NATIONAL MARINE FISHERIES SERVICE (NMFS) REPORT
ON SWORDFISH MANAGEMENT PROJECT PLANNING

Updates on the Status of Deep-set Buoy Gear (DSBG) Exempted Fishing Permits (EFPs)
The Federal Register Notice soliciting public comment on DSBG EFPs recommended by the Council during the March and June 2017 meetings published on August 28, 2017 (82 FR 40751). The public comment period will close on September 27, 2017. At the conclusion of the public comment period, and in consultation with the states of California and Oregon and enforcement representatives, NMFS will draft revised terms and conditions based on Council recommendations to be applied to all issued EFPs as well as future EFPs.

NMFS anticipates completing the required environmental analysis for the expected buoy gear EFPs (both DSBG and Linked Buoy Gear) in September, and is working with the Protected Resources Division on the level of consultation regarding species protected under the Endangered Species Act and Marine Mammal Protection Act. NMFS has also initiated the vetting of applicants and vessels with the NMFS Office of Law Enforcement.

The NMFS West Coast Region Observer Program (WCROP) recently allocated funds to cover the costs of observers for DSBG EFPs. This observer coverage will be through the WCROP's observer provider contract with Frank Orth and Associates. These funds will provide up to 200 sea days of observer coverage and will be available to all EFP participants through May 2018. Revised trip notification procedures have been communicated to existing DSBG EFP holders (e.g., PIER and Perguson). Currently, PIER has been utilizing observers from Frank Orth and Associates to meet their coverage obligations.

Deep-Set Buoy Gear EFP Logbook/Observer Data Form
NMFS has developed the attached form to collect data on DSBG EFP daily activity. On trips observed by NMFS-contracted observers, the contractor will collect the forms and provide the observer data to NMFS. For other trips, the EFP terms and conditions will require the vessel operator to submit completed forms to NMFS. NMFS will own the data and can provide vessel specific data to EFP holders to aid in the drafting of their required annual reports. The observer data form is included here as an attachment.

EcoCast Update
Attached to this report is an update on the EcoCast fishery sustainability tool. EcoCast aims to predict in near real-time the spatial distributions of highly migratory ocean species, including non-target species (e.g., leatherback sea turtles) and target species (e.g., swordfish). EcoCast was first presented to the Council via public comment during the March 2016 meeting (See Agenda Item F.2.c). Since then, the developers have released two portions of the tool and are actively soliciting feedback from fishers, scientists, and managers. Some of the DSBG and longline EFP participants have agreed to help beta test EcoCast. NMFS is also hopeful that drift gillnet (DGN) fishery participants will assist in testing EcoCast.

NMFS recommends that the Council allow time during the November Council meeting for a presentation from the developers of EcoCast. This presentation will provide the Council and HMS fishermen with an update on the progress of the tool's development. The developers will

also be able to provide more detail and answer questions from the Council on the benefits of EcoCast's applications.

Increased Monitoring in the DGN Fishery

Background Information

Increased monitoring in the drift gillnet (DGN) fishery has been discussed for several years. Although the purpose for increased monitoring has evolved over the years, the interest to increase the monitoring of the DGN fishery remains. Beginning in March 2012, the Pacific Fishery Management Council (Council) started to explore ways to enhance swordfish fishing opportunities in the Pacific Leatherback Conservation Area (PLCA). The Council provided guidance to the Highly Migratory Species Management Team (HMSMT) to investigate potential changes to the timing and area boundary of the PLCA. The Council discussed hard caps on sea turtles and increased monitoring of the DGN fishery in the PLCA as conditions to modifying the PLCA.

During the March 2013 meeting, the Council passed a motion (Agenda Item I.2.d.) that tasked the HMSMT and NMFS with evaluating changes to the DGN fishery. Regarding the observer coverage, two of the five options in the motion would have required 100 percent observer coverage. However, some of the vessels participating in the fishery are considered unobservable due to safety or accommodation reasons. Therefore, the HMSMT was asked to evaluate whether current observer coverage was adequate to monitor turtle interactions. NMFS was also asked to determine whether the 20 percent observer coverage target in the DGN fishery was adequate in estimating bycatch. NMFS had targeted 20 percent coverage since it began placing observers on DGN vessels in 1990, and the 2013 biological opinion on the DGN fishery expected 20 percent coverage to continue[1]. In 2013, NMFS obtained additional DGN observer funding and increased target coverage to 30 percent to meet a recommendation in NMFS's 2011 National Bycatch Report.

As a result of the Council's request, the HMSMT presented a report at the March 2014 Council meeting which suggested the use of electronic monitoring (EM) to meet any increases in DGN monitoring. The HMSMT report outlines the history and reasoning behind observer coverage levels in the DGN fishery.

In June 2014, the Council set forth several policy objectives for the West Coast swordfish fishery. The list of objectives included an increase in monitoring (through increased observer coverage or EM) in the DGN fishery above 2013 levels to facilitate implementation of bycatch reduction measures such as hard caps. The Council identified the beginning of the 2016/2017 DGN fishing season as a target for implementing full monitoring and accountability through onboard observers and/or EM systems.

[1] From 2013 through 2016, observer coverage of the fishery by calendar year was 37.4 percent (2013), 29.8 percent (2014), 20.5 percent (2015), and 18.2 percent (2016). During this period, NMFS observed 25.5 percent of all fishery effort, which is higher than the 20 percent average observer coverage expected in the biological opinion.

In March 2015, the Council discussed whether 100 percent observer coverage is necessary to understand bycatch in the DGN fishery. As a result of that conversation, the Council requested further analysis from the HMSMT and Scientific and Statistical Committee to help determine optimal DGN observer coverage levels. The Council also discussed using observer coverage to understand whether protected species bycatch are truly rare events or have been undetectable due the level of observer coverage. The HMSMT responded to the Council's request in a report for the June 2015 meeting. In section 4.3 of the HMSMT report the team uses various statistical methods to determine if interactions with protected species are truly rare events, or just undetectable. According to the report, DGN fishery interactions with the species being considered for hard caps appeared to be rare events (e.g., infrequent occurrence, long intervals between incidents).

In September 2015, the Council selected a final preferred alternative (FPA) for "hard caps" in the DGN fishery. Also, following the HMSMT report from June 2015 determining that the level of observer coverage in the DGN fishery was sufficient to monitor rare bycatch events, the Council selected a DGN monitoring FPA that included maintaining 30 percent observer coverage level at a minimum and/or requiring EM (for the purpose of catch and bycatch accounting), removing the unobservable vessel exemption, and achieving 100 percent monitoring by 2018. Proposed regulations to implement the Council's decision have not been formally transmitted to NMFS for consideration, nor has an implementing rule been issued, pending resolution of several questions described below.

A draft of the Swordfish Management and Monitoring Plan (SMMP) was also presented during the September 2015 Council meeting. This plan was initially designed to encourage DGN fishery participants to use other gear types, but the SMMP was broadened to look at all feasible gear types to harvest swordfish while minimizing bycatch. The SMMP states that the Council intends to minimize protected species bycatch through a variety of mitigation and management measures. More specifically, the Council noted that it would "work with NMFS to increase DGN fishery monitoring and/or develop statistical methods to better estimate bycatch in the absence of 100 percent monitoring."

In response to interest in improved DGN bycatch estimation, NMFS published a Technical Memorandum[2] in 2017 that explored the 'random forest regression tree' model as a method to better estimate rare event bycatch. This method addresses the systematic bias that occurs in ratio estimates of bycatch (which is the method that had been used). Ratio estimates tend to either over or underestimate bycatch of protected species. The model-based approach used in this study showed more stable estimates of bycatch because it utilized all bycatch data available (1990-2015). This regression tree study also included oceanographic, location, and gear variables to improve bycatch estimates. The authors suggest that this method to estimate bycatch will produce less volatile, less biased, and more precise estimates. A presentation on the methods of this memorandum was made to the Council by the lead author, Dr. James Carretta, at the March 2017 meeting.

[2] Carretta, J.V., J.E. Moore, and K.A. Forney. 2017. Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p.

Purpose and Need of Increased DGN Monitoring

The Council should consider revising the purpose and need for 100 percent monitoring in the DGN fishery. The Council adopted the purpose and need for hard caps, DGN monitoring, and DGN performance metrics in March 2015 as part of its draft Swordfish Management and Monitoring Plan. Currently, the purpose and need reads as follows:

> "The purpose of the proposed action is to conserve non-target species and further reduce bycatch, including incidental take of ESA listed species and other marine mammals, in the DGN fishery below levels currently permitted by applicable law while maintaining or enhancing an economically viable west-coast-based swordfish fishery."
>
> "The proposed action is needed to better integrate fishery management under the HMS Fishery Management Plan (FMP) with enhanced protection of ESA-listed species and other marine mammals, and to address National Standard 9 and Section 303 of the Magnuson-Stevens Act to minimize bycatch and bycatch mortality and conserve non-target species to the extent practicable."

NMFS is uncertain how to evaluate the Council's existing alternatives for increased monitoring against the purpose and need that the Council originally adopted for a suite of DGN management measures. For example, the stated purpose is to reduce bycatch, however it is unclear how increasing monitoring would reduce bycatch in the DGN fishery. NMFS believes that the current purpose and need for 100 percent monitoring could be clarified to more accurately express why increased monitoring is necessary, and the goals of increased monitoring.

Potential Options for Achieving 100 Percent Monitoring in the DGN Fishery

Require 100 percent human observer coverage on all DGN vessels through regulation

Current funding would only allow the West Coast Regional Observer Program to continue to fund a portion of observer coverage. One hundred percent coverage would require an industry-funded program. Since observer coverage costs approximately $600/day this would place a significant burden upon DGN participants. Additionally, there are between six and eight vessels in the fishery that are unobservable. A rule of this type would effectively exclude those vessels from the DGN fishery.

Require 100 percent human observers on observable vessels and EM on unobservable vessels

This is a similar pathway to the one above, however it would allow for EM to be installed on unobservable vessels to give them the option to continue fishing. The cost of industry-funded observers for observable vessels would be significant. EM purchase, installation, maintenance, and video review for unobservable vessels would likely be industry-funded, while EM administrative costs would require government funding.

In August 2017, NMFS published a final rule to modify the Alaska Region's observer program (82 FR 36991). This rule allows vessels that may have difficulties carrying observers to opt-in to an EM program each fishing season. If they choose to not opt-in, then they will be subject to observer coverage (See Appendix A for additional examples of Federal fisheries with EM programs).

Develop an Exempted Fishing Permit (EFP) program for Electronic Monitoring
Many other federal fisheries began their EM programs through an EFP. The EFP process has allowed each program to adapt to necessary changes to achieve the stated goals of the EFP. The lessons learned from the EFP program would allow for future regulations to be a written to require minimal adjustment as the program adopted more users. The EFP process may allow for different EM systems to be used as well, which could result in developing lower-cost solutions for DGN participants. The EFP program has been a useful tool in developing EM regulations for the groundfish fishery. However, similar efforts to develop an EFP program for the DGN fleet has suffered from a lack of interest by fishery participants.

Potential Hurdles to Achieving 100 percent Monitoring
The limited funding available for human observers combined with an unobservable portion of the DGN fleet present challenges to achieving the goal of 100 percent monitoring in the fishery by 2018. While achieving EM can help the DGN fishery achieve 100 percent monitoring, it also has several issues that would need to be resolved prior to implementation.

Third Party Video Review
In the groundfish EM program, the Pacific States Marine Fisheries Commission currently conducts the video review on behalf of NMFS. This arrangement is proposed to continue through 2019, when the program will transition to industry-funded third party video review (see the proposed rule). At its April 2017 meeting, the Council requested that NMFS determine if the Pacific States Marine Fisheries Commission (PSMFC) could be a sole provider of video review, funded by industry, beginning 2020. PSMFC has shown it can review video quite cheaply, and industry would like the option to continue to work with them once the program transitions to industry-funded, third party video review. NMFS has been researching this issue and is expected to provide the Council with its findings at the September 2017 meeting. The final regulations for the groundfish EM program have been delayed pending resolution of this issue. The implementation of an EM program for the DGN fishery would similarly have to await resolution of this issue and finalization of third party video review standards.

Clarification of Objectives
NMFS recommends that the Council clarify the objectives for increased DGN monitoring before the Council and NMFS can move forward with designing an appropriate program to meet those objectives.

Costs
EM can be a less costly monitoring alternative to observers. However, this largely depends on the design of the program, including the level of coverage, the amount and purpose of the video review, and the amount of fishing effort. Analysis of costs in the groundfish EM program have shown that EM can provide a significant cost savings for vessels that practice maximized retention, which greatly simplifies video review, and for those that fish many sea days, which spread out the fixed EM costs over more activity (see NMFS Report Agenda Item F.a.2).

NMFS prepared preliminary cost estimates for a potential EM program for the DGN fleet, presented in Table 1. NMFS developed these estimates using effort information from the

observer program, the 2006 report on the DGN EM project (McElderry et al. 2006), and EM cost information from the West Coast Groundfish EM EFP program. Based on the estimates developed, it appears industry-funded EM could be a less costly monitoring option relative to industry-funded observers for the DGN fishery, at a cost of $361.22 per sea day (See Appendix B for details on cost calculations). There are also some new advancements on the horizon that have not yet been deployed in operational fisheries, such as automated video review and low-cost EM units. As these advancements become operational, they may improve the cost/benefit ratio of implementing an EM program for the DGN fleet.

Table 1. Preliminary cost estimates of a potential EM program for the DGN fishery.

Multipliers	
Number of active vessels	20
Number of annual sets	500
Number of annual sea days	750
Number of sets/sea day	0.67
Haul-back time (hr)	6
Review rate	0.18
EM Costs	
Annual equipment cost (amortized over 3 yrs)	$3,333.33
Annual field service subscription fee	$8,000.00
Video review cost (per set)	$54.00
Data storage (per sea day)	$23.00
Inseason field service visits	Unknown
Total EM cost per sea day	$361.22

Vessel participation

The EFP program model has been a beneficial tool to use in testing and developing an EM program for the West Coast groundfish fishery. Some EFP work has been done in the DGN fleet and in other fisheries that could be used to develop EM regulations for the DGN fishery (see Appendix A). The DGN fishery could still benefit from additional EFP work but lack of interest among DGN vessels remains a significant impediment to progress. The Nature Conservancy received a federal grant for EFP project with DGN vessels in 2016, but was not able to get

participants. This also raises concerns about the success of any EM program in regulations - EM is most successful in fisheries where there is buy-in from fishermen. EM programs shift many of the duties of an onboard observer to the captain and crew, who have to be willing to take on the extra work. Programs that do not have industry buy-in may have a longer learning curve and suffer from chronic compliance issues.

Conclusion

The Council's FPA was as follows:
"Maintain the 30% target observer coverage level at a minimum and/or require electronic monitoring (for the purpose of catch and bycatch accounting). Remove the unobservable vessel exemption. Achieve 100% monitoring by 2018."

Additional input from the Council on the purpose and need and objectives may reveal a path forward for evaluating the need for 100% monitoring versus lower cost alternatives. The Council could task the HMSMT and HMSAS to consider additional language for clarifying the purpose and need and objectives for increased monitoring of the DGN fishery and to identify whether the alternatives analyzed in the Preliminary Draft Environmental Assessment presented to the Council in September 2015 provide sufficient options for meeting such objectives.

Appendix A: Examples of Electronic Monitoring in other Federally Managed U.S. Fisheries

Atlantic HMS Fishery

In August 2014, NMFS published a final rule that required EM on all vessels issued an Atlantic Tunas Longline permit that fish with pelagic longline gear by June 1, 2015. The purpose of this rule was to provide a way to monitor and verify all bluefin tuna catches (including landings and dead discards). Upon completion of a fishing trip, the vessel operator must mail the removable EM system hard drive containing all data to NMFS or the NMFS-approved contractor within 48 hours.

Pacific Coast Groundfish Limited Entry Trawl Fishery

NMFS has issued a proposed rule that would make EM an option for midwater trawl vessels in the Pacific whiting fishery and fixed gear vessels in the individual fishing quota (IFQ) fishery. The proposed regulations would establish standards and requirements for vessel owners and operators using EM, processors receiving catch from EM trips, and EM service providers. Vessel operators would self-report discards using logbooks, which would be audited using the EM data, and used to debit discards of IFQ species from a vessel owner's IFQ account or a cooperative's allocation. Video data would also be used to monitor compliance with the requirements of the Groundfish Trawl Program. Currently, the Pacific States Marine Fisheries Commission handles all video review for this fishery. The proposed rule proposes transitioning to industry-funded, third party video review providers in 2020.

EM Feasibility Study for the Shallow-set Longline (SSLL) Fishery in the Pacific Islands Region

In June 2016, NMFS' Fisheries Information System and National Observer Program provided funding for EM cameras in the Hawaii longline fishery. The project will enable approximately seven vessels in the Hawaii SSLL fishery to obtain data via EM and allow a comparison with data collected by on-board human observers. Saltwater, Inc. installed cameras on five longline vessels in February 2017. Pacific Islands Fisheries Science Center (PIFSC) and the Joint Institute for Marine and Atmospheric Research contractors will review the video and compare observer data to the video data. PIFSC prefers testing EM on SSLL vessels targeting swordfish rather than deep-set longline vessels targeting tuna because SSLL vessels have 100 percent observer coverage and catch retrieval occurs during daylight, facilitating species identification. As of 2015, the Hawaii SSLL fleet comprised 22 active vessels.

EM Pilot Program for the Gulf of Mexico Commercial Longline Fleet

In 2011, a pilot study by the Ocean Conservancy and Mote Marine Laboratory (Mote) was developed to determine if EM could be used to monitor commercial catch in the Gulf of Mexico. The results of that study showed that EM was a viable option for observing the bottom longline fleet in the Gulf. Since the pilot study, Mote has continued to partner with the Gulf of Mexico Reef Fish Shareholders' Alliance, Archipelago Marine Research (Archipelago), commercial fishermen, and more recently, the National Fish and Wildlife Foundation (NFWF) to continue to test EM in the Gulf. In late 2016, Mote received a $500,000 grant from the NFWF to install EM on bottom longline vessels. In January 2017, the Shareholder's Alliance and Mote applied for an EFP to continue their study. The EFP application states, "A primary goal of the program is to

broaden the scope and depth of EM to collect and provide timely and accurate characterization of this fisheries catch (retained and discarded), interaction with protected species, and identification of bycatch "hotspots" in this valuable federally managed fishery through collaboration with vessels in Florida, Louisiana, and Texas." Each vessel will be provided training and equipment, GPS to help detect where fish are caught, and a monitor and computer control center with a portable hard drive that will later be returned to Mote for viewing and data analysis.

Pilot EM studies in the DGN Fishery

In 2006, NMFS contracted Archipelago to evaluate the feasibility of using EM in the DGN fishery. In this study, EM systems and observers were simultaneously in place on five vessels for 11 trips. Protected species identification was identical between the onboard observers and those that reviewed the video footage. Archipelago conducted another EM study in the DGN fishery in 2007. Due to the reluctance of fishermen to participate, the study only used one vessel over a six week period. The second study focused on using a hydrophone to detect the presence of pingers while the net was in the water. EM was successful in detecting the presence of pingers, however, quantification of pingers was not possible. The researchers concluded that further research would be required if EM were to be used to quantify the number and placement of pingers on the net.

Appendix B: Potential Costs of EM for DGN Fishery

To generate the estimates in Table 1, we assumed 20 active vessels with EM coverage, fishing 500 sets over 750 sea days. This is the number of sets and sea days that the observer program uses to project observer coverage. These assumptions have been fairly representative of actual recent fleet activity, with the exception of 2016, which saw a higher level of effort.

We assumed that the program would focus on documenting bycatch and, therefore, that the time period of interest that would be recorded and reviewed would be the haul-back. This is when bycatch species are usually disentangled and discarded. We assumed that video would not be recorded, or at least not reviewed, during other parts of the trip. According to the observer program, haul-backs typically take 4-6 hours; we assumed 6 hours to be conservative. This would result in 6 hours per set that would need to be reviewed. We multiplied the haul-back time by the review rate reported in the 2006 EM study (18%) to determine the number of hours of review. We applied a cost of per-hour video review at $50, provided by the PSMFC and used in the groundfish EM cost assessment, to get a per-set review cost of approximately $54.

We also factored in the cost of equipment and maintenance. The cost of an EM unit is typically estimated at $10,000 per unit. This upfront cost can be amortized over the lifetime of the equipment to get an annualized equipment cost. The lifetime of the equipment will depend on how well it is maintained by its owner and the conditions it is subjected to at sea. Previous discussions with EM providers have indicated EM units may last 3-5 years and even 10 years in some cases. We amortized the equipment cost over 3 years to be conservative. Vessel owners would also need to pay a provider for "field services" like maintenance, repairs, and technical support. In the groundfish EFP program, vessels pay an annual upfront fee to their service provider for these services. The exact amount charged to each vessel is not known, and would be confidential, so NMFS has used an estimate of $300,000 for field services for the entire groundfish EM fleet for one year. Depending on the fleet size, this results in a per vessel cost of $6,000-8,000 per year. This may not be entirely representative of the field services costs to the DGN fleet, or a sub-set of the DGN fleet if only unobservable vessels are covered. However, it is important to include some estimate of field services costs, so we used an assumption of $8,000 per vessel per year. Note that this cost would be an initial upfront cost and does not include the per-visit costs of visits by the technician to the vessel to make repairs and adjust equipment. NMFS has not been able to estimate the cost of individual visits, but included them in the table as "unknown" so that the Council and public would be aware that there would be costs to the industry in addition to the EM sea day cost computed in the Table 1. Depending on how well the equipment is maintained by the crew and the conditions they fish in, only two or three visits per vessel may be needed each year, including a preseason check-up before the start of each season.

In addition to reviewing the video to document bycatch, the EM service provider would be responsible for storing the video data for some period of time. A retention period of 3 years is proposed in the groundfish fishery, but 1 to 5 years have also been discussed. The storage costs in Table 1 were taken directly from the groundfish cost assessment, which was based on a 3-year retention period. DGN would likely have much lower data storage costs, because the activity of interest is only the 4-6 hours around haul-back. In the groundfish fishery, cameras record continuously when fish are onboard the vessel, from the first haul until the vessel begins

offloading at the dock. This is to ensure compliance with the requirement to retain species that cannot be identified on camera. This results in thousands of hours of video that would likely not be needed in the DGN fishery.

Converting the annual costs and the per-set costs to sea day costs, results in a total cost to DGN participants of approximately $361.22 per sea day for EM.

EcoCast: A dynamic ocean tool for fisheries sustainability
Briefing for PFMC: September 16th, 2017

Background

EcoCast is a new fishery sustainability tool that produces daily predictions of the spatial distributions of important highly migratory species, including both target species (swordfish) and bycatch species (leatherback sea turtles, California sea lions and blue sharks). Using this tool, fishers and managers can better evaluate how to allocate fishing effort across space and time to maximize target catch while minimizing bycatch. EcoCast is being developed by a team of collaborators from several universities and NOAA, in direct collaboration with resource managers, fishing industry and other stakeholders.

How it works

The EcoCast tool is run every day in three stages (Figure 1). In stage 1 – **Acquisition** – real-time satellite data are acquired from several online sources. In stage 2 – **Prediction** – species distribution models for the target and bycatch species are predicted over the real-time satellite data and the species weightings are applied to produce the official EcoCast product. In stage 3 – **Dissemination** – the EcoCast product is disseminated to fishers, managers and the public via a restful URL and rshiny apps. Stages 1&2 are complete and run automatically every day without technician input. Stage 3 is partially complete (items in black, Figure 1) with some items under development (items in blue, Figure 1).

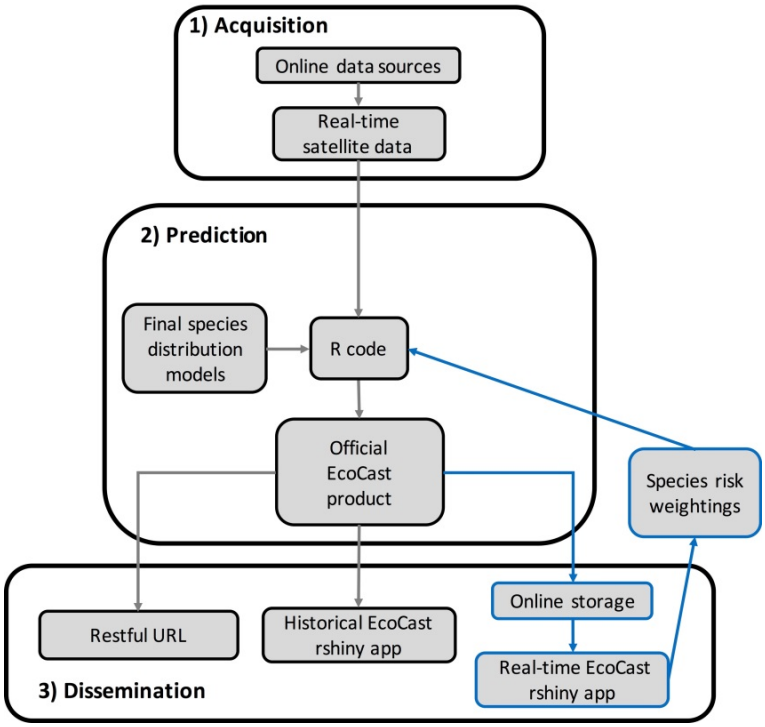

Figure 1. Workflow of EcoCast operationalization

Tool status

We have two products that are ready for release and testing. The first is the daily EcoCast product (Figure 2A). This product can be accessed at the restful URL, which means it is a link to the most current official product, and can be accessed at:
http://oceanview.pfeg.noaa.gov/ecocast/output/mean/EcoCast_ecocastrisk_latest_mean.png
The second product is a scenario analysis tool (Figure 2B) which provides stakeholders with the complete set of EcoCast products from previous fishing seasons (August – November 2016), and allows fishers, managers and the public to explore historical patterns in oceanographic conditions and species distribution patterns. A demo version of this tool can be accessed at:
https://heatherwelch.shinyapps.io/rshinyapp_historical/.

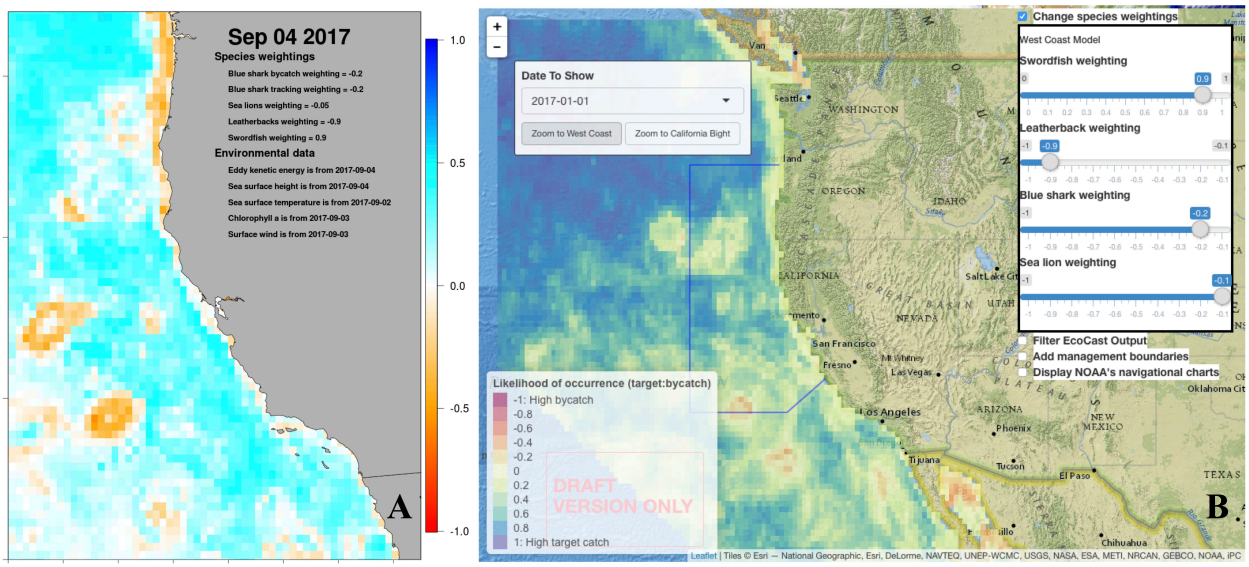

Figure 2. The EcoCast product (A) and historical tool (B).

Sensitivity and error analyses

To ensure that the EcoCast product is robust even with gaps in oceanographic data, we have completed a comprehensive sensitivity analysis of the tool's accuracy in the event of missing satellite data. Occasionally a variable (e.g. chlorophyll) will be unavailable for a given day due to issues with the satellite, or with the online data source where it's housed. In addition, if fishers are at sea without access to an updated product, we wanted to know how long the previous product would still be relevant. Preliminary results indicate that we are able to substitute a variable from the previous day without losing significant product accuracy. In addition, our analysis suggests that EcoCast products are likely still useful up to three days out when new products are unavailable.

Future work

We continue to solicit feedback and guidance from fishers, NOAA scientists and managers. We are exploring the best approaches towards data dissemination, including the restful URL, mobile applications, or through an existing subscription services (e.g. Seaview Fishing Services). Any of these approaches would allow fishers to have access to the EcoCast product in remote areas. We will continue to identify end users who are willing to participate in EcoCast testing and reporting. We are working the sensitivity analyses results into the tool workflow (Figure 1) to guide how the tool operates in the event of missing real-time data.

For questions contact Elliott Hazen (elliott.hazen@noaa.gov) or Heather Welch (heather.welch@noaa.gov)

Vessel Name /ID		**Fishing Date:**			**Date /Time of Departure**						**Page of**
Trip #:		**Port**	**Depart:** / **Return:**		**Date /Time of Return**						**Condition** - A/D/U Alive/Dead/Unknown
Observer #:		**Other Fishing during trip (Circle all that apply)**			Harpoon	DGN	SetNet	Troll	Rod &Reel		**Disposition**- K/RA/RD/RU; Kept/Released Alive/Released Dead/Released Unknown
		Other:			Light Boat	Groundfish	Lobster	Crab	Other Trap		**Hook Position-** Bottom hook=1, Upper hook=2, High hook=3
Notes:						**Fish Ticket #s**					**Bait- S**quid=S, Mackerel=M, Other-write out name
											Light color- Green=G, Blue=B, White=W, Multicolor=M
											Bait Predation- Y if portion of any bait chewed, N if bait intact

Buoy #	Set Time	Set position: Lat/Long	Haul Time	Haul position: Lat/Long	Catch	Length (FL, LJFL)	Condition	Disposition	Number of Hooks	Hook Position	Bait	Light color	Bait Predation	Notes (i.e. traceability tag #)(Specimen#)
1														
2														
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Buoy #	Set Time	Set position: Lat/Long	Haul Time	Haul position: Lat/Long	Catch	Length (FL, LJFL)	Condition	Disposition	Number of Hooks	Hook Position	Bait	Light color	Bait Predation	Notes (i.e. traceability tag #)(Specimen#)
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Buoy #	Set Time	Set position: Lat/Long	Haul Time	Haul position: Lat/Long	Catch	Length (FL, LJFL)	Condition	Disposition	Number of Hooks	Hook Position	Bait	Light color	Bait Predation	Notes (i.e. traceability tag #)(Specimen#)
													Y N	

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