FishSmart process is to conduct a literature review and evaluate catch and release mortality estimates currently incorporated in fishery management plans as well as other peer-reviewed release mortalities for species targeted in U.S. marine recreational fisheries. Many fishery management plans (and their underlying models) for saltwater recreational fisheries incorporate an estimate of catch-and-release mortality. I am making this request for information to each Regional Fishery Management Council.

Specifically, the information requested is identification of FMPs that utilize release mortality rates for recreationally caught and released species (voluntary or regulatory) and if those rates are based on empirical data or are assigned through some other mechanism. For those based on studies or reports, the citation of the report is requested.

I would greatly appreciate your response by January 14th directly to Gil Radonski (gcrgmr@earthlink.net) who is working in conjunction with ASMFC on this. If you have any questions, please feel free to contact Gil or I directly.

In advance, thank you for your assistance.

Regards,
Vince

Appendix B. Excerpt of Section 6 of the 2005 Sustainable Fisheries Act Comprehensive Amendment Addressing Barotrauma:

"Because of the nature of the reef fish fishery, in that fishermen can harvest numerous reef fish species from the same location, it is possible that the benefit of a seasonal closure may be impacted from bycatch mortality. Fishermen would not be prohibited from fishing in particular areas, and thus may still incidentally catch species such as grouper or snapper that are encompassed by a closed season. Should the fish be harvested from deep water, the greater the chance the fish will not survive its release due to barotrauma and/or predation risk. As Alternatives 2a - 2e only apply to federal waters, and the various affected species in each alternative are predominantly found in state waters due to the prevalence of habitat (Figure 1; more applicable to Puerto Rico than the USVI), intensified fishing pressure in state waters could negate any biological benefit from a seasonal closure in federal waters. Therefore, it is unclear if Alternatives 2a - 2e would be successful in ending overfishing for those species undergoing overfishing or are overfished, and it is unlikely that any of these alternatives would result in sufficient declines in fishing mortalities so that landings are approximating that of OY. However, Alternative 2b would be consistent with a currently-existing seasonal closure in Puerto Rican waters, and Puerto Rico and the USVI stated at the 117th Council meeting in San Juan that they would work to implement consistent (to the preferred alternatives) seasonal closure periods in state waters."

Appendix C. Gulf of Mexico Fishery Management Council Response

Ms. Meredith Wilson
Executive Assistant
Atlantic States Marine Fisheries Commission
1050 N. Highland Street
Suite 200 A-N
Arlington, VA 22201

Dear Ms. Wilson:
Our Executive Director, Dr. Steve Bortone, asked me to reply to your recent e-mail request. My colleague Steven Atran and I collaborated on this request. The Gulf of Mexico Fishery management Council manages 69 species within 7 fishery management plans (FMPs). None of our fisheries are managed as catch and release fisheries. However, many of the regulations implemented under our FMPs result in regulatory discards. The regulations that most often result in regulatory discards include minimum size limits, closed seasons, closed areas, and recreational bag limits. In addition, the commercial red snapper, grouper, and tilefish fisheries are managed under individual transferable quota (IFQ) systems, and can result in regulatory discards if a fisherman does not have sufficient IFQ shares to land his catch.

The Magnuson-Stevens Fishery Conservation and Management Act contains 10 national standards that must be adhered to when developing fishery management plans. Two of these national standards directly address bycatch and bycatch mortality.

National Standard 1 requires the Council to prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery. Also, under the Magnuson-Stevens Act, the Council's Scientific and Statistical Committee is responsible for recommending a level of acceptable biological catch (ABC) which the Council cannot exceed when setting annual catch limits. The National Standard 1 guidelines published by the National Marine Fisheries Service (NMFS) specify that acceptable biological catch (ABC) should be expressed in terms of catch, but may be expressed in terms of landings as long as estimates of bycatch and any other fishing mortality not accounted for in the landings are incorporated into the determination of ABC. Stock assessments produced under the Southeast Data, Assessment and Review (SEDAR) process include estimates of release mortality when projecting landed yields that are consistent with management objectives and benchmarks.

The release mortality rates used in the assessment generally come from two sources. They may be estimated based on studies conducted by NMFS and other researchers, and often published in the peer review literature. Also, in some fisheries, primarily commercial or headboat fisheries, NMFS is able to place observers on a portion of the vessels. This allows direct observations of immediate survival of released fish. Delayed mortality, however, remains unknown and is often a subject of debate. Where sufficient data exists for catch-at-depth, a variable release mortality by depth is used in the stock assessments. In addition, release mortality estimates are made separately for each sector and gear type (e.g., commercial longline, commercial handline, headboat, charter boat, and private recreational vessel).

National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. This National Standard was added to the Act in 1996. Since then, the Council has taken a number of measures to prevent or reduce mortality from regulatory discards.

The following actions were implemented at least in part to reduce bycatch mortality in the recreational fishery.

Reef Fish Amendment 16B, implemented in 1999, set a slot limit of 14 to 22 inches fork length for lesser amberjack and banded rudderfish. This rule was implemented because lesser amberjack and banded rudderfish can be difficult to tell apart from juvenile greater amberjacks, which have a minimum recreational size limit of 30 inches. As a result, these two species would frequently be thrown back, with the attendant release mortality, by fishermen seeking to avoid violating the greater amberjack size limit. Lesser amberjack and banded rudderfish rarely get larger than 22 inches, so this rule allows their retention and reduced release mortality while still providing protection for fish in the 22 to 30 inch range, which are clearly juvenile greater amberjacks.

Joint Reef Fish Amendment 27-Shrimp Amendment 14, implemented in 2008, made revisions to the red snapper rebuilding plan. As part of those changes, the amendment implemented requirements for the use of non-stainless steel circle hooks when using natural baits, and require the use of venting tools and dehooking devices when participating in all commercial and recreational reef fish fisheries. These requirements were intended to reduce the likelihood of a fish being gut-hooked, and to increase survival of released fish. The following description is taken from the Gulf Council webpage:

“Amendment 27/14 was implemented in February, 2008, and addresses overfishing and bycatch issues in both the red snapper directed fishery and the shrimp fishery. The amendment sets TAC at 5.0 mp between 2008 and 1020. The commercial sector will receive a quota of 2.55 mp, with the remaining quota of 2.45 mp going to the recreational sector. The amendment also reduces the commercial size limit to 13”, reduces the recreational bag limit to two fish, eliminates a bag limit for captain and crew aboard a for-hire vessel, and sets the recreational fishing season from June 1 – September 30. In addition, all commercial and recreational reef fish fisheries will be required to use non-stainless steel circle hooks when using natural baits, as well as venting tools and dehooking devices.

For the shrimp fishery, the amendment establishes a target reduction goal for juvenile red snapper mortality of 74% less than the benchmark years of 2001-2003, reducing that target goal to 67% beginning in 2011, eventually reducing the target to 60% by 2032. If necessary, a seasonal closure in the shrimp fishery will occur in conjunction with the annual Texas closure (which begins on or about May 15). The need for a closure will be determined by an annual evaluation by the NMFS Regional Administrator.”

Amendment 30B addresses release mortality of the fishes from the aggregate shallow water grouper complex:
"Amendment 30B addresses the overfishing of Gag grouper, and defines its minimum stock size threshold (MSST) and optimum yield (OY). The amendment also sets interim allocations of gag and red grouper catches between recreational and commercial fisheries, and makes adjustments to the red grouper total allowable catch (TAC) to reflect the current status of the stock, which is currently at OY levels. Additionally, the amendment establishes annual catch limits (ACLs) and accountability measures (AMs) for the commercial and recreational red grouper fisheries, commercial and recreational gag fisheries, and commercial aggregate shallow-water fishery.

For the commercial sector, the amendment for 2009 reduces the aggregate shallow-water grouper quota from 8.80 mp to 7.8 mp, increases the red grouper quota from 5.31 mp to 5.75 mp, and sets a gag quota of 1.32 mp. The gag and shallow-water grouper quotas are scheduled to increase in subsequent years as the gag stock rebuilds. When 80 percent of a grouper species quota is reached, the allowable catch per trip for that species will be reduced to an incidental catch limit of 200 pounds until the species quota is filled in order to reduce discard mortality of that species while fishermen target other species.

The amendment repeals the commercial closed season of February 15 to March 15 on gag, black and red grouper, and replaces it with a January through April seasonal area closure to all fishing at the Edges 40 fathom contour, a 390 nautical square mile gag spawning region northwest of Steamboat Lumps. In addition, the Steamboat Lumps and Madison-Swanson fishing area restrictions will be continued indefinitely.

For the recreational sector, the amendment reduces the aggregate grouper bag limit from five fish to four, increases the red grouper bag limit from one fish to two, and sets a two-fish bag limit for gag. A recreational closed season on shallow-water grouper was established from February 1 through March 31. Finally, the amendment requires that all vessels with federal commercial or charter reef fish permits must comply with the more restrictive of state or federal reef fish regulations when fishing in state waters."

The gag amendment, Amendment 32, directly addresses release mortality of both live and dead discards. However, this amendment is still being written by Gulf Council staff and National Marine Fisheries personnel. In addition, the amberjack amendment will also address release mortality, but it is still in the developmental stage pending completion of additional data analyses and the amberjack stock assessment.

Cordially,
Karen Burns
Karen Burns, Ph.D.
Ecosystem Management Specialist
Gulf of Mexico Fishery Management Council

Appendix D. Mid Atlantic Fishery Management Council Response

This is in response to Vince O'Shea's request for the Mid-Atlantic Council to identify which of its' FMPs utilize release mortality rates for recreationally caught and released species (voluntary or regulatory) and if those rates are based on empirical data or are assigned through some other mechanism. He also requested the associated citations for the studies or reports utilized.

The Mid-Atlantic Council currently manages a number of species which have recreational fishery components including summer flounder, scup, black sea bass, bluefish, Atlantic mackerel, spiny dogfish, and tilefish. The Council currently utilizes assumed release mortality rates for recreationally caught fish in either the stock assessment or in the calculation of TAL for all of these species, with the exception of Atlantic mackerel and tilefish. For tilefish, the recreational component of the total catch is so small that it is ignored in the stock assessment. In the case of Atlantic mackerel, recreational landings are incorporated in the catch-at-age matrix of the stock assessment model but the estimate of the discarded portion of the recreational catch is small and is not included. Therefore, no assumptions are required relative to the fraction of dead recreational mackerel discards. A summary of the post release mortality rate assumptions utilized by the Council for fish taken in the recreational fisheries by species (and associated citations) are given below.

Summer Flounder, Scup and Black Sea Bass FMP

Summer Flounder Recreational Discard Mortality

Source of Excerpted Text: Northeast Fisheries Science Center. 2008. 47th Northeast Regional Stock Assessment Workshop (47th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-12a; 335 p

"Studies conducted to estimate hooking mortality for striped bass and black sea bass suggest a hooking mortality rate of 8% for striped bass (Diodati and Richards 1996) and 5% for black sea bass (Bugley and Shepherd, 1991). Work by the states of Washington and Oregon with Pacific halibut (a potentially much larger flatfish species, but otherwise morphologically similar to summer flounder) found "average hooking mortality...between eight and 24 percent" (IPHC, 1988). An unpublished tagging study by the NYDEC (Weber MS 1984) on survival of released sublegal summer flounder caught by hook-and-line suggested a total, non-fishing mortality rate of 53%, which included hooking plus tagging mortality as well as deaths by natural causes (i.e., predation, disease, senescence). Assuming deaths by natural causes to be about 18%, (an instantaneous rate of 0.20), an annual hooking plus tagging mortality rate of about 35% can be derived from the NYDEC results. In the SARC 25 (NEFSC 1997b) and earlier assessments of summer flounder, a 25% hooking mortality rate was assumed for summer flounder released alive by anglers. However, two more recent investigations of summer flounder recreational fishery release mortality suggest that a lower release mortality rate is more appropriate. Lucy and Holton (1998) used field trials and tank experiments to investigate the release mortality rate for summer flounder in Virginia, and found rates ranging from 6% (field trials) to 11% (tank experiments).

Malchoff and Lucy (1998) used field cages to hold fish angled in New York and Virginia during 1997 and 1998, and found a mean short term mortality rate of 14% across all trials. Given the results of these release mortality studies conducted specifically for summer flounder, a 10% release mortality rate was adopted in the Terceiro (1999) stock assessment and has been retained in all subsequent assessments."

Bugley K, Shepherd G. 1991. Effect of catch-and-release angling on the survival of black sea bass. N Am J Fish Mgmt. 11: 468-471.

Diodati PJ, Richards RA. 1996. Mortality of striped bass hooked and released in saltwater. Trans Am Fish Soc. 125(2): 300-307.

IPHC. 1988. Annual Report, 1987. International Pacific Halibut Commission. Seattle, Washington. 51 p.

Lucy JA, Holton TD. 1998. Release mortality in Virginia's recreational fishery for summer flounder, (*Paralichthys dentatus*) VA Mar Res Rep. 97-8. 48 p

Malchoff MH, Lucy J. 1998. Short-term hooking mortality of summer flounder in New York and Virginia. Interim report for Cornell Univ/DEC Project MOU 000024. 6 p.

Weber AM. MS 1984. Summer flounder in Great South Bay: survival of sub-legals caught by hook-and-line and released. New York State Department of Environmental Conservation, Division of Marine Resources. Stony Brook, NY. 27 p.

Northeast Fisheries Science Center (NEFSC). 1997b. Report of the 25th Northeast Regional Stock Assessment Workshop (25th SAW): Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NEFSC Ref Doc. 97-14. 143 p.

Scup Recreational Discard Mortality

Source of Excerpted Text: Part A: Northeast Data Poor Stocks Working Group. 2009. The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting. Part A. Skate species complex, deep sea red crab, Atlantic wolffish, scup, and black sea bass. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-02; 496 p

"The mortality rate due to discarding in the recreational fishery has been reported to range from 0-15% (Howell and Simpson 1985) and from 0-13.8% (Williams, pers. comm.). Howell and Simpson (1985) found mortality rates were positively correlated with size, due mainly to the tendency for larger fish to take the hook deep in the esophagus or gills. Williams more clearly demonstrated increased mortality with depth of hook location, as well as handling time, but found no association with fish size. Based on these studies, a discard mortality rate in the recreational fishery of 15% appears reasonable and has been used in previous and the current assessments."

Howell PT, Simpson DG. 1985. A study of marine recreational fisheries in Connecticut. March 1, 1981 - February 28, 1984. CTDEP, Fed Aid to Sport Fish Restoration F54R. Final Rep. 60 p.

Williams E. Pers. comm. University of Rhode Island, Department of Fisheries and Aquaculture. Kingston, RI. November 1, 1994.

Black Sea Bass Recreational Discard Mortality

A recreational discard mortality estimate of 5% (Bugley and Shepherd 1991) was derived based on cage experiments conducted in relatively shallow water. Based on the Delphi method, an estimate of 25% was considered to be more representative of expected conditions, including deeper water; therefore 25% has been used in recent stock assessments.

Bugley K, Shepherd G. 1991. Effect of catch-and-release angling on the survival of black sea bass. N Am J Fish Mgmt. 11: 468-471.

Atlantic Bluefish FMP

Bluefish Recreational Discard Mortality

Excerpted text from: A report of the ASMFC Technical Committee/Assessment Subcommittee, SAW-41.

"As in previous bluefish stock assessments, a discard mortality rate of 15% was assumed for type B2 catches based on Malchoff (1995) and as modified by the ASMFC Bluefish Technical Committee (NEFSC 1997)."

Malchoff, M.H. 1995. Effects of catch and release on important northeast marine fishers: mortality factors and applications to recreational fisheries. NY Sea Grant Extension Program, Cornell Cooperative Extension Report, Riverhead, NY.

Spiny Dogfish FMP

Spiny dogfish Recreational Discard Mortality

In the two most recent spiny dogfish assessments, a discard mortality rate of 25% was assumed for recreationally caught and released dogfish based on analogy with assumed rates for other "hook" gear types. No published studies are referenced.

43rd Northeast Regional Stock Assessment Workshop (43rd SAW): 43rd SAW assessment report. US Dep Commer, Northeast Fish Sci Cent Ref Doc 06-25; 400 p.

Appendix E. New England Fishery Management Council

Dear Meredith,

Sorry for the late response to your request about catch and release estimates that are included in Council-managed FMPs. NEFMC FMPs do not have measures that are typically thought of as ‘catch and release’ provisions, but there are minimum size restrictions for several the following species:

Cod	22” (58.4 cm)
Haddock	19” (48.3 cm)
Pollock	19” (48.3 cm)
Witch flounder (gray sole)	14” (35.6 cm)
Yellowtail flounder	13” (33.0 cm)
Atlantic halibut	36” (91.4 cm)
American plaice (dab)	14” (35.6 cm)
Winter flounder (blackback)	12” (30.5 cm)
Redfish	9” (22.9 cm)

Of these, only cod, haddock, pollock and winter flounder are targeted or caught in any substantial quantity in the recreational fishery. There also is a prohibition on retention of Atlantic wolffish and retention of more than one Atlantic halibut. Both of these are sometimes caught but not thought to be targeted by anglers. Silver hake may also be caught by anglers, but has is no minimum size restrictions.

Citations of estimates of discard mortality usually are not included in our FMPs because discard mortality is estimated in stock assessments prior to the development of FMP measures; nevertheless, below is some information pertaining to recreational stocks/species that have size or possession limits that perhaps could help in the literature search.

The allocations of GOM cod and GOM haddock were based on numbers of fish caught by the rec and commercial fisheries over the time period used for the allocations (2001-2006). We used the numbers that came out of the assessment. For the recreational catch that includes A+B1, which does not include B2/discards. Commercial included both landings and discards.

The GOM cod and GOM haddock assessments, at present, assume that 100 percent of the B2 fish/discards survive. We have heard rec fishermen claim the assessment assumes they are all dead. This is false. For the commercial fishery all discards are assumed dead and we believe the same approach is used for GB cod.

The winter flounder assessments do not assume all commercial discards are dead. They apply a survivor rate of 50 percent, so only half the discards are assumed dead. This is based on one very weak mortality study done by one of the states years ago. Rec discards are assumed to have a discard mortality rate of 15%. Both of these rates are based on Howell et al.(1992). I am sorry I don’t have a more complete citation but it might be the following:

Howell P, Howe A, Gibson M, Ayvazian S (1992) Fishery management plan for inshore stocks of winter flounder *Pseudopleuronectes americanus*. . Atlantic States Marine Fisheries Commission, Fishery Management Report No. 21, Washington, D.C.

The recent pollock assessment assumed that all recreational discards are dead. This is not based on any empirical study. The assessment report says:

"A tagging study (Clay et al. 1989) estimated 16% total mortality from a hook fishery in a three-month period, 11% of which was attributed to tagging of fish. That study suggested that neither 100% mortality nor 100% survival would be an obviously justifiable assumption for recreational discard mortality of pollock. In the absence of more information, the working group chose to assume 100% mortality of discarded recreational catch (B2). This assumption is also consistent with the 100% discard mortality assumed for commercial discards. Furthermore, because recreational catch is a minor component of the total catch, assuming 100% mortality was not expected to contribute undue influence on model results."

A Groundfish Assessment Review Meeting (GARM) III working paper summarized mortality studies applicable to the groundfish stocks. It can be found at this link:

http://www.nefsc.noaa.gov/GARM-public/1.DataMeeting/B.3%20Disc_survival_GARM2008.pdf

The summary did not pick up on the Clay et al. 1989 about pollock. The full cite is:

Clay D, Stobo WT, Beck B, Hurley PCF. 1989. Growth of juvenile pollock (*Pollachius virens* L.) along the Atlantic coast with inferences of inshore-offshore movements. J Northwest Atl Fish Sci. 9: 37-43.

Wolffish – Although there are no studies of recreational catch and release mortality / survival of wolffish, the following study, which is cited in the Northeast Multispecies FMP - Amendment 16, provides valuable information on survival in the commercial fishery that probably can be extrapolated to recreationally-caught wolffish:

Grant, S.M., W. Hiscock, and P. Brett. 2005. Mitigation of capture and survival of wolffish captured incidentally in the Grand Bank yellowtail flounder otter trawl fishery. Centre for Sustainable Aquatic Resources, Marine Institute of Memorial University of Newfoundland, Canada. P-136, xii + 68p.

If you have any questions, please don't hesitate to contact me.
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