

Briefing on fishery dependent data and bycatch estimation

Objective: Collecting and analyzing fishery dependent data is required under many federal laws and authorities such as the [Marine Mammal Protection Act](#) (MMPA), the [Endangered Species Act](#) (ESA), the [Magnuson-Stevens Fishery Conservation and Management Act](#) (MSFCA), and the [Sustainable Fisheries Act](#). Fishery dependent data are used to estimate and understand bycatch of protected species in commercial fisheries, and also to identify and monitor mitigation strategies. Estimating and assessing the impact of bycatch on protected species populations addresses requirements under the MMPA (Section 117, to prepare Stock Assessment Reports, and Section 118, to develop and implement take reduction plans to assist in the recovery or prevent the depletion of strategic marine mammal stocks that interact with [Category I and II fisheries](#)); the ESA (Section 7, to ensure that any action federal agencies authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species); and the MSFCA (Section 301, national standard 9 to minimize bycatch and the mortality of such bycatch, and Section 303 to minimize bycatch and mortality in Fishery Management Plans).

Data sources: The data used include details of fishing hauls and trips from a sample of the commercial fishery (observer data) and a more general census of the fishing effort (effort data). In addition, both observed and non-observed fishing locations are often linked to remotely-sensed environmental data when bycatch rates are modeled as a function of environmental covariates.

1) Samples of the commercial fisheries are collected by the Northeast Fisheries Science Center's [Fisheries Sampling Branch](#) (FSB) which manages the Northeast Fishery Observer Program (NEFOP) and the At-Sea Monitoring Program (ASM). These programs collect, process, and manage data and biological samples obtained by trained fishery observers. Data include information about the trip, haul, gear characteristics, fishing practices, kept and discarded catch, biological data of protected species brought onboard, and incidental sightings of protected species around the boat. There is an extensive QA/QC process by both the FSB and analysts within PSB that result in data that can be used in protected species bycatch analyses (Warden and Orphanides 2008). More information on the observer programs can be found in **NEFSC Observer Presentation_finalf.pdf**¹.

2) Strandings are collected by the [Northeast Regional Stranding and Disentanglement Program](#) (**NERStrandHistory.pdf**). These animals provide biological information about the species and sometimes the cause of mortality can be determined. The numbers and general locations of strandings and entanglements are reported in the Stock Assessment Reports. These data can provide general information on bycatch locations and types of fisheries involved, which have been particularly useful in times and areas where observer program coverage is low or non-existent.

3) Fishing effort data includes data from [Vessel trip reports](#) (VTR), [Dealer reports](#), [State databases](#), and the [vessel monitoring system](#) (VMS). VTRs (required for almost all federally regulated fisheries) are the best source of location and fishing effort data and are filled out by the captain (**Dealer & Vessel Reportingtf.pdf**). Dealer reports are filled out by dealer houses and so are considered a census of all landings, but they do not contain location and fishing effort data (Dealer & Vessel Reportingtf.pdf). To obtain fishing effort data from areas not covered by VTRs, in particular off [North Carolina](#) and [Virginia](#), the state fishing effort

¹ Documents in bold are core background documents for this review.

databases are used. Several data sources are often used together to estimate total fishing effort (Murray 2009). Currently the VMS data are not being used for bycatch related analyses.

4) To compliment observer data, environmental data are obtained from satellites, ocean-models, or static environmental layers. See Murray and Orphanides (2013) as an example.

Bycatch analyses: NEFSC provides bycatch estimates for cetaceans, pinnipeds, sea turtles and sea birds in the observed commercial fisheries, where most of the bycatch are in seven New England and Mid-Atlantic fisheries. Methods used to estimate total bycatch include stratified ratio estimators (Belden et al. 2006; Bisack 2003; **Hatch and Orphanides 2013**; Hatch and Orphanides in review; Kocik et al. 2014; Lyssikatos in review; Wigley et al. 2014), generalized additive models (**Murray 2009**; 2011; Orphanides 2009; Warden 2011), and Bayesian techniques (Hatch in review). To calculate accurate and unbiased bycatch estimates of these rare events, the analyses have to consider issues that are specific to the situation, e.g., season and area, gear characteristics and fishing practices, mitigation measures, observer program vessel selection procedures, serious injury determination (Waring et al. 2014; in review), and finite correction factors. The type of model or method used to estimate bycatch, as well as the unit of effort in the analysis, is often dictated by the structure and quality of the observer and commercial data. Additional bycatch estimation papers are listed in Appendix 1.

Biological information: The animals caught in observed fishing trips have provided a wealth of information on basic cetacean biology (Koopman et al. 2002; McLellan et al. 2002; Westgate and Read 2007), demographic parameters (Moore and Read 2008), stock structure (Adams and Rosel 2006; Luca et al. 2009; Rosel et al. 1999a; 1999b; Vollmer 2011; Westgate 2007), and diet/foraging patterns (Craddock et al. 2009; Gannon et al. 1998; **Wenzel et al. 2013**). Loggerhead curved carapace length measurements recorded by observers are used to translate observed and total bycatch into “adult equivalents”, which provides a better measure of the population impact of bycatch (Haas 2010; Murray 2011).

Management needs: Results from bycatch analyses have been used to meet a variety of management goals (Appendix 1). For instance, studies on factors affecting bycatch rates, and the spatial and temporal distribution of bycatch rates, have been used at all of the six take reduction teams that deal with US Atlantic fisheries, as well as fishery management Plan Development Teams and conservation engineering workshops.

For example, at the [2012 harbor porpoise take reduction team meeting](#) information related to fishery dependent data on the following were presented: overview of the observer program, background on how bycatch is estimated, compliance levels (Orphanides 2010; 2012; Orphanides and Palka 2010), non-compliance behavior research, gear characteristics and fishing practices related to high and low levels of bycatch (**Palka et al. 2008a**; b), modeled predicted bycatch under potential mitigation options (**Palka and Orphanides 2008**), and research on developing gear modifications that could reduce bycatch.

The fishery dependent data have also been used to inform management of loggerhead turtle takes. For example, the spatial and temporal distribution of bycatch rates (Murray 2011) helped inform seasonal closures of the scallop dredge fishery, as required under an ESA Section 7 Biological Opinion, as well as research into dredge gear modifications to reduce sea turtle injuries (Smolowitz et al. 2010). Furthermore, bycatch estimates for each managed fishery are the basis of ESA Incidental Take Statements (**Murray 2013**). The impact of bycatch removals are subsequently considered in population assessments (Haas 2010; Warden and Murray 2011; **Warden et al. 2015**).

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Appendix 1.

Additional papers related to this topic, but not directly referred to

Bycatch analyses Cetaceans and pinnipeds

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Bycatch analyses

Turtles

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Bycatch analyses

Fish

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Bycatch analyses

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Biology

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Related to management

Cetaceans and pinnipeds

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Related to management

Turtles

- Merrick, R., Haas, H. 2008. Analysis of Atlantic sea scallop (*Placopecten magellanicus*) fishery impacts on the North Atlantic population of loggerhead sea turtles (*Caretta caretta*). NOAA Tech Memo NMFS-NE-207.

Warden, M.L. 2011. Proration of loggerhead sea turtle (*Caretta caretta*) interactions in US Mid-Atlantic bottom otter trawls for fish and scallops, 2005–2008, by managed species landed. NEFSC Reference Document 11–04.

Related to management

Experiments to developing mitigation measures

A.I.S., Inc. 2010. The effects of hanging ratio on marine mammal interactions and catch retention of commercially important finfish species (NOAA contract No. EA133F10SE2585).

Silva, R.D., DeAlteris, J.T., Milliken, H.O. 2011. Evaluation of a pound net leader designed to reduce sea turtle bycatch. *Marine Fisheries Review* 73: 36–45.

Smolowitz, R., Haas, H., Milliken, H.O., Weeks, M., Matzen, E. 2010. Using sea turtle carcasses to assess the conservation potential of a Turtle Excluder Dredge. *North American Journal of Fisheries Management* 30: 993–1000.

Related to management

Seabirds

Hatch, J.M., Wiley, D., Murray, K.M., Welch, L. in press. Integrating satellite-tagged seabird and fishery-dependent data: a case study of Great Shearwaters (*Puffinus gravis*) and the U.S. New England sink gillnet paper. *Conservation Letters*.