Testing of a Sea Scallop Dredge Dual Mesh Size Twine Top For Bycatch Reduction

A Proposal Prepared for the 2009 Sea Scallop Research Set-Aside

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Project Summary

This project will focus on testing a dual mesh twine top design to further decrease fish and skate bycatch. The twine top will have three rows of 6-inch mesh at the aft end where scallop losses have been shown to occur. The remaining forward section of the twine top, where fish attempt escape, will be 12-inch mesh. The twine top will be hung with a low hanging ratio of one: one 12-inch mesh to each 4-inch skirt ring. The design changes will be tested on the new turtle excluder dredge frame but will be applicable to the standard New Bedford dredge as well. The primary testing will take place on Georges Bank, in areas of high yellowtail bycatch, and the mid-Atlantic, in areas of high summer flounder bycatch. Five commercial vessels will each make one trip of seven DAS comparing two identical turtle excluder dredge frames; one with a standard bag and twine top and the other with the experimental twine top. All catch will be measured and then returned to the sea. In addition, electronic tracking tags will be placed on yellowtail flounder bycatch as part of a proposed RSA project to be submitted by Rutgers University if approved.

Research Priority Addressed:

4. Identification and evaluation of methods to reduce groundfish and summer flounder bycatch.

Project Goals and Objectives

- To test the impact on scallop catch of a dual mesh size twine top design that will reduce the bycatch rate of non-target species including yellowtail flounder, summer flounder, other flatfish species, and skates.

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Project Management

Ronald Smolowitz, Matt Weeks	Project management, data analysis, reporting
Bill Dupaul, Dave Rudders	Field testing and biological analyses
Ronnie Enoksen, Peter Anthony	Dredge and scallop bag construction
Tor and Hans Bendiksen	Twine top construction

All the participants will work closely with each other on all aspects of the project; the purpose of the above list is to indicate the key roles of the participants.

Project Duration March 1, 2009 to February 28, 2011

Background

Bycatch of yellowtail flounder in the scallop fishery is governed by a hard TAC when fishing occurs in the scallop special access areas on Georges Bank. On a number of occasions the bycatch TAC has been taken before the scallop TAC and the areas have been closed resulting in the loss of tens of millions of dollars in revenue to the fishery. As more fisheries are managed with hard TACs similar problems will arise with summer flounder, winter flounder, and skates throughout the range of the fishery.

Coonamessett Farm research efforts to date have demonstrated that the use of a 10-inch mesh twine top can reduce the catch of flatfish, on average, by about 50-60% compared to the historical standard 6-inch twine top (Smolowitz et al, 2001, 2002, 2004). This reduction can be accompanied by a 10-20% reduction in scallop catch. The loss of scallops results in the need for increased bottom time which mitigates some of the bycatch reduction benefits and other benefits possibly associated with decreases in bottom time. The loss of scallops and bycatch through the 4-inch rings and 10-inch twine top has a lot to do with weather conditions as well as the length frequency distribution of the catch. Our video work has shown the loss of larger scallops occurs through the aft end of the twine top just forward of the sweep during tows and haulback.

SER Enterprises of New Bedford, with Coonamessett Farm and MIT Sea Grant, received an S-K Grant in 1994 to develop and demonstrate techniques to eliminate or reduce the by-catch of fish in the New Bedford style scallop dredge. Several dredge modifications were field tested to determine their impact on scallop and fish catch. This initial work demonstrated that an 8-inch square mesh twine top can significantly reduce the catch of flatfish and cod without reducing the catch of commercial size scallops when catch rates are low. Ten inch mesh twine tops were shown to reduce the bycatch further but with a loss of scallop catch (Henriksen et al, 1997).

Coonamessett Farm, and its industry and academic partners, have continued research into means to further reduce bycatch. Funding mechanisms have included scallop TAC Research Set Aside (RSA) and Exempted Fishing Permits (EFP's). These projects lead to the development of a new scallop dredge frame design concept that allows for a sweep to be located across the entire width of the dredge in front of the cutting bar. Preliminary trials, on two TAC set aside collection trips (F/V Generation and F/V Westport) indicated the new dredge caught between ten and twenty percent more scallops. When rigged with a fish sweep the catch has thirty to forty percent less flatfish and skates than a conventional dredge rigged with a 10-inch twine top, but scallop catches were also reduced. This dredge design works by forcing the fish up off the bottom in front of the frame. The reductions have occurred because some of these fish then swim over the dredge. One major problem was that the fish sweep testing showed highly variable results.

Modifications to the scallop dredge twine top were tested during the 1998 industry survey of the Georges Bank CAII (Dupaul et al 1999). The results of the experiments indicated that there were no differences in finfish bycatch when 8 inch diamond and 8 inch square mesh twine tops were compared. However, there were significant differences in finfish bycatch when a 12 inch square mesh was used but the loss of scallops greater than 70 mm (23 %) was considered unacceptable.

During July and August 2002 the F/V Westport and F/V Nordic Pride conducted four research trips to closed and opened areas of Georges Bank. A total of 311 paired tows were made to test the new scallop dredge frame, 10-inch twine tops, and the use of fish sweeps and excluder rings. The project demonstrated that 10-inch twine tops, when compared to 6-inch twine tops, reduced yellowtail flounder bycatches by 34-84% with an overall weighted average of 59%. The largest reductions of bycatch were also accompanied by a 51% loss of scallop catch. The tests also demonstrated that the fish sweep was effective in reducing bycatch by about 42%. The impacts of the various reduction strategies (twine top mesh size, dredge frame design, fish sweep, excluder rings) have proven not to be cumulative but are in fact interactive. Again, results were highly variable.

What became apparent by the end of the tests is that the most important parameters are associated with mesh size and how the twine top is hung. Changing the width and length of the twine top alters both scallop and flatfish retention. When we decrease the number of meshes in the width of the twine top we allow more scallops and fish to escape. However, regardless of the number of meshes, if the twine top is installed so that it is under high tension, resulting from too many meshes being removed, escapement does not occur. The length of the twine top is also very important for scallop retention; key factors being the twine top location relative to the sweep chain and the tension in the meshes. Fishermen rig their gear so that the twine top ends just above the center of the sweep. We hypothesize that if the twine top ends further aft more scallops are lost by going out through the meshes, and that if it ends further forward, the dredge opening is closed down, forcing scallops under the sweep reducing catch as well.

A review of all our experimental data collected through 2002 indicated high variability in the results due to many factors beyond dredge rigging. These factors include area fished, scallop and bycatch length frequency, scallop and bycatch density, tow direction, and weather. Weather is extremely complicating because it alters in multiple ways how the gear is handled. Rough weather conditions cause more fish and scallops to wash out of the dredge but at rates that are different depending on which side of the vessel the dredge is being fished. The weather dictates the tow direction and prohibits switching the dredges between sides hence risking an experimental bias.

During October 2003, the F/V Westport and F/V Kathy Marie completed 253 tow pairs to the same areas as in 2002 described previously. The primary objective was to understand the factors that were causing the variability in the previous test results by holding as many parameters as possible constant. Briefly, the two vessels participating in the experiment used the same dredge frame on both sides, used identical 10-inch twine tops rigged identically on the experimental side, had the same rigging for the control dredge, fished the same test areas as the previous year, and kept towing speed constant (though each vessel towed at a different speed). The effects of scallop length frequency distribution and weather were apparent and were statistically analyzed. In an area with very large scallops, there was no scallop loss between a 6-inch and a 10-inch twine top while flatfish catches were reduced by about 50%. In areas of smaller scallops there was about a 20% loss of scallops with about a 70% loss of flatfish. A test of blocking the last few rows of the 10-inch twine top found that the scallop loss was reduced substantially but there was still considerable escapement of fish. This, in combination with our video work, leads us to believe that a dual mesh twine top may be very advantageous to achieving the goal of scallop retention and fish escapement.

In 2005 Coonamessett Farm received RSA funds to develop a new turtle excluder dredge incorporating improvements to the design that in all likelihood will reduce sea turtle injury and mortality. We submitted a 2006 RSA proposal to continue to design and test this new dredge frame concept that would be lighter, structurally stronger, and designed to reduce the capture and retention of sea turtles, skates and flatfish species. The 2006 RSA project utilized tow tank testing for cutting bar hydrodynamics and computer modeling for frame component design. Besides reducing bycatch of yellowtail (50% reduction) and summer flounder (30% reduction), the new turtle excluder dredge has been shown to reduce threat of injury to sea turtles, maintain scallop catches and hold up to the rigors of fishing (Smolowitz and Weeks, 2008; Milliken et al, 2007)). A 2007 RSA project continued the field testing of this dredge. Preliminary results from these recent field tests indicate that larger twine top meshes may further reduce the bycatch rates of skates and summer flounder if we can also reduce the loss of scallops. These RSA projects are a continuation of efforts started in 1994 that have successfully decreased the bycatch of key bycatch species of concern. This proposal will be a continuation of the program by testing a dual mesh size twine top design for the turtle excluder dredge. The twine top design will be also available for use on the existing standard New Bedford dredges.

A recent study on the effect of scallop dredge twine top hanging ratios (Milleville 2008) found a significant reduction of finfish bycatch when a 60 mesh twine top was compared to a 90 mesh twine top (1.76 vs 2.64 hanging ratio). The reduction in finfish bycatch remained positive when considering varying degrees of scallop catches but this may not be the case when bycatch species are more abundant and scallops are less abundant. The results of this study indicate that standardizing the hanging ratio of the twine top at 2 could be an effective counter to hanging ratios of 3 or higher for the reduction of finfish bycatch. However, there are many ways a fisherman can alter his gear to negate the impacts of various hanging ratios. In the same series of experiments, it was found that short twine tops where the sweep chain was located forward of the bottom meshes of the twine top had a significantly greater catch of finfish as opposed to larger twine tops where the sweep was located behind the bottom meshes.

A gear solution to the problem of bycatch interactions with scallop dredges has significant beneficial economic consequences to the individuals that make up the scallop industry. The only regulatory alternative to gear modifications is seasonal area closures. A gear solution would allow optimum utilization of the scallop resource and the associated profitability.

Statement of Work

Ron Smolowitz will design and specify the dual mesh twine top and turtle excluder dredge scallop bag. Tor and Hans Bendiksen will construct the dual mesh twine top and Ronnie Enoksen will oversee the construction of the scallop bags. Coonamessett Farm and VIMS participants will conduct the field trials and analyze the resulting data.

There will be two types of trips during this project; directed research with no retained catch and compensation trips. On all trips the turtle excluder and standard dredges will conform to all existing regulations, with the exception of the small mesh portion of the twine top. On the directed research trips we will compare two identical turtle excluder dredge frames rigged with identical bags (with the exception of the twine tops), chains, and club sticks. To insure that the bags are identical, ten identical bags will be constructed for the project. The

10-inch standard twine top will be hung with the same hanging ratio as the experimental dual mesh twine top in the first experiment (one mesh to one skirt ring). Three trips will fish in the scallop special access areas within groundfish CAI and/or CAII. These areas have the highest ratios of bycatch to scallop catch for yellowtail (CAII), skates (CAI & CAII), winter flounder (CAI) and summer flounder (CAI).

Two trips will be fished in the mid-Atlantic special access areas when summer flounder are know to be abundant (late fall and early spring). In November we expect summer flounder to be in the Delmarva Scallop Access Area and Open Areas south and west of Shinnecock NY in the shoal water as they begin to move off (16-20 fathoms). In December, summer flounder should be in all Areas (Open,HCCA,ETAA,Delmarva) This is best time for fluke to be on the traditional scallop grounds(20-35 fathoms). In January the fluke will be in All Areas (Open,HCCA,ETAA,Delmarva) along the deep curve (35-45 fathoms). Two dredges will be towed simultaneously during all five trips. Towing speeds will be maintained at 4.5 knots and wire scope will be three to one.

On all directed research trip tows the entire scallop catch will be counted in bushel baskets and a one basket sub-sample measured in 5 mm increments. A one bushel sample has been found to accurately represent the size of the scallops in a commercial catch (4-inch ring dredge bag) based on our previous research. The fish catch will be counted and measured, in one cm increments, by species. **All scallops and fish will be returned to the sea.** We will accomplish a minimum of 80 fully documented tow pairs per trip. For each area a standard tow time will be chosen based on catch rates. Particular attention will be paid to minimize variability between tows on any given trip. We may consider testing 30 minute versus 60 minute tow times (alternating tow times) to document the impact of tow time on bycatch rates. A sub-sample of yellowtail flounder will receive electronic tracking tags if a proposed RSA project by Rutgers University is approved. Those fish will be tracked by a second vessel to determine post-discard survival and recapture.

Data from this project will be analyzed to determine differences in catch rates between dredges of target and non-target species and any differences in size selectivity of the target and non-target catch. A paired t-test at the alpha=0.05 level will be used to test for significance in catches between the standard control and experimental dredge. Multivariate problems will inevitably exist due to weather and geographic variability but the experimental design of this project limits the variance between gears by pairing tows and using newly constructed gear. We also plan to switch gear between sides at least once per trip. In addition to the paired t-test, other non-parametric statistical tests could be performed to avoid assumptions such as homogeneous distribution of the resource.

We propose three compensation trips to the ETA and two compensation trips to the Delmarva areas as soon as authorized during the summer/fall season. We are seeking an EFP to allow those trips to test the experimental twine top, but in a different manner. There will be two dredges onboard; one turtle excluder dredge and one standard dredge, and both will have the new twine top if allowed. The dredges will be fished without turtle chains **under an existing NMFS turtle permit** and data collected by an onboard observer funded by an **existing NMFS NEFSC contract.** Two additional compensation trips are proposed for the CAII and will be conducted in a manner similar to the CAI/CAII research trips except the catch will be retained for sale. These vessels will be required to complete 60 tow pairs per trip. This is accomplished by moving off the high density scallop concentrations that occur in the scallop access areas.

This is about 20 tows more than would normally be required to collect the compensation limit of scallops. The primary purpose of these comparisons is to examine the effectiveness of the new dredge in reducing sea turtle interactions. The 60 tows achieved each trip is part of a much larger data collection effort trying to achieve 5000 tow pairs over time. Another important aspect of the compensation trips is to have the Captain's adjust the dredge bag attached to the turtle excluder dredge frame to optimize its fishing characteristics before conducting the research trips.

A final report will be submitted upon completion of the project. Ronald Smolowitz is the Technical Advisor to the Fisheries Survival Fund (FSF), the primary industry organization for the vast majority of the limited access sea scallop fleet. The results of this project will be disseminated to all members of the FSF. Ronnie Enoksen is the leading dredge builder in New Bedford and we expect that improvements in dredge design will be utilized by his shop and others will follow. Tor and Hans Bendiksen are the leading twine top builders in the New Bedford area and will similarly apply successful results. An article will be prepared for Commercial Fisheries News and a publication will be prepared for the peer reviewed literature as results warrant.

After consideration of the scope of work for the proposed project, we believe that a waiver of twine top mesh size regulations and special access area restrictions is required. We believe an EFP is all that would be needed as catch will not be retained during the test trips. We have submitted an EFP request to the NERO last year which has been approved and will need to be renewed.

Sea Turtle Handling

Since we plan to do some of the work in the ETA we may encounter sea turtles. Ronald Smolowitz and Matt Weeks are Cooperative Investigators (CI's) on the NEFSC ESA Sea Turtle Permit and have been trained in sea turtle handling/sampling. This project will test the effectiveness of the new dredge design on sea turtles. Any sea turtles brought aboard that are comatose or inactive turtles shall be handled in accordance with Sea Turtle Resuscitation Regulations at 50 CFR 223.206(d)(1). Sea turtles that are actively moving shall be released by the crew of the vessel over the stern of the boat when gear is not deployed and engine gears are in neutral position, in areas where they are unlikely to be recaptured or injured by vessels. When possible live injured turtles will be transferred to a cooperating U.S. Coast Guard Vessel and delivered to an authorized rehabilitation facility. Loggerhead turtles injured within 36 hours of anticipated return will be brought in to the dock, unless arrangements can be made for a U.S. Coast Guard vessel to pick up the animal. All sea turtle interactions will be reported.

Vessels

Each vessel will make one compensation trip and one research trip under charter.

F/V Celtic	Captain Charles Quinn
F/V Westport	Captain Edward Welch
F/V Diligence	Captain Scott Larsen
F/V Tradition	Captain Ronnie Shrader
F/V Kathy Ann	Captain Mike Francis

Specific Exemptions Requested:

Exemption to twine top mesh size:

Three Compensation trips to the ETA (about 20 DAS fishing total)
Two Compensation trips to the CAII (about 20 DAS fishing)
Three Compensation trips to the Delmarva area (30 DAS fishing total)
Three Research trips into CAI and/or CAII (no catch retained; 21 DAS fishing)
Two Research trips into mid-Atlantic access areas (no catch retained; 14 DAS fishing)

This exemption was requested since three rows of the experimental twine top will be under the 10-inch minimum mesh size required by current regulations.

Exemption to scallop special access area closures:

Three research trips into the scallop special access areas within CAI and/or CAII (no catch retained; 21 DAS fishing). Two research trips (no catch retained; 14 DAS fishing) will take place in mid-Atlantic access areas but the areas have not been chosen at this time.

This exemption is requested in that these two special access areas (CAI & CAII) are the only locations where there currently is a significant bycatch of yellowtail flounder and sea scallops. High levels of catch are needed to obtain the statistically needed sample sizes in the time allotted. Similarly, the mid-Atlantic trips will fish in the areas of highest summer flounder bycatch and may require an exemption once the areas have been finalized.

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