Results of Young of Year Rockfish Surveys in Puget Sound

2015-2016

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NOAA FISHERIES
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ROCKFISH CONSERVATION
Bottom-up Recovery of Puget Sound

Abstract

Knowledge of rockfish recruitment dynamics and habitat utilization by recently settled rockfishes is valuable for developing appropriate fishery management and recovery actions. However, no current survey effort provides the spatial and temporal data necessary to fill these data gaps. To address this need, NMFS has collaborated with state and federal agencies, non-profit groups and academic institutions to develop a citizen science SCUBA survey program directed at young-of-year (YOY) rockfish. In this program, divers perform timed roving surveys in discrete habitat types, taking data on rockfish abundance in four morphological classes and qualitative data on habitat. These methods were implemented in 2015 and 2016 throughout Puget Sound to gather a small amount of baseline data and develop relationships with citizen groups as a pilot methodology to inform the development of a larger YOY monitoring program. Fifteen divers from six institutions, along with several unaffiliated citizens participated in this initial effort. Rockfish densities were expectedly low and variable, highlighting the need for this program to increase effort to be effective in the future. This current report documents preliminary effort and only an expanded, sustained program provide necessary data to better characterize rockfish recruitment.

Introduction

Rockfish comprise a suite of viviparous species within the genus *Sebastes* that function as mid-level predators in nearshore marine habitats. While they are found throughout the west coast of the United States, populations in Puget Sound have decreased in the past century primarily as a result of over-fishing and reductions in habitat quality. NOAA's National Marine Fisheries Service (NMFS) has listed both yelloweye rockfish (*Sebastes ruberrimus*) and bocaccio (*Sebastes paucispinis)* under the Endangered Species Act and subsequently released a draft recovery plan in August of 2016. An important action listed in the draft recovery plan is to enable a greater understanding of listed rockfish population abundance and habitat associations. Included under this action are annual surveys of young of year (YOY) rockfish throughout Puget Sound. Because listed YOY rockfish are particularly rare (YOY bocaccio have yet to be documented in the Puget Sound) a comprehensive effort on *Sebastes* YOY abundance and habitat association in the region would shed additional light on recruitment dynamics in association with climatic, oceanic and habitat variables and help shape various management efforts.

Rockfish begin their life cycle as planktonic larvae that drift throughout pelagic habitat. After three to six months, they settle as juveniles into nearshore or benthic habitats. Juveniles are known to aggregate in areas of high rugosity or submerged aquatic vegetation, such as kelp and seagrass (Buckley 1997). Reefs and vegetated areas with low densities of adult and subadult rockfishes have been shown to hold higher densities of YOY (Matthews 1990; West et al 1994). As rockfish typically reproduce in the spring, YOY are often found in nearshore habitats in the summer and fall (Doty et al 1995), though interannual and spatial variation in abundance is high (Sakuma et al 2006; Ralston et al 2013). This information on rockfish life history allows for a more robust, long-term sampling program that quantifies recruitment strength and may be applied to stock assessments and habitat management.

The utilization of relatively shallow and nearshore habitats by YOY rockfish makes surveys on SCUBA possible. A visual census on SCUBA allows for direct observation of fishes in vegetated, high-relief and/or shallow habitats that may be challenging for other sampling approaches. However, SCUBA surveys at this scale are resource-intensive, which may pose a challenge for any lone stakeholder interested in monitoring juvenile rockfish throughout Puget Sound. Engaging with citizen divers

provides an opportunity to collect sufficient data to answer the project's core questions and engage with a valuable stakeholder group for rockfish recovery. There are numerous examples of recreational divers effectively collecting scientific data on biodiversity (Goffredo et al 2010), elasmobranchs (Ward-Paige and Lotze 2011) and fish abundance (Bodilis et al 2014). In addition, the Seattle area has an active dive community that could support such an effort. Given the biology of rockfish, effectiveness of citizen dive surveys and pool of divers, NMFS began designing a program to monitor YOY rockfish abundance throughout Puget Sound. This report presents results from development and preliminary data collection in support of a long-term YOY rockfish monitoring program.

Methods

From 2014 through 2015, NMFS consulted with many regional rockfish and fish survey experts to plan an effective approach for citizen monitoring including: Washington Department of Fish and Wildlife, The Northwest Straits Initiative, The Seattle Aquarium, The SeaDoc Society, NOAA's Northwest Fisheries Science Center, UC Santa Barbara and REEF. The most important tradeoff in designing this citizen science methodology was to make the approach robust enough to collect useful data yet manageable for recreational divers[1]. The current methodology is outlined below, though it should be noted that this is considered a living program and is open to revision in the future.

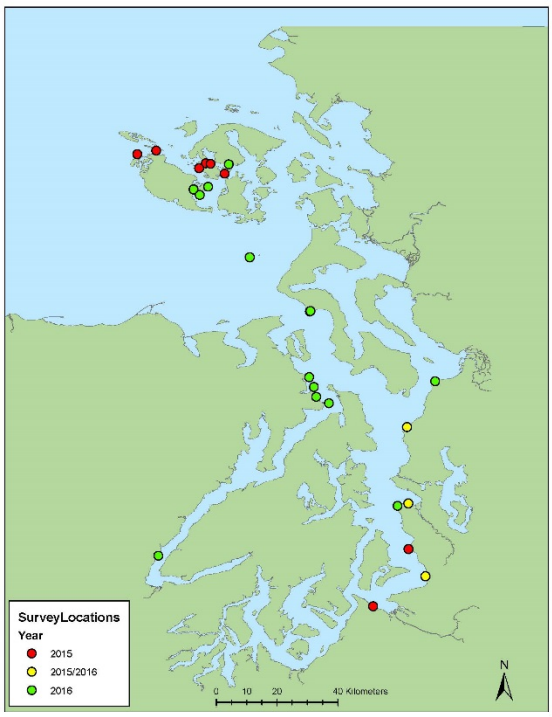


Figure 1. Map of sampling locations in 2015 and 2016.

Fish

The diver recording fish (if in a buddy pair) documents all visible YOY/juvenile rockfish (individuals < 10 cm) within 1m on either side of their swimming path and 1 m of the substrate. This survey is timed and lasts as long as new habitat is being searched. During 2015, the swimming path was a five minute transect (i.e. a single heading) while in 2016 divers utilized a timed roving survey. If habitat is patchy (i.e. areas of one habitat type are separated by a distinctly different habitat type), distinct patches are counted as separate surveys. If macroalgae or eelgrass were being surveyed, the diver lightly disturbs the vegetation to better expose individuals. If rocky substrate is present, the surveyor should use a flashlight to illuminate potential hiding places. YOY rockfish do not need to be recorded to species. Instead, they are classified into one of four categories based on Lonhart's YOY fish guide (Appendix 1): 1) Deep body with dorsal spot, 2) deep body without dorsal spot, 3) elongate body with dorsal spot and 4) elongate body without dorsal spot. If the diver could not classify the individual to one of those groups, "YOY" was simply noted.

Habitat

[1] Surveys were undertaken during regular recreational diving activities.

The diver recording habitat (if in a buddy pair) follows the fish sampler and takes data on habitat type. As each survey is completed in an area dominated by a single habitat type, the sampler records several categorical metrics to further describe the habitat. These metrics are general and may be completed following the dive based on discussion between both divers. Video or still images may also be taken to improve evaluation of habitat type metrics. In addition, survey depths were recorded and contained within one of three bins: shallow (≤ 20 feet), intermediate (21-60 feet) and deep (> 60 feet).

Rocky Reef

Relief – > 3 feet, 1-3 feet, < 1 foot

Presence of benthic macroalgae – Common, Sparse, Rare to non-existent

Eelgrass

Density – high (greater than 10 turions/square foot), medium (1-9 turions/square foot) and low (< 1 turions/square foot). These measures are approximate as the divers do not carry a quadrat

Length - These measures are approximate as the divers do not carry a measuring device.

Kelp Forest

Kelp density – high (> 100 stipes encountered during five minutes of survey), medium (20-100 stipes encountered during five minutes of survey) and low (<20 stipes encountered during five minutes of survey).

Canopy height

Soft-bottom

Sediment type – sand or silt

Detrital algae – common, occasional or rare

Listed Species Documentation

Concurrent to this project, NMFS and WDFW initiated a program for citizens to report YOY encounters of yelloweye rockfish, canary rockfish and bocaccio. Outreach staff developed a flyer with identification and reporting information that was distributed to various dive organizations, non-profit and academic institutions. This program was distinct from the above as it required no specific survey protocol and data collection beyond an observation of species

Table 1. *Sampling effort in 2015 and 2016.*

	2015		2016	
Basin	Transects	Sampling Events	Transects	Sampling Events
Central	11	4	9	4
South	3	1	5	2
Whidbey	0	0	4	1
Hood Canal	0	0	8	3
San Juan	28	2	11	2
Total	42	7	37	12

presence. If divers encountered an individual, they were asked to take a picture, note its location and depth and send NOAA the information at *RockfishID@noaa.gov*.

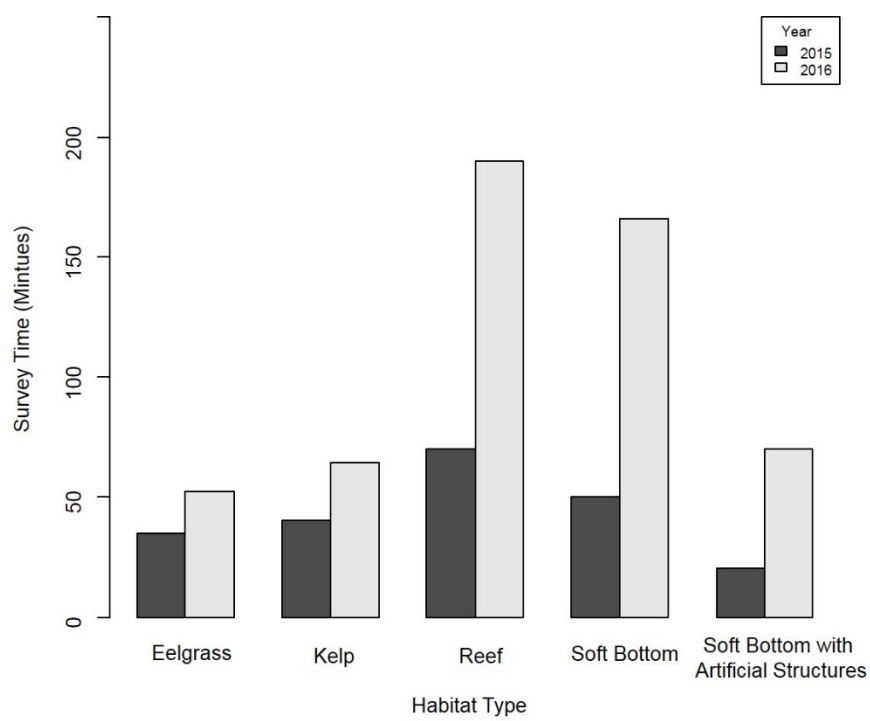
Results

Table 2. *YOY rockfish encounter statistics in 2015 and 2016.*

	2015	2016
Total Fish	56	70
Total Sampling Time (min)	210	542
CPUE (fish/min)	0.266667	0.129151

Fifteen divers, either from one of six institutions or unaffiliated citizens, took part in surveys. Eighty transects were completed over 19 sampling events that included all five basins of Puget Sound (Table 1; Figure 1). Survey effort was focused on reef and soft-bottom habitats, followed by kelp and eelgrass (Figure 2). The majority of surveys were conducted in the shallow depth zone (42 transects), followed by intermediate (30 transects), then deep (8 transects). Given low sample sizes and high variation, the following comparisons were assumed to lack statistical significance and were not tested. Instead, these general trends are intended to inform future work. More rockfish were located in 2016 than 2015, though this result was driven by increased survey time as catch per unit effort (CPUE) declined (Table 2). Mean CPUE for each basin was below one YOY · minute^{-1} in both 2015 and 2016. The highest CPUE by region and year was in Central Sound in 2015, primarily driven by a single dive at Edmonds Underwater Park where three transects averaged 3.33 YOY · minute^{-1} (Figure 5A). Among habitat types, kelp forests exhibited the highest mean CPUE followed by rocky reefs, eelgrass and artificial structures interspersed amongst mostly soft-bottom habitat (Figure 5A). CPUE was greatest in the intermediate depth bin (Figure 5A). Variability in CPUE was high across all regions, years and habitat types with coefficient of variations typically greater than 100% (Table 3). Only deep-bodied rockfish without a dorsal spot were found in 2015 while in 2016 elongate rockfish with (18%) and without (9%) a dorsal spot were encountered though deep-bodied rockfish without a dorsal spot were still dominant (73%).

Figure 3. *Survey effort by habitat type in 2015 and 2016.*



The listed species reporting program has received eight reports of YOY listed yelloweye or recently delisted canary rockfish. Five responses reported YOY yelloweye at Sund Rock in Hood Canal while YOY canary rockfish were found in Central Sound, Whidbey Island and the San Juan Islands (Figure 4).

Discussion

This effort was a valuable first step in establishing a citizen young of year rockfish survey program in Puget Sound to explore trends in density, habitat utilization species composition. Many divers from a diversity of backgrounds and affiliations joined in the data collection with expectations of additional surveys in the future. However, collecting sufficient amounts of data to draw meaningful conclusions on rockfish recruitment requires a substantial resource investment beyond what was included for this pilot study. The high CVs in CPUE throughout all sections of Puget Sound support that conclusion. However, valuable insights have been gained through this initial work. For example, coefficients of variation may be used in development of a power analysis to determine the appropriate sampling effort to obtain meaningful results. The paucity of data on YOY rockfish throughout Puget Sound make these results valuable in any related future study (e.g. habitat modeling). And finally, habitat information on YOY rockfish in Puget Sound may direct establishment of permanent monitoring sites for this project. Therefore, results of this study should be appropriately caveated in that they, like participation in this program, represent a first step in a long-term goal of evaluating rockfish recruitment across regions and habitat types in Puget Sound.

Table 3. *Coefficients of Variation by habitat type and basins of Puget Sound. ¥ denotes data were collected in 2016 only and * indicates data collected in 2015 only.*

Habitat Type (CV)	Basin (CV)
Eelgrass (276.49)	Central (135.33)
Kelp (328.83)	Hood Canal (210.43)*
Reef (353.37)	San Juan (529.15)¥
Soft Bottom (359.94)	South (176.53)
Soft Bottom with Artificial (91.13)	Whidbey (167.98)*

The results of this study are consistent with expectations:

- Density of YOY rockfish was low and patchy (Hayden-Spear 2006),
- Individuals showed a preference for eelgrass, kelp and rocky reefs, (Danner et al 1994; Dean 2000; Murphy et al 2000)
- The majority of recorded individuals were deep-bodied with no dorsal spot, a group that comprises the most common rockfish in Puget Sound (Palsson et al 2009).

taken by Pat Lynch, and submitted to rockfishid@noaa.gov.

The lack of YOY rockfish found in the San Juan Islands was surprising given the abundance of reef habitat in the region as compared with South and Central Puget Sound. This result may be caused by the abundance of preferable habitat (e.g. rocky reef, kelp) in the San Juan Islands that leads to a decrease in density as compared with other regions, and subsequent YOY surveys in the San Juan area found an abundance of YOY's (SeaDoc 2016). Because survey efforts throughout Puget Sound often target preferable habitats, YOY rockfish frequency may be overestimated in the Central and Southern regions.

This possible artifact in the data should be considered during future analyses and illustrates the benefit of collecting preliminary observations. Thus, the data are not yet sufficient to answer broader questions regarding recruitment. However, that preliminary data were consistent with the literature suggests additional effort over time will help address these questions, particularly if they are complimented with additional YOY recruitment monitoring via complimentary sampling methods.

Given the utility of these data in rockfish recovery and interest from various groups, NMFS will pursue expansion of this program in the future. NOAA's Northwest Fisheries Science Center is currently working on a YOY sampling design that will provide divers with suggested survey locations and an idea of effort needed to draw meaningful conclusions. The Seattle Aquarium is creating an outreach pamphlet that describes basic YOY rockfish identification, survey methods and other useful information that will promote participation. The WDFW documents YOYs through Remotely Operated Vehicle surveys and is developing additional YOY sampling technologies such as fish traps. Non-profit groups, such as REEF, may also provide useful data that could be incorporated into a broader assessment. These tools will help research partners engage with the community to create a long-term database of YOY rockfish that can be associated with various oceanic, climatic and habitat variables to inform future management.

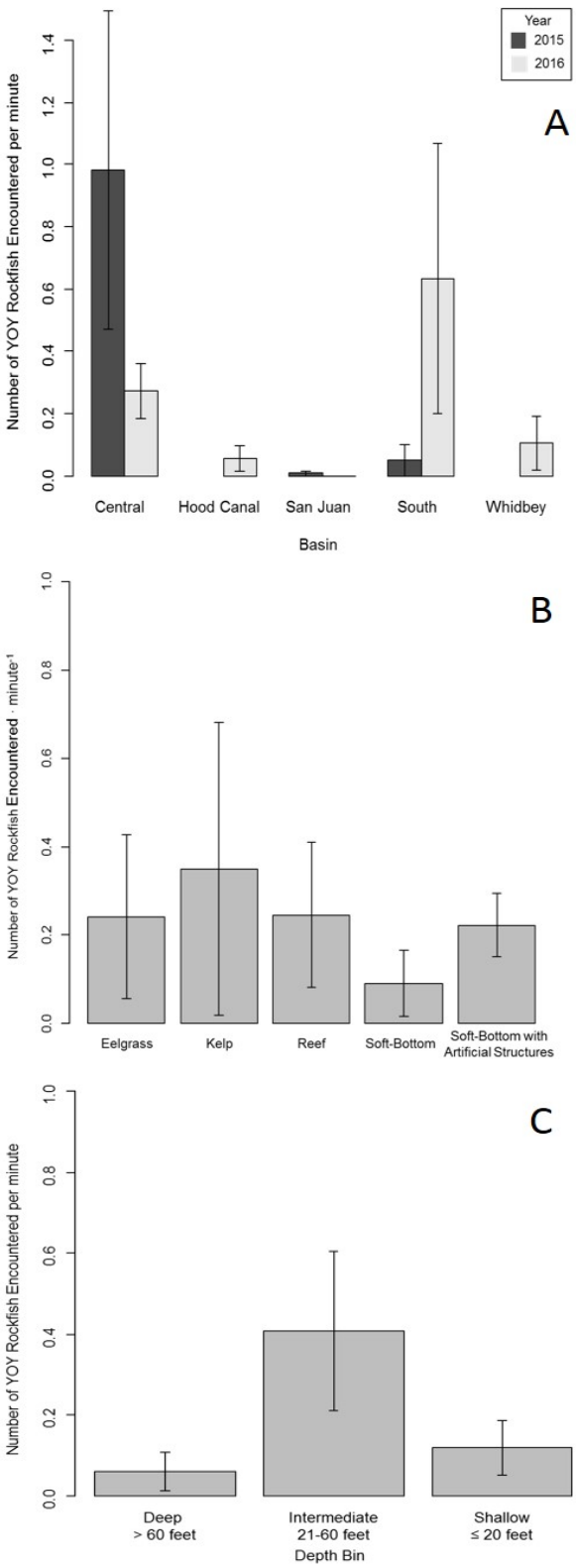


Figure 4. *Catch per unit effort based by (A) basin, (B) habitat type and (C) depth. Error bars are standard error.*

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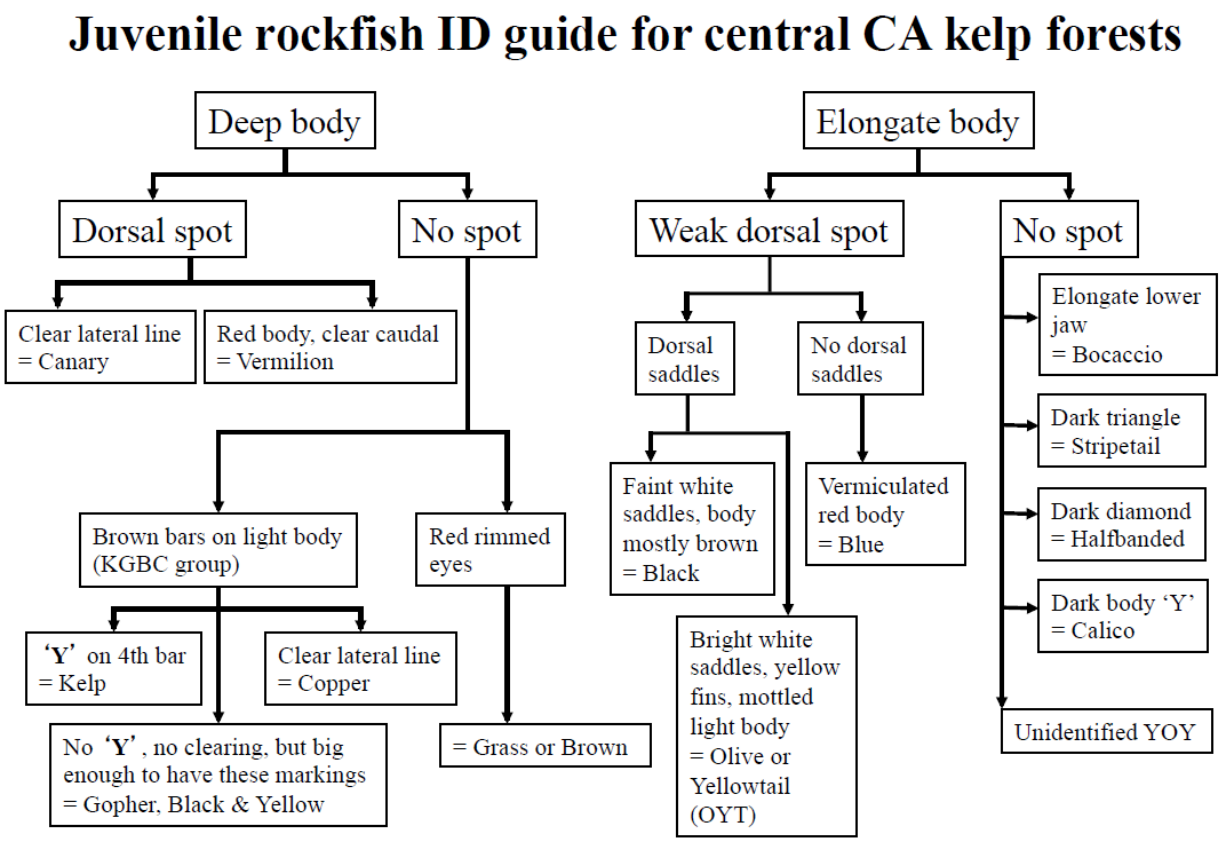
Appendix 1. Lonhart's identification guide for YOY rockfish.