# Red Snapper Discard Mortality Review

The South Atlantic Fishery Management Council requested information on discard mortality of red snapper with information on the potential of descending devices decreasing discard mortality and the potential for compliance with regulations. There are five sections to the paper: Introduction; Recent Circle Hook, Descending Device, and Venting Studies Findings; Synopsis of Recent Red Snapper Studies and an excerpt from SEDAR 41 Discard Mortality Section; Pacific Fishery Management Council Rockfish Management with Descending Devices; and an Appendix with additional literature regarding barotrauma and recompression.

## Introduction

Several studies have been conducted to estimate discard mortality of red snapper in the Southeast region (Gulf of Mexico and South Atlantic). Most research has been completed in the Gulf of Mexico and estimates developed in the Gulf of Mexico might vary from the actual mortality rate in the South Atlantic region. This paper includes a description of recent work (2011-2016) to estimate red snapper discard mortality and the effects of hook type, descending device, and venting; an excerpt from SEDAR 41 Discard Mortality Section; and descending device related actions by the Pacific Fishery Management Council for rockfish. An updated table of discard mortality estimates from SEDAR 41 is provided, which includes red snapper studies from the Gulf of Mexico and South Atlantic from 1984 to 2016 (**Table 1**), depth related discard estimates (**Figure 1**), and discard mortality values used in stock assessments (**Table 2**).

## Do circle hooks reduce discard mortality of red snapper?

Two recent studies indicated that circle hooks decreased red snapper discard mortality (Sauls and Alaya 2012, Sauls et al. 2015) and two studies indicated circle hooks did not decrease discard mortality (Burns and Froeschke 2012, Campbell et al. 2012). Burns and Froeschke 2012 was based on tag return rate and included fish from the Gulf of Mexico and South Atlantic and found no difference in survivorship when comparing J hooks and circle hooks. Campbell et al. 2012 was a meta-analysis of previous research and concluded that the positive effect of circle hooks might have been masked by other factors included in the analysis. Sauls and Alaya 2012 was based on potentially lethal hooking injuries and observed fewer potentially lethal hooking injuries with circle hooks. Sauls et al. 2015 was based on hooking location on fish caught in the South Atlantic and conditioned mortality on tag return data from the Gulf of Mexico. There is an effort to combine tagging data from Burns and Froeschke 2012 and Sauls et al. 2015 to reanalyze the two tagging datasets to determine if there is a sufficient number tagged in the South Atlantic upon which to base any conclusions.

## Does venting or descending devices reduce discard mortality of red snapper?

Two recent red snapper discard mortality papers reported on the potential for using descending devices and venting to improve survivorship of released red snapper (Curtis et al. 2015, Drumhiller et al. 2014). Surface released fish (non-vented and not descended) were 3 times as likely to suffer mortality compared to descended fish and 1.9 times as likely to suffer mortality compared to vented fish (Curtis et al. 2015). The researchers also noted an effect of season on impacting discard mortality. Rapid recompression (descending device simulation) reduced discard mortality for fish with simulated capture from 30 and 60 meters (98 and 197 feet) (Drumhiller et al. 2014). The mortality for fish released at 30 meters decreased from 33% to 0% and for fish released at 60 meters decreased from 83% to 17% - 0%. There is an effort to combine tagging data from Burns and Froeschke 2012 and Sauls et al. 2015 to reanalyze the two tagging datasets to determine if there is a sufficient number tagged in the South Atlantic upon which to base any conclusions.

Diamond et al. 2011 indicated that recompression and venting did not significantly improve discard mortality rates although the study noted some issues with tag recovery and acoustic reception. Campbell et al. 2012 indicated that venting reduced the immediate discard mortality but venting increased the delayed discard mortality rates. The researchers indicated that descending devices might be the best option and venting might be a good second option to help the fish resubmerge although descending devices were not included in their analysis.

## Short descriptions of papers since 2011 that discuss discard mortality of red snapper in chronological order.

Diamond et al. 2011 conducted a study in the Gulf of Mexico to determine the effectiveness of descending devices to reduce red snapper discard mortality using mark-recapture and acoustic tagging. The number of red snapper tag returns was low (n=58, 4.8%) and factors that significantly affected discard mortality included depth, total length, year, and year*total length interaction. A significant effect on release mortality for season and release treatment (fish released at the surface, vented, or recompressed) was not detected. Predation was noted for 3% of the surface released fish with the potential for higher unseen predation events. For the passive acoustic tracked fish, the control treatment survived best of all treatments in summer and winter. Recompressed (descending device) red snapper survived better than non-vented surface released fish in the summer. Non-vented surface released fish survived better in the winter. The authors stated the findings were hampered by low tag returns and the acoustic tagging had issues collecting acoustic data.

Burns and Froeschke 2012 conducted a mark-recapture study in the Gulf of Mexico and South Atlantic to determine the effectiveness of circle hooks to reduce discard mortality for red snapper. Immediate mortality was observed for 13.6% of red snapper captured. Damage from J hooks accounted for 49.1% of the immediate mortality (mortality during capture and through release of fish). Recapture of tagged red snapper originally caught on circle hooks was less than recapture rate of tagged red snapper originally caught on J hooks. The authors concluded that the feeding behavior of red snapper (biting as opposed to suction feeding like groupers) caused circle hooks to be less effective at decreasing discard mortality.

Campbell et al. 2012 conducted a meta-analysis of 11 studies conducted in the Gulf of Mexico and used in SEDAR 31 to estimate discard mortality for red snapper. The meta-analysis developed discard mortality values for depths from 10 to 95 meters (33 to 312 feet) every 5 meters (16 feet). The authors investigated the impact of depth, study type (tagging, hyperbaric chamber, surface release, or caging), timing (immediate or delayed mortality), season, fishing sector, hook type, venting treatment, and sample size. The authors used a weighted general linear model to estimate the effects of each of the factors. Depth, fishing sector, timing*venting interaction, winter, and spring were found to affect red snapper discard mortality. Discard mortality increased with depth. The commercial sector had a higher discard mortality rate than the recreational sector. Vented fish had the lowest immediate discard mortality rate. However, vented fish had a higher delayed discard mortality rate than non-vented fish. Spring and winter released fish had a lower discard mortality rate compared to an annual estimate and estimates from summer and fall. The study did note that circle hooks did not have a significant effect on discard mortality but mentioned that fishing sector, study type, and season might have masked the effect of hook type. Unfortunately, the study did not include information on rapid recompression (descending device).

Sauls and Alaya 2012 conducted a study to determine the effectiveness of the circle hook requirement in the Gulf of Mexico. In the study, they compared the rate of potentially lethal hooking injuries with circle hooks compared to other hooks based on observation of hooking location (mouth, gut, eye, etc.). Potentially lethal hooking injuries diminished from 17.1% with J hooks to 6.3% with circle hooks.

Drumhiller et al. 2014 focused on assessing impact of decompression and effectiveness of venting and rapid recompression in a laboratory setting. They tested the effects of venting and recompression by simulating capture from 0, 30, and 60 meters (0, 98, and 197 feet) in compression chambers. For fish released at the surface, vented fish survival rate was 100% when decompressed from 30 and 60 meters. Non-vented fish survival rate was 67% when decompressed from 30 meters and 17% at 60 meters. For fish that were rapidly recompressed, fish not vented upon release and rapidly recompressed to 60 meters had a survival rate of 83%. All fish decompressed from 30 meters and rapidly recompressed or rapidly recompressed and vented had 100% survival. The survival rate was also 100% for fish decompressed from 60 meters, vented and rapidly recompressed or vented only.

Sauls et al. 2015 developed a working paper for SEDAR 41 to estimate potential lethal hooking injuries based on hook type using methods from Sauls et al. (2012) and estimate discard mortality using a mark-recapture technique using methods from Sauls (2014). Non-offset, circle hooks had the lowest percent of potentially lethal hooking injuries (4.5%). Offset circles hooks had 7.16% potentially lethal hooking injuries, non-offset J hooks had 10.19%, and offset J hooks had 18.62%. Based on the mark-recapture part of the study, the discard mortality estimates for the headboat and charter boat components were 29.2% and 28.2%, respectively. Discard mortality rates for types of hooks, venting and/or use of descending device was not calculated.

Curtis et al. 2015 focused on discard and delayed mortality associated with barotrauma and set up the study to avoid effects of hooking and surface predation. Only fish that were mouth hooked were included in the analysis and fish that were moribund or died on deck were excluded. Surfaced released fish were released in a bottomless cage to prevent predation. Immediate surface mortalities were included in the analyses. They noted the impact of season and release type (surface released, vented, and recompressed). Surface released fish (non-vented and not descended) were 3 times as likely to suffer mortality compared to descended fish and 1.9 times as likely to suffer mortality compared to vented fish. The overall (untreated, vented, and descended) survival rate was 85% immediate and 72% total survival (includes immediate + delayed mortality).

## Excerpt from SEDAR 41 Discussion on Discard Mortality

<u>*Consideration of Depth Effects*</u>
*Several studies have focused on depth as an important factor in determining discard mortality due to the visible impact of barotrauma. Studies conducted in depth of less than 35 meters (115 feet) estimated discard mortality rates of 20% or less (Parker 1985, Render and Wilson 1994, Patterson et al. 2002, Burns et al. 2006). Studies conducted in greater than 35 meters generally estimated higher discard mortality rates ranging from 17% to 93% (Gitschlag and Renaud 1994, Burns et al. 2004, Nieland et al. 2007, Burns 2009, Diamond and Campbell 2009, Stephen and Harris 2009). This increase in discard mortality rate with increasing depth is an expected result and has been described for Red Snapper and other snapper grouper species (Patterson et al. 2001, Burns et al. 2002, Patterson et al. 2002, Rudershausen et al. 2007, Stephen and Harris 2009).*

*To account for increasing discard mortality rate with increasing depth, three models were reviewed in SEDAR 24. Two of the models (Burns et al. 2002, Diamond et al. unpublished data) used a logistic regression function to model the mortality rate (Figure 2.2) and one used a linear trend (Nieland et al. 2007). All three of the models had overlap in the estimation of discard mortality particularly between 50 and 90 meters (see SEDAR 24 DW 12 reference for plots). The linear model had a higher discard mortality rate for Red Snapper caught in depths less than 40 meters than the other two studies (Nieland et al. 2007), likely due to commercial fishing practices observed in the GoM. These fishermen were fishing bandit fishing reels with terminal gear consisting of 20 hooks spread over 4.5 to 6 meters (S. Baker, Jr, personal communication). Typical recreational fishermen in the South Atlantic and GoM as well as commercial fishermen in the South Atlantic fish for snapper/grouper species with terminal gear having less than 5 hooks (Gulf and South Atlantic Fisheries Foundation 2008). The other two models describing discard mortality also included delayed discard mortality in their discard mortality estimate. Koenig (Burns et al. 2002) used a cage study to determine the effects of depth on Red Snapper. Additionally, Red Snapper and gag grouper data were combined in the model since there was no significant difference in the percent mortality at depth. The Diamond et al. (unpublished) combined data from several different studies including the Burns et al. (2002) and Nieland et al. (2007). The discard mortality curves from these two studies were similar with less than 20% discard mortality for fish caught in less than 20 meters increasing to 100% mortality for fish caught in greater than 90 meters.*

*Consideration of Hook Effects*

*Hooking related injuries are also important when trying to determine discard mortality (Rummer 2007, Burns et al. 2008). Necropsy results from headboat caught fish showed Red Snapper suffered greatest from acute hook trauma (49.1%), almost equaling all other sources of Red Snapper mortality combined in the headboat fishery in waters less than 42 meters (50.9%, Burns et al. 2008). These hook related injuries caused both immediate and delayed mortality in Red Snapper. The delayed mortality was a result of the hook nicking an internal organ, causing the fish to slowly bleed internally eventually leading to death after a few days (Burns et al. 2004). Circle hooks are generally thought to reduce the discard mortality rate for Red Snapper (SEDAR 7; Rummer 2007); however, Burns et al. (2004) did not observe decreased discard mortality rate when comparing recapture rates of Red Snapper caught on circle and j-hooks. Recent work by Sauls et al. indicated that circle hooks reduced discard mortality for Red Snapper and SEDAR 31 used a discount for regulations that were established in 2008 for the GoM (circle hooks, dehooking devices, and venting). In SEDAR 31, it was stated that the requirement to vent was not quantifiable, but it was included in their model (SEDAR 31).*

*Consideration of Additional Factors*

*Additional factors that influence discard mortality rate, such as size of the fish, temperature, and predation, have been considered for Red Snapper but currently data are too limited to include these parameters in a quantifiable estimation of discard mortality. Temperature has been noted in some studies as a significant factor determining discard mortality rate for Red Snapper (Render and Wilson 1994, Rummer 2007, Diamond and Campbell 2009). In these studies, the discard mortality rate increased with increasing temperature. More importantly, both Rummer (2007) and Diamond and Campbell (2009) found the temperature differential between surface and bottom water was more important in determining the discard mortality rate than water temperature alone. A greater differential between the surface and bottom temperature resulted in a higher discard mortality rate.*

*Red Snapper are preyed upon by several different species including barracuda, sharks, and amberjack (Parker 1985). Dolphins have been listed as a predator in the GoM but this behavior has not been observed in the South Atlantic. In the South Atlantic, the predators of Red Snapper are generally present during months when water temperatures are warmer (personal communication with commercial fishermen).*

*Descending Devices*

*Descending devices were mentioned as a potential tool to reduce discard mortality. One fisherman brought in his homemade descending device which he started using in 2014. Currently, the change in discard mortality rate due to descending devices is unknown. There is some research being conducted to determine if descending devices reduce discard mortality. The fishermen pointed* *out that very few people are using descending devices. Descending devices were not considered for the discard mortality rate.*

## Usage of Descending Devices by Pacific Fishery Management Council

Descending devices were known to reduce discard mortality of rockfish on the Pacific coast. The Pacific Fishery Management Council (PFMC) discussed usage of descending devices to reduce the number of takes of cowcod and yelloweye rockfish, which were considered choke species at the time. Recommendations were developed by the Groundfish Management Team and provided to the SSC. The SSC provided values to the Council for use in management. The Council slightly modified the discard mortality based on depth and requested information on descending device usage be collected before the changes in discard mortality rate would be applied. Links are provided below regarding descending devices and management by PFMC.

First motion to consider use of values

http://www.pcouncil.org/wp-content/uploads/D2e_SUP_AMENDED_MIW_JUN2012BB.pdf

Approved use of values

http://www.pcouncil.org/wp-content/uploads/0413decisions.pdf

Minutes of the meeting (pg 29)

http://www.pcouncil.org/wp-content/uploads/FINAL_April_2013_Minutes.pdf

Motion 10 approves usage of values. Note they wanted values on usage rates.

http://www.pcouncil.org/wp-content/uploads/FINAL_April_2013_Voting_Log.pdf

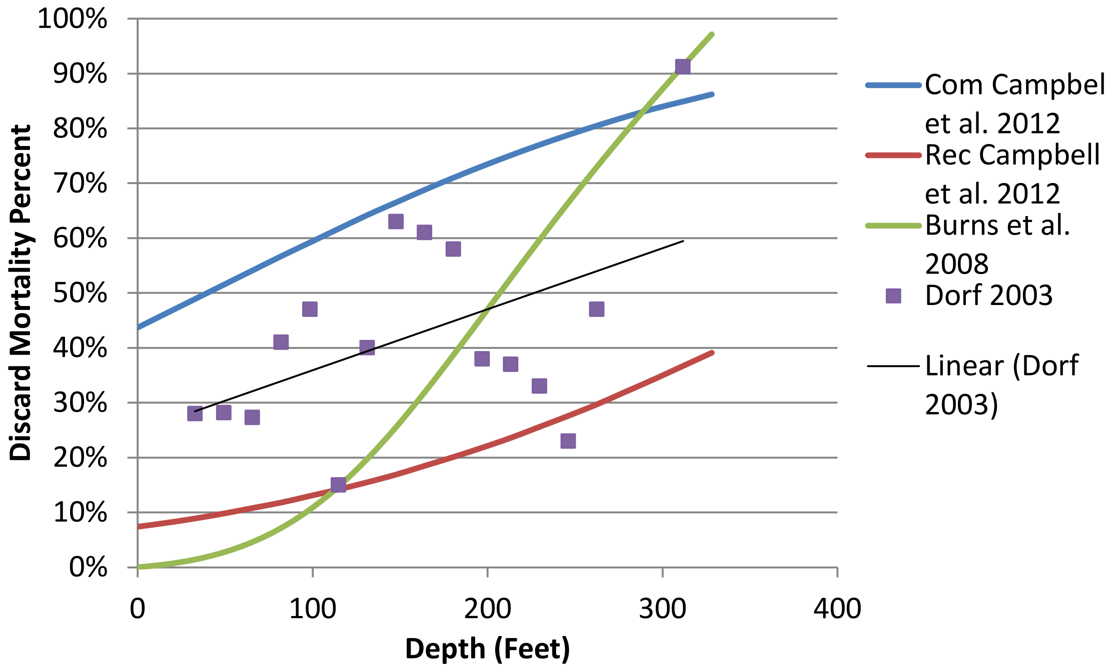


**Figure 1**. Depth related discard mortality estimates from Dorf 2002, Burns et al. 2008, and Campbell et al. 2012.

**Table 1**. Red snapper discard mortality studies, fishing sector, type of study, gear used in study, sample size (N), depth range of the study, and mortality type reported. Type of study laboratory (L), surface observation (S), cage study (C), metadata (M), and tagging study (T) are shown. Gears include hook and line gears and bandit reels. Mortality rates were separated into surface mortality, delayed mortality, and total mortality (Updated from SEDAR 41).

| | | | | | | | Depth Range | | Mortality Type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Research Documents | Year | Sector | Area | Type | Gear | N | Meters (range) | Feet | Surface | Delayed | Total |
| Parker | 1985 | | GOM/SA | L S C | H&L | 44 | 30 | 98 | | 11-12% | |
| Parker | 1991 | | GOM/SA | Lit | | | 21-40 | 69-131 | 64-100% | | |
| Gitschlag and Renaud* | 1994 | Rec | GOM | C | H&L | 55 | 50 | 164 | | 36% | |
| Gitschlag and Renaud* | 1994 | Rec | GOM | S | H&L | 232 | 21-40 | 69-131 | 1-44% | | |
| Render and Wilson | 1996 | Rec | GOM | C | H&L | 282 | 21 | 69 | | 20% | |
| Patterson et al. | 2001 | Rec | GOM | T S | H&L | 2,232 | 21-32 | 69-105 | 14% | | |
| Burns et al. | 2004 | Rec | GOM/SA | L S C | H&L | | 0-61.3+ | 0-201 | | | 64% |
| Rummer and Bennett | 2005 | | GOM | L | | | 0-110 | 0- 361 | | | 25-90% |
| Burns et al. | 2006 | Rec | GOM/SA | T S | H&L | 590 | 0-30.8+ | 0-101 | 12% | | |
| Nieland et al. | 2007 | Com | GOM | S | Bandit | 2,900 | 43 (9-83) | 141 | 69% | | |
| Burns | 2009 | Rec | GOM/SA | L T S | H&L | 1,259 | 10.4-42.7 | 34-140 | 13.60% | 57% | |
| Diamond and Campbell | 2009 | Rec | GOM | C | H&L | 320 | 30, 40, 50 | 98, 131, 164 | 17% | 64% | |
| Stephen and Harris | 2009 | Com | SA | S | Bandit | 67 | 50-70 (20-300) | 164-230 | 93% | | |
| Diamond et al. | 2011 | Both | GOM | T | H&L | 58/40 | | | | | |
| Burns and Froeschke | 2012 | Rec | GOM/SA | S T | H&L | | 0-43 | 0-140 | 13.6% | 29% | |
| Sauls and Ayala | 2012 | Rec | GOM | M | H&L | 8,038 | | | | | 4.5-18.6%* |
| Drumhiller et al. | 2014 | | GOM | L | H&L | 67 | 0, 30 ,60 | 0, 98, 187 | | | 0-83% |
| Sauls et al. | 2015 | Rec | SA | S T | H&L | 2,450 | | | | | 28.2-29.2% |
| Curtis et al. | 2015 | Rec | GOM | T | H&L | 111 | 30, 50 | 98, 164 | 15% | 13% | 28% |

*Indicates potentially lethal hooking injuries.

Table 2. Red snapper discard mortality rates used in stock assessments. Time varying refers to different estimates used for different regulation periods.

| Assessment | Year | Sector | Area | Time Varying | Estimate |
|---|---|---|---|---|---|
| Manooch et al. | 1998 | Both | SA | | 10-25% |
| SEDAR 7 | 2005 | Com | GOM | | 71-88% |
| SEDAR 7 | 2005 | Rec | GOM | | 15-40% |
| SEDAR 15 | 2009 | Com | SA | | 90% |
| SEDAR 15 | 2009 | Rec | SA | | 40% |
| SEDAR 24 | 2010 | Com | SA | | 48% |
| SEDAR 24 | 2010 | Rec | SA | | 39% Private Rec/ 41% For-Hire |
| SEDAR 31 | 2013 | Com | GOM | Yes | 55-91% |
| SEDAR 31 | 2013 | Rec | GOM | Yes | 10-22% |
| SEDAR 31 Update | 2014 | | GOM | Yes | Same As SEDAR 31 |
| SEDAR 41 | 2016 | Com | SA | Yes | 39% |
| SEDAR 41 | 2016 | Rec | SA | Yes | 28.50% |

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## Appendix 1. Results of a Literature Review on Barotrauma and Descending Devices conducted by Melanie Sciochetti requested by Lora Clarke with The Pew Charitable Trusts.

| Author(s) | Year | Article Title | Species | Study Conclusion |
|---|---|---|---|---|
| Blain | 2014 | The Effects of Barotrauma and Deepwater-Release Mechanisms on the Reproductive Viability of Yelloweye Rockfish in Prince William Sound, Alaska | Yelloweye Rockfish | Forced decompression and recompression did not affect spawning 1 or 2 years following event. |
| Brown et al. | 2010 | An Improved Technique for Estimating Short-Term Survival of Released Line-Caught Fish, and an Application Comparing Barotrauma-Relief Methods in Red Emperor (Lutjanus Sebae Cuvier 1816). | Red Emperor | There was no benefit of venting and recompression for fairly resilient species. |
| Brownscombe et al. | 2017 | Best Practices for Catch-and-Release Recreational Fisheries – Angling Tools and Tactics | Review Paper | Use proper equipment for released fish, have a good educational program, and venting and recompression have been beneficial for some species. |
| Burns and Froeschke | 2012 | Survival of red grouper (*Epinephalus morio*) and red snapper (*Lutjanus campechanus*) caught on J-hooks and circle hooks in the Florida recreational and recreational-for-hire fisheries | Red Snapper | Circle hooks did not significantly reduce dead discards of red snapper. |
| Butcher et al. | 2013 | Physical Damage, Behaviour and Post-Release Mortality of Argyrosomus Japonicus after Barotrauma and Treatment | | Fish suffering from barotrauma stayed at shallower depths and more research was needed to estimate benefits of descending and venting. |

| Author(s) | Year | Article Title | Species | Study Conclusion |
|---|---|---|---|---|
| Campbell et al. | 2012 | Release Mortality in the Red Snapper (Lutjanus Campechanus) Fishery: A Meta-Analysis of 3 Decades of Research | Red Snapper | Several factors influenced discard mortality. The authors indicated recompression would likely increase survivorship and venting was likely better than no treatment. |
| Curtis et al. | 2015 | Quantifying Delayed Mortality from Barotrauma Impairment in Discarded Red Snapper Using Acoustic Telemetry | Red Snapper | Venting and descending increase survival of discarded red snapper. |
| Diamond et al. | 2011 | Reducing Discard Mortality of Red Snapper in the Recreational Fisheries Using Descender Hooks and Rapid Recompression | Red Snapper | Different methods of release may be appropriate under different temperature and predator conditions. |
| Drumhiller et al. | 2014 | Venting or Rapid Recompression Increase Survival and Improve Recovery of Red Snapper with Barotrauma | Red Snapper | Venting and recompression increase survivorship of decompressed red snapper |
| Hall et al. | 2014 | Clinical Signs of Barotrauma in Golden Perch, Macquaria Ambigua (Richardson), and Associated Effects on Post-Release Mortality and Health | Golden Perch | Recompressed fish survived better than surface released fish and vented fish. |
| Jarvis et al. | 2008 | The Effects of Barotrauma on the Catch-and-Release Survival of Southern California Nearshore and Shelf Rockfish (Scorpaenidae, Sebastes Spp.) | Rockfish (Sebastes) | Rapid recompression significantly reduced discard mortality |
| Mclennan et al. | 2014 | Surviving the Effects of Barotrauma: Assessing Treatment Options and a ‘Natural’ remedy to Enhance the Release Survival of Line Caught Pink Snapper (Pagrus Auratus) | Pink Snapper (Pagrus auratus) | Stomach and side venting did not have a significant difference in mortality for pink snapper. |

| Author(s) | Year | Article Title | Species | Study Conclusion |
|---|---|---|---|---|
| Pribyl | 2010 | A Macroscopic to Microscopic Study of the Effects of Barotrauma and the Potential for Long-Term Survival in Pacific Rockfish | Rockfish (Sebastes) | Recompressed rockfish have a better chance of survival than non-recompressed fish but were observed to have behavioral changes. |
| Roach et al. | 2011 | Effects of Barotrauma and Mitigation Methods on Released Australian Bass Macquaria Novemaculeata | Austrailian Bass | Fish should be released immediately with no treatment. If the fish cannot swim down, then recompress it. Fish held in live wells should be vented and released. |
| Ferter et al. | 2015 | Dive to Survive: Effects of Capture Depth on Barotrauma and Post-Release Survival of Atlantic Cod (Gadus Morhua) in Recreational Fisheries | Atlantic Cod | Forced recompression may increase survival of floating released fish. Most fish swam down post release (98%). |
| Hannah et al. | 2012 | Use of a Novel Cage System to Measure Postrecompression Survival of Northeast Pacific Rockfish | Rockfish (Sebastes) | Recompression devices help to increase survival of some rockfish species. |
| Hannah et al. | 2014 | The Divergent Effect of Capture Depth and Associated Barotrauma on Post-Recompression Survival of Canary (Sebastes Pinniger) and Yelloweye Rockfish (S. Ruberrimus) | Rockfish (Sebastes) | Depth significantly decreased survival for canary rockfish when released after being released from surface holding pen, but there was no effect for yelloweye rockfish. |
| Hochhalter and Reed | 2011 | The Effectiveness of Deepwater Release at Improving the Survival of Discarded Yelloweye Rockfish | Yelloweye Rockfish | Deepwater releases significantly increases survivorship of yelloweye rockfish. |

| Author(s) | Year | Article Title | Species | Study Conclusion |
|---|---|---|---|---|
| Pulver | 2017 | Sink or Swim? Factors Affecting Immediate Discard Mortality for the Gulf of Mexico Commercial Reef Fish Fishery | Snapper Grouper Species | Venting decreased immediate mortality for most species. |
| Rankin et al. | 2017 | Delayed Effects of Capture-Induced Barotrauma on Physical Condition and Behavioral Competency of Recompressed Yelloweye Rockfish, Sebastes Ruberrimus | Yelloweye Rockfish | Recompressed rockfish had orientation and visual problems post release. |
| Rogers et al. | 2011 | Recovery of Visual Performance in Rosy Rockfish (Sebastes Rosaceus) Following Exophthalmia Resulting from Barotrauma | Rosy Rockfish | Recompression helps to increase survivorship and visual performance of discarded rockfish compared to no treatment. |

| Informational Websites | Title |
|---|---|
| http://www.afsc.noaa.gov/quarterly/jfm2013/divrptsABL2.htm. | **Recompression Experiments on Rougheye Rockfish with Barotrauma** |
| http://www.fisheries.noaa.gov/stories/2014/06/06_13_14recompression_devices_video.html | **Recompression Devices: Helping Anglers Fish Smarter** |
| http://www.npr.org/templates/story/story.php?storyId=374187614 | **How Anglers Are Learning to Save Fish That Get 'the Bends', National Public Radio, Inc. (NPR).** |