National Fish and Wildlife Foundation (NFWF) and
National Oceanic and Atmospheric Administration (NOAA)

HOTSPOTS MAPPING INITIATIVE

APRIL 2022 WORKSHOP REPORT

Introduction

> "I have gotten a very good feel for hotspot efforts in this meeting, and I'm impressed. I just think it's cool that everyone can sit here and work together."
>
> **GARY GRAHAM**
> *Shrimp Vessel Owner*

BACKGROUND

In 2016, the Natural Resource Trustees for the Deepwater Horizon oil spill finalized a comprehensive restoration plan for the Gulf that includes a settlement of up to $8.8 billion to resolve claims for natural resource damages related to the spill. The Hotspots Mapping Initiative is one of 18 projects included in the Deepwater Horizon Open Ocean Trustee Implementation Group Restoration Plan 2; this Plan is designed to partially compensate for injuries to fish and water column invertebrates from the oil spill. This initiative is being managed by NFWF and NOAA and seeks to collaborate with fishermen and anglers in and around the Gulf coast. The goal of the project is to evaluate the feasibility of fisheries hotspot communication networks in and around the Gulf to improve fishing by increasing efficiency, reducing bycatch through avoidance of unwanted species, and minimizing discard and release mortality through avoidance of depredation.

SUMMARY

On April 20–21, 2022, NFWF and NOAA held a hybrid (in-person and remote) Hotspots Mapping Initiative Workshop in New Orleans, LA. This workshop, attended by 35 scientists, managers, and fisheries stakeholders (see Appendix 1 for attendee list) included a description and discussion of the Initiative, case studies of established and developing hotspot networks, a discussion of data and technology requirements to make networks successful, and discussion of incentives to foster participation. The workshop also featured themed panel discussions and full group discussions to explore hotspot mapping efforts and associated communication networks (Appendix 2 presents the full workshop agenda). Throughout the report, we have included comments from some of the attendees.

Presentation Overviews

PRESENTATION 1

EcoCast

Elliott Hazen, NOAA Fisheries, Southwest Fisheries Science Center

SUMMARY

Fleet/region/target catch: California drift gillnet swordfish fishery.

Bycatch: Leatherback turtles, blue sharks, and sea lions.

Data: Satellite tracking data, fishery observer data, water temperature data.

Incentives: Political pressure to restrict or eliminate this fishery.

Findings: EcoCast supported closed areas that reduced bycatch but also had a large economic impact on the fishery.

Other points: Investigators explored building EcoCast as a smartphone app but learned most fishermen do not have smart phones; EcoCast was built on previous mapping programs such as TurtleWatch, which was created to help the Hawaii longline fishery avoid bycatch of loggerhead and leatherback turtles.

LESSONS LEARNED

1. Dynamic Ocean Management (DOM) is a management approach that monitors changes in space and time at scales relevant for animal movement and human use. DOM relies on environmental data and species distribution knowledge to predict problem areas.[i]
2. A DOM meta-analysis of 15 global fisheries showed that DOM[ii] was up to 3.6 times more effective than static management at reducing bycatch while maintaining catch.
3. This meta-analysis showed that a high correlation between target catch and bycatch resulted in less efficacy for DOM approaches.
4. Sustainable management of fishery resources, especially highly migratory species, requires a portfolio of integrated multi-scale management that incorporates fixed, adaptive, and dynamic approaches.

i Lewison et al. (2015) BioScience.
ii Pons et al. (2022) PNAS

PRESENTATION 2

Hotspot Mapping and Information Sharing to Avoid Unwanted Catches

Dr. Julia Calderwood, Marine Institute (Foras na Mara)

SUMMARY

Fleet/region/target catch: Celtic Sea demersal fishery, which targets species with plentiful quota (e.g., Whiting).

Bycatch/avoiding: Haddock (quota limited species).

Data: Observer data from countries that border the Celtic Sea (Ireland, France, and England), which are combined and put into a mapping app using other existing/historic data.

Incentives: Requirement to comply with the European Union's landing obligation, which is designed to eliminate discards through selective fishing and bycatch avoidance.

Other points: The IFISH (Irish Fisheries Information Sharing Network Development) project aims to investigate how new technologies and mobile phone apps could be used to share real-time information to help skippers avoid unwanted catches and reduce discards. IFISH data help vessels target species with higher quotas and avoid choke species, and resulting maps can be overlaid to show multiple species and target catch.

LESSONS LEARNED

1. Models suggest hotspot maps help economics. The maps have the potential to help fishermen better target areas with more whiting and less haddock bycatch, which could result in greater target catch with less effort and fuel.
2. Observer data are limited with poor spatial and temporal resolution. The data a network provides need to be near real-time, or else the data will simply reflect what fishermen expect to see and are not different from fishermen knowledge.
3. Fishermen want to use mapping as a basis for targeting desired fish and then add in an extra layer of real-time data on undersized fish.
4. Fishermen were happy to share with peers but not others; the Marine Institute is working to build individual access and hopes fishermen will be incentivized to report additional data.

PRESENTATION 3

Requirements for the Rolling Salmon Hotspot Closures in the Bering Sea Pollock Fishery

Steven Martell, Sea State, Inc.

SUMMARY

Fleet/Region/target catch: Federally managed pollock and non-pollock trawl fisheries; Bering Sea; Pollock.

Bycatch/avoiding: Chinook salmon.

Note on definitions from the rolling hotspot program: "Bycatch rate" is defined as bycatch amount/target catch amount; "Hotspot" is defined as an area where the bycatch rate is greater than the fleet average rate or a defined base rate.

Data: Using haul level data 24/7; 100% observer coverage, haul-level data, and cooperative participation; fish ticket, vessel monitoring system (VMS), and exempted fishing permit (EFP) data. All data go through Sea State and then to co-op managers, vessel operators, and fishing companies.

Other program requirements: Cooperative and inter-cooperative legal agreements; third party to implement business rules of program; independent audit of the data.

Incentives: Participating vessels gain access to fishing in some restricted areas.

"This has been eye-opening, and I appreciate that you all have captured the scope, the diversity, and the challenges that we have here in the Gulf."

JULIE FALGOUT
Louisiana Sea Grant

LESSONS LEARNED

1. These types of projects require accountability. Initially, only two vessels were interested in this program, but interest increased dramatically once accountability measures, such as legal agreements, were introduced.
2. Hotspot programs need digestible, empirical data designed for fishermen, not scientists.
3. Hotspot projects need clear business rules, including hotspot definitions and minimum thresholds for hotspots, consequences including exclusion from fishing areas for "bad performers", and rules allowing limited fishing in closed areas by good performers.

> "One thing is clear: There are a lot of issues, but that also means that there are a lot of opportunities."
>
> **RYAN SCHLOESSER**
> *Mote Marine Laboratory*

PRESENTATION 4

Cornell Cooperative Extension Program

Scott Curatolo-Wageman, Cornell Cooperative Extension (CCE)

SUMMARY

Fleet/region/target catch: 74 vessels, mostly commercial but some recreational, from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Virginia; finfish, squid, groundfish.

Bycatch/avoiding: Although this project began as an effort to reduce the bycatch of butterfish and river herring/shad, it has expanded to include additional species including yellowtail flounder, windowpane flounder, northern red hake, and Georges Bank haddock.

Data: CCE designed a system to collect information on incidental catch that expands the use of existing VMS technology and relies on the active fishing fleet to provide real-time data. Participating vessels supply real-time communications about bycatch rates of select species during fishing activities, and in turn, CCE compiles the information and sends it back to active fishing vessels to avoid "hotspots", as well as posting it online. This information is conveyed in grids with 10 mile by 10 mile squares, which helps maintain confidentiality about the precise locations of boating vessels. ArcGIS software visually represents trends in bycatch levels.

Incentives: This is a voluntary program, which required close work with the industry to get its approval and cooperation. This program requires frequent and intentional communication with the industry. The CCE was also able to offer rewards for boats that had the most bycatch rate reports for a month.

LESSONS LEARNED

1. Fishermen make great project ambassadors. When CCE faced pushback or skepticism from new fishermen, they found a good solution was having them talk to other fishermen who participate in the project. Hearing the news straight from another fisherman helped build the project's credibility.
2. In proposed future work, CCE will use project data to identify and monitor ecosystem changes and resulting bycatch interactions.
3. CCE found that it is also important to know where bycatch isn't and to include that information in their reports.
4. Regular weekly reminders help encourage more frequent reporting.

PRESENTATION 5

Hotspot Mapping for Salmon in the North Pacific

Jordan Watson and Noelle Yochum, NOAA Fisheries, Alaska Fisheries Science Center

SUMMARY

Fleet/region/target catch: Pelagic trawl fishermen; High Seas, Bering Sea, Gulf of Alaska; Pollock.

Bycatch/avoiding: Various salmon species (including pink, chum, sockeye, and chinook).

Data: Machine learning models for dynamic predictions of hotspot locations. Developing these analytic frameworks for bycatch hotspot mapping can support more predictive analytics to help fishermen avoid these areas and understand potential high-risk areas for illegal fishing. Analysis includes sea surface temperatures and analysis of species and age stock-specific patterns. Scientists combine observer and VMS data with sea surface temperature and the Alaska Fisheries Information Network (AKFIN) database to build this analysis.

Other points: Boat captains were interested to learn how sea surface temperature affected catches.

LESSONS LEARNED

1. The ability to build predictive models helps anticipate where bycatch will be, which can be used to enhance real-time reports of bycatch hotspot locations.
2. It is important to clearly communicate program needs to technology companies/groups. For this project, leaders were initially pulling data manually before a conversation with AKFIN revealed that the process could be automated.

> "Having access to good data and cooperative research that helps fishermen and helps the resource become more sustainable would be a great success."
>
> **CAPTAIN SCOTT HICKMAN**
> *Circle H Outfitters*

> "There are a lot of possibilities with this project. Identifying your criteria and ranking in terms of what fits in meeting your goals is key."
>
> **LAURA PICARIELLO**
> *Texas Sea Grant*

PRESENTATION 6

Hotspot Analyses for Northeast Fisheries using Trawl, Dredge, and Gillnet Gears

Ryan Knotek and Nick Whitney, New England Aquarium

SUMMARY

Fleet/region/target catch: Trawl, dredge, and gillnet fisheries; New England multispecies fishery for groundfish, sharks, skates, and rays.

Bycatch/avoiding: Thorny skate.

Data: Species distribution and abundance data were used to forecast hotspots. These data were integrated with fishing effort data to identify hotspots at different confidence levels.

Incentives: If quotas are exceeded in a particular year for the Northeast skate complex, which includes thorny skates, then accountability measures could be triggered for the next fishing year, which would limit harvest.

LESSONS LEARNED

1. Confidence levels of hotspot mapping should match conservation priorities.
2. Match spatiotemporal resolution on a case-by-case scenario (i.e., according to fisheries, species, or management measures).
3. Various species distribution and abundance data sources are available for bycatch hotspot avoidance; need to select most appropriate in context.
4. Incorporation of additional biologically relevant data can make hotspot identification more specific.

PRESENTATION 7

Hotspot Mapping and Highly Migratory Species

Katie Westfall, Environmental Defense Fund

SUMMARY

Fleet/region/target catch: Highly migratory species pelagic longline (HMS PLL) fleet (80 active vessels); Atlantic and Gulf; Atlantic swordfish, yellowfin tuna, bigeye tuna, and dolphinfish.

Bycatch/avoiding: Sharks, sea turtles, billfishes, marine mammals.

Data: Timely, high-quality bycatch and environmental data can be used to predict species spatiotemporal distribution (real-time, seasonal) and determine bycatch hotspots. **Other points:** This effort is focusing on long-term climate impacts to the Gulf coast and is trying to determine whether fishery economics and conservation could be improved, especially via evaluation of closed areas and shifts in species ranges and ocean conditions. Long-term climate change impacts may alter HMS species behavior and distributions, reduce larvae growth and survival, and cause increased mortality in bycatch species.[iii]

LESSONS LEARNED

1. Climate resilience best practices and fisheries best practices have significant overlap and can complement each other to address climate change effects.
2. Adaptive/dynamic management approaches and predictive capabilities can minimize catch of non-target species without compromising yield of target species.[iv]
3. The HMS PLL fishery has contributed to sustainable fishing by testing innovative bycatch monitoring solutions such as electronic monitoring.
4. There is a need for pilot studies and holistic fishery performance analysis.
5. Scientists and managers should consider using the NOAA PRiSM (Predictive Spatial Modeling) tool, which is a hybrid statistical geographic approach to mapping climate, to determine species abundance and the environmental characteristics to identify best habitats.
6. Interviews with PLL fishermen revealed that they are already seeing climate change impacts, have low confidence in the economic viability of alternative gear (e.g., greenstick gear) tested to date, and are interested in exploring new technology, as long as it benefits the fishery as opposed to just the agency.

iii Dell'Apa et al. (2018) Marine Environmental Research 141, 1–11.
iv Hilborn et al. (2022) Fish and Fisheries 23, 492–518

PRESENTATION 8

Hotspot Analyses using Electronic Monitoring

Ryan Schloesser, Max Lee, Carole Neidig, Mote Marine Laboratory,
Center for Fisheries Electronic Monitoring at Mote (CFEMM)

SUMMARY

Fleet/region/target catch: Federally managed Gulf reef fish fisheries; All reef fish species, primarily red grouper and red snapper.

Bycatch/avoiding: Undersized reef fish including red snapper and red grouper; sharks including Sandbar sharks and abundant small-body species, including Sandbar sharks and other abundant small shark species.

Data: Electronic monitoring provides permanent documentation from set-haul events, which can be linked to environmental conditions and other metadata; includes integration of a underwater camera to improve data on large shark sex, condition, and short-term post-interaction fate, and stern cameras for evaluating discards short-term survival and predator interaction. The team has over five years of data from 22 vessels from Florida and Texas. In addition, the team is working to reduce video review time through Artificial Intelligence (AI) applications and automating production of frequent catch, condition, fate, temporal patterns, and spatial distributions using ArcGIS Optimized Hotspot Analysis.

Incentives: Creating this tool can help fishermen maintain fishery access and collect valuable data on catch, bycatch, and discards.

Other points: The electronic monitoring system integrates video, various sensors, and location data with detailed species annotations provided by reviewers.

LESSONS LEARNED

1. The Mote CFEMM wants to use new technologies and approaches for data processing, including artificial intelligence development, environmental data integration, and automated map production.
2. The closer data is to real-time, the easier it is to understand relationships between species and the environment.
3. The team is exploring the possibility of integrating data on depredation through this project.

PRESENTATION 9

Area-Based Management Tools for Quasi-Real-Time and Long-Term Avoidance of Temporal and Spatial Bycatch Hotspots

Eric Gilman, The Safina Center

SUMMARY

Area-based management tools (ABMT), including dynamic tools such as move-on rules and fleet communication, are one of a broad range of approaches to mitigate the catchability and fishing mortality risk of threatened bycatch.

Several criteria can be used to assess alternative bycatch management strategies and individual mitigation measures, including: (1) the tier in a sequential mitigation hierarchy, (2) strength of evidence of the efficacy, (3) the risk of exacerbating the catch rate of other threatened bycatch species, (4) costs to commercial viability, and (5) the likelihood of compliance given the fishery-specific enabling environment and potential for fishing industry support.

High quality datasets from observer and electronic monitoring programs support statistical modeling approaches that produce robust estimates of temporal and spatial bycatch hotspots. Effort needs to be standardized to account for explanatory predictors of bycatch catchability and fishing mortality.

Other points: Bycatch can have different definitions, including absolute bycatch amounts or bycatch-to-target catch ratios. This analysis looked at several static and dynamic bycatch ABMTs including seasonal, real-time, permanent, spatially explicit, and other area-based measures.

LESSONS LEARNED

1. A combination of measures may be needed to achieve bycatch management goals.
2. The following conditions are necessary for quasi real-time bycatch hotspot avoidance to be effective:
   - 2.1. Economic, practicality, safety or regulatory incentives need to be larger than disincentives
   - 2.2. The interactions need to be rare and patchy spatially or temporally. Quasi-real-time bycatch avoidance through move-on rules and fleet communication are likely inappropriate approaches to address a fisheries' bycatch problem when interactions are common, occurring across fishing grounds and seasons.
   - 2.3. Based on characteristics of the bycatch species, fleet communication networks may be effective in avoiding some species, such as albatrosses, but not as effective in avoiding others, such as odontocete whales.
   - 2.4. If there's a risk that competitors will obtain information on fishing locations, companies may decline to participate.
   - 2.5. Technical capacity is needed to facilitate near-real-time communication. If near-real-time communication is a regulatory requirement, it would require robust observer or electronic monitoring programs – where an electronic monitoring audit model could be used.

Key Findings/Recommendations for the Project

1. Tailor talking points about the project to the specific fisheries and those fisheries' needs in order to enhance effectiveness of outreach.
2. Leverage industry organizations and partners for communications and outreach, and to help build trust.
    a. Outreach efforts should include industry events; fishermen often do not have smartphones or check email frequently.
3. Use this project as an opportunity to educate stakeholders on benefits of hotspots identification.
    a. Put together a project description that is less technical and easily understandable to the general public.
    b. Describe hotpot mapping as a "tool in the toolbox" and clearly articulate the value added to fishermen.
    c. Define the problem for an individual fishery and then present hotspot networks as one aspect of a solution.
4. Identify incentives that exceed negative impacts.
    a. Economic incentives include maintaining catch levels while reducing inputs of time, fuel, and gear wear and tear.
    b. Enhancement of fishing and angling experiences through avoidance of shark depredation.
    c. Marketing opportunities include Marine Stewardship Council certification, eco-labeling, and traceability.
    d. Regulatory incentives to participate in hotspot mapping programs include the ability to use experimental gear or access restricted fishing areas.
    e. Good media/press.
    f. Need for adaptive approaches in light of climate impacts.
5. Explore measures/initiatives to enhance trust and participation such as established industry groups or the Gulf of Mexico Fisheries Management Council such as shrimp and/or Reef Fish—and bringing in a third party for data management.
6. Determine technology and data specific to the fishery that benefits the fishermen, including considering bycatch rates versus bycatch amounts as appropriate, and ensuring timely communication of data.

APPENDIX 1:
ATTENDEES

Lee Benaka, National Oceanic and Atmospheric Administration (NOAA), Fishery Management Specialist

David Bethoney, Commercial Fisheries Research Foundation, Executive Director

Ellen Bolen, National Fish and Wildlife Foundation (NFWF), Director, Coastal and Marine Conservation

Julia Calderwood, Marine Institute (Foras na Mara), Postdoctoral researcher

Scott Curatolo-Wagemann, Cornell Cooperative Extension of Suffolk County, Senior Resource Educator

Michael Dance, LSU, Assistant Professor

Julie Falgout, Louisiana Sea Grant, Seafood Industry Liaison

Brett Falterman, Fisheries Research Support, Fisheries Liaison

Erika Feller, Marine Stewardship Council, Regional Director, Americas

Elizabeth Fetherson-Resch, NOAA, Marine Mammal Restoration Coordinator

Eric Gilman, The Safina Center, Senior Fellow

Heather Glon, NOAA, Knauss Fellow/Fisheries Dependent Data Specialist

Gary Graham, Teal Trawlers, Shrimp Vessel Owner

Janelle Hangen, Environmental Defense Fund (EDF), Senior Specialist, Fisheries Innovations

Elliott Hazen, NOAA, Research Ecologist

Cheryl Hennessy, Cardno, Senior Project Scientist

Scott Hickman, Charter Boat Captain

Hazel Horvath, The Hatcher Group, Senior Associate

Alison Johnson, Marine Stewardship Council, Gulf of Mexico Fisheries Manager

Ryan Knotek, New England Aquarium, Assistant Scientist

Max Lee, Mote Marine Laboratory, Staff Biologist

Steve Martell, Sea State Inc, Scientist

Stephanie Martinez-Rivera, NOAA, Fishery Biologist

Carole Neidig, Mote Marine Laboratory, Staff Scientist

Kelli O'Donnell, NOAA, Fisheries Biologist

Cate O'Keefe, Fishery Applications Consulting Team, Principal Consultant

Kristen Peterson, The Hatcher Group, Vice President

Laura Picariello, Texas Sea Grant, Fisheries Extension Specialist

Gray Redding, NFWF, Manager, Fisheries Conservation

James Reinhardt, NOAA, Marine Resource Specialist

Ryan Schloesser, Mote Marine Laboratory, Staff Scientist

Jordan Watson, NOAA, Mathematical Statistician

Katie Westfall, EDF, Acting Senior Director, Resilient Fisheries

Nick Whitney, New England Aquarium, Senior Scientist

Noelle Yochum, NOAA, Research Fisheries Biologist

APPENDIX 2:
WORKSHOP AGENDA

WEDNESDAY, APRIL 20

Time (CT)	Programming
9:30 am WELCOME (15 mins)	Gray Redding provides welcome, introductions, review of agenda
9:45 am OVERVIEW (15 mins)	Gray and Lee Benaka provide overview of Hotspots Mapping Initiative
10:00 am SESSION (20 mins)	**EcoCast** Elliott Hazen, NOAA Fisheries, Southwest Fisheries Science Center
10:20 am SESSION (20 mins)	**Hotspot Mapping and Information Sharing to Avoid Unwanted Catches** Dr. Julia Calderwood, Marine Institute (Foras na Mara)
10:40 am SESSION (20 mins)	**Requirements for the Rolling Salmon Hotspot Closures in the Bering Sea Pollock Fishery** Steven Martell, Sea State Inc.
11:00 am SESSION (20 mins)	**Cornell Cooperative Extension Program** Scott Curatolo-Wagemann, Cornell Cooperative Extension
11:20 am PANEL (60 mins)	Panel discussion Moderator: Lee Previous presenters plus Dave Bethoney, Commercial Fisheries Research Foundation, and Cate O'Keefe, Fishery Applications Consulting Team
12:20 pm LUNCH (60 mins)	LUNCH BREAK - delivered to room by 12:30

APPENDIX 2:
WORKSHOP AGENDA

WEDNESDAY, APRIL 20 *continued*

Time (CT)	Programming
1:20 pm SESSION (20 mins)	**Hotspot Mapping for Salmon in the North Pacific** Jordan Watson and Noelle Yochum, NOAA Fisheries, Alaska Fisheries Science Center
1:40 pm SESSION (20 mins)	**Hotspot Analyses for Northeast Fisheries using Trawl, Dredge, and Gillnet Gears** Ryan Knotek and Nick Whitney, New England Aquarium
2:00 pm SESSION (20 mins)	**Hotspot Mapping and Highly Migratory Species** Katie Westfall, Environmental Defense Fund
2:20 pm SESSION (20 mins)	**Hotspot Analyses using Electronic Monitoring** Ryan Schloesser, Max Lee, Carole Neidig, Mote Marine Laboratory, Center for Fisheries Electronic Monitoring at Mote (CFEMM)
2:40 pm SESSION (20 mins)	**Area-Based Management Tools for Quasi-Real-Time and Long-Term Avoidance of Temporal and Spatial Bycatch Hotspots** Eric Gilman, The Safina Center
3:00 pm BREAK (15 mins)	BREAK – snacks delivered to room
3:15 pm PANEL (60 mins)	Panel discussion Moderator: Gray Previous presenters
4:15 pm SESSION (15 mins)	Preview of Day 2 Brett Falterman, Fisheries Research Support, LLC
4:30 pm CLOSING	ADJOURN

APPENDIX 2:
WORKSHOP AGENDA

THURSDAY APRIL 21

Time (CT)	Programming
9:30 am OPEN (15 mins)	Welcome and discuss Hatcher/Cardno role Gray Redding Hatcher gives recap of Day 1 Kristen Peterson
9:45 am SESSION (45 mins)	Results of Stakeholder Interview Sessions Kristen Peterson, Brett Falterman
10:30 am PANEL (75 mins)	Panel Discussion: How Might Hotspot Mapping Work in the Gulf? Moderator: Brett Falterman Panelists: Gary Graham, Teal Trawlers, Laura Picariello (TX Sea Grant), Stephanie Martínez-Rivera (NOAA Fisheries), Kelli O'Donnell (NOAA Fisheries), Elizabeth Fetherston-Resch (NOAA Fisheries)
11:45 am BREAK (25 mins)	BREAK – snacks delivered to room
12:10 pm SESSION (50 mins)	Lessons Learned from Workshop, Thoughts on Ingredients for Success in the Gulf Lee Benaka; Jamie Reinhardt, NOAA Fisheries
1:00 pm CLOSING	ADJOURN


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE


NATIONAL FISH AND WILDLIFE FOUNDATION

NFWF