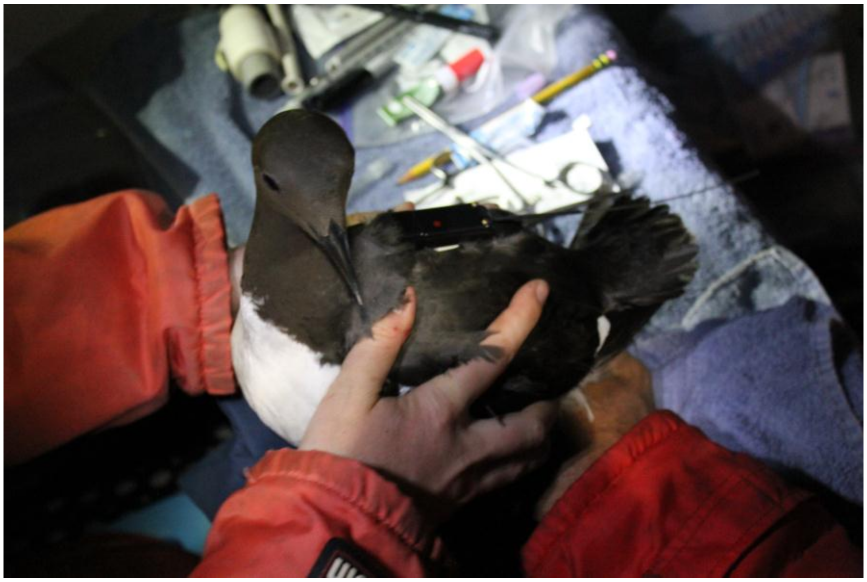
Yaquina Head Seabird Colony Monitoring
2015 Season Summary



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Project Overview

Yaquina Head Outstanding Natural Area (YHONA) is home to some of Oregons's largest and most publically visible seabird colonies, including over 60,000 Common Murres (*Uria aalge*). The seabird colonies surrounding Yaquina Head present a unique opportunity for research and monitoring given their close proximity to viewing platforms and intensive oceanographic studies of surrounding waters. Additionally, this has been one of the most rapidly growing and productive murre colonies on the Oregon coast. In the past 5 years however, reproductive success has been greatly reduced and colony size has fluctuated markedly. Summer 2015 was the 9th consecutive year of collaboration between Oregon State University, U.S. Fish and Wildlife Service, and the Bureau of Land Management. Combined with similar studies conducted by Julia Parrish (University of Washington) at YHONA from 1998 to 2002, we are extending a much needed time series investigation for the Oregon Coast (currently at 14 years). Unfortunately, no reproduction and diet data (other than stable isotope samples) were collected at YHONA from 2003-2006, a timeframe containing highly anomalous ocean conditions. Basin scale ocean conditions in 2015 were widely considered anomalous, with a 'warm blob' of warm water persisting offshore and the development of El Niño conditions that continued to grow throughout the year. This year followed on the heels of a predicted El Niño in 2014 that never fully developed; conditions in the NE tropical Pacific remained below the El Niño threshold until March 2015. The conditions in 2015 started with a slightly earlier than average spring transition with strong upwelling winds during June, somewhat similar to the conditions during 2006. Looking ahead, the El Niño conditions are forecasted to remain strong through the spring and summer of 2016 and may be comparable in strength to the 1997-1998 event. Therefore, these continue to be interesting years to capture seabird responses to environmental variability on the central Oregon coast.

In general, we are interested in how seabird breeding chronology, reproductive success, diet, and foraging activities are affected by changing ocean conditions. Furthermore, we wish to quantify the effects of Bald Eagles and other sources of predation on or disturbance to seabirds during the breeding season. At YHONA, we monitored 12 plots on Colony Rock and Flattop Rock (Fig. 1) throughout the breeding season (April-August). Within these plots, we closely observed breeding birds (Fig. 2), watching and recording when eggs were laid and then following the success of each breeding pair through egg incubation and chick rearing. Simultaneously, we watched for disturbances to the breeding colony and recorded the frequency, duration, and consequences (e.g., loss of eggs or chicks) of these events. For prey identification, we used a digital camera and spotting scope (digiscoping; Fig. 3) to photograph fish in the bills of murres returning to the colony. This information allows us to analyze the birds' diet and provide information about foraging conditions and link to oceanographic investigations adjacent to these seabird colonies. We also conducted observations to estimate the time elapsed between chick feeding events, which can be used as a proxy for prey availability near the colony.

Results

In 2015 we logged 110 hours during 46 days of observations between 27 May and 28 July (Table 1). **Common Murres had a total reproductive failure (reproductive success = 0.00 ± 0.00 SE) on both Colony Rock and Flat Top.** This was the first time in 14 years of data collection that both sub-colonies failed, maintaining a 5 year run (2011-2015) of low reproductive success that is less than half the success for the first four years of study (2007-2010, Table 1).

During 110 hours of observation, we witnessed 65 disturbance events where a minimum of 360 eggs, and 24 adult murres were taken (Table 1). Like the previous two seasons, much of the reproductive loss in 2015 was due to egg predators. The total number of disturbances was lower than 2014, yet remained high like the previous five years which were all 3-10 times higher than 2007-2009. **Despite slight decrease in disturbance events, 2015 had the highest rate of murre egg and adult loss with 3.27 eggs destroyed and 0.22 adult murres fatalities per hour (Table 1).** Disturbance rates first began to increase in 2010, and then greatly escalated in 2011 and 2012. The reduced disturbance rate is possibly an artifact of reduced predator observation effort due to murre absence after hatchling failure and that many disturbance events were already in progress when observers arrived early in the morning. Therefore, the rate of egg and adult murre loss should be considered conservative estimates. **Bald Eagles (*Haliaeetus leucocephalus*) were again the dominant disturbance source (Fig. 5, 81%, 53 of 65 disturbances), with only a small number of disturbances for which the primary cause remained unknown (20%, 13 of 65). In many cases, these disturbance events were initiated prior to observers arriving for the day, and were likely also caused by eagles.** There were no disturbances caused by Brown Pelicans, and pelicans were not observed landing on the colony.

Murre diets have varied annually. Preliminary results of forage fish species consumed in 2015 included smelt (Osmeridae) and secondarily Pacific herring or sardine (Clupeidae) (Fig. 6). The total failure of the colony prior to chick rearing provided an added challenge for diet data collection this year. We combined our traditional digiscoping method with timelapse photos taken using a remote DSLR camera to collect sufficient samples from birds returning to the colony during the early season. Unlike previous years, the diet samples during 2015 may not have been fed to chicks. **A notable difference in diets in recent years has been the dominance of smelt since 2010 (with minor exception of 2011). Prior to this period, annual diet composition varied between dominance of smelt, sand lance, and clupeids, or occasionally relatively equal proportions of each in a given year.** In 2016, however, there was an increase in clupeids compared to the past 5 years.

For the sixth year we also conducted chick provisioning rate watches, although challenging due to the total failure of both Colony Rock and Flat Top. We generally conduct four per year throughout chick rearing, but in 2015 we found chicks only on Lower Colony Rock (a sub-colony of Colony Rock) allowing us to perform only one chick provisioning rate watch. Observers recorded the frequency that adult murres were delivering food to chicks at selected nests. Chick feeding rates (also foraging trip duration) are a good overall measure of food availability and will be a valuable metric to compare among years. Due to the reproductive failure, we were not able to collect feathers of beach-cast murre chick carcasses from Yaquina Head for stable isotope analyses of diet composition and nutrient sources. We did, however, obtain feather samples from murre chicks fledged from colonies off Bandon Oregon, 125 miles south of Yaquina Head.

Brandt's and Pelagic Cormorant nests were monitored for the eighth consecutive year and we have incorporated reproductive results for all years on Tables 2 and 3. In 2015 Brandt's and Pelagic Cormorants had very distinct reproductive outcomes. Brandt's Cormorants had a reproductive success of above 1 chick per nest in 2015 compared to less than 1 chick per nest in 2014 (Table 2). Despite Brandt's late median hatch date, it did not result in poor reproductive success as it did in 2012 (re productive success = 0.18, Table 2). In fact, 2015 was the best reproductive year for Brandt's since 2008, average brood size was more than two chicks per nest and fledge success was 0.73 (Table 2).The only year with similar outcomes occurred in 2009, all other years have had a reproductive success of less than one chick per nest (Table 2).

Pelagic Cormorants on the other hand, had a reproduction failure (reproduction success = 0.00, Table 3). There were only 11 nests visible from observation platforms, less than half the number of nests observed in 2014. Pelagic Cormorants did not go far into their reproduction cycle, average brood size was less than one chick per nest and most nests were abandoned during incubation. However, reproductive success has been highly variable in Pelagic Cormorants (2008-2015, Table 3). The highest reproductive outcome occurred in 2013 with more than two chicks per nest fledging and 2015 was the second reproductive failure observed. Reproductive failure was first witnessed in 2011 when even fewer nests were monitored than in 2015 (n=6, Table 3).

Summary and Future Directions

The reproductive failure at the Yaquina Head colony raises questions and concerns about the shifting dynamics between murres and eagles, along with secondary predators. Although disturbance and predation rates have been variable in the past five years, the disturbance activity has remained elevated compared to the early years of our study (2007-2009). The predation rates in 2010-2015 have ranged from 4 to 10 times the average disturbance rate (disturbances/hour of observation) during 2007-2009. These elevated disturbance rates have taken a toll on reproductive output of the colony and could begin affecting overall size of the colony. Murre diets over the past few years reflected more warm water associated smelt in 2010 vs. cooler water associated sand lance (and fewer smelt) in 2011, which is consistent with El Nino vs. La Nina influenced summers, respectively. During both 2012 and 2013 the El Nino conditions were neutral, and the diets also reflected an intermediate proportion of prey species and both years were relatively similar in murre diet composition. 2014 was also a neutral El Nino year, yet the diets reflected elevated smelt levels more typical of warmer water conditions. The 2015 summer was affected by strengthening El Nino conditions and the warm "Blob", which increased ocean temperatures on the West Coast by ~3°C. Murre diets continued to be dominated by smelt, but we observed a higher proportion of herring than in recent years.

We will continue studies in 2016 with the ultimate goal of maintaining long-term monitoring at this site. We remain interested in exploring the use of remote cameras for data collection. With the extension of fiber optic cables to the headland, we will evaluate possibilities to connect cameras to internet access. An internet connected camera would enhance our data collection opportunities and provide an excellent public education and outreach tool. In 2015, we initiated a three-year, multi-species at-sea tracking and habitat use study funded by the U.S. Bureau of Ocean Energy Management, which included common murres among the focal species. In 2016, we will refine our methods and tag more individuals with the intention of providing greater insights into murre foraging ecology.

Long-term research and monitoring efforts at YHONA are becoming increasingly valuable to oceanographic research and monitoring off Oregon, such as the Newport Hydrographic Line and a wide array of other research conducted by NOAA Fisheries and Oregon State University, including the cabled ocean observing system offshore of Yaquina Head (Endurance Array http://www.whoi.edu/page.do?pid=29616 & http://www.nanoos.org/about_nanoos/intro.php)

Publications

Gladics, A. J., R. M. Suryan, J. K. Parrish, C. A. Horton, E. A. Daly, and W. T. Peterson. 2015. Environmental drivers and reproductive consequences of variation in the diet of a marine predator. Journal of Marine Systems 146:72-81

Acknowledgements

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Table 1. Preliminary summary metrics from studies of Common Murres at the Yaquina Head colony, 2007-2015.

	Observation			**Hatch Date**					**Predation Rate # per hour[c] (total #)**		
Year	**Hours**	**Days**	**# plots**	**1st**	**Med**	**Hatching Success[a]**	**Reproductive Success[b]**	**# disturbances**	**Egg**	**Chick**	**Adult**
2007	149	30	11[d]	6/20	6/27	0.70 (± 0.05 SE)	0.54 (± 0.07 SE)	23	0.21 (32)	0.00 (0)	0.06 (9)
2008	117	35	11[d]	6/10	6/23	0.86 (± 0.04 SE)	0.77 (± 0.05 SE)	20	0.21 (25)	0.00 (0)	0.04 (5)
2009	140	53[f]	10[e]	6/17	6/24	0.86 (± 0.03 SE)	0.77 (± 0.04 SE)	27	0.36 (50)	0.00 (0)	0.04 (6)
2010	223	56	11[d]	6/24	7/8	0.87 (± 0.04 SE)	0.68 (± 0.04 SE)	20	1.07 (239)	0.04 (10)	0.00 (0)
2011	372	79	11[d]	6/28	7/8	0.36 (± 0.07 SE)	0. 22 (± 0.05 SE)	186	2.78 (1034)	0.38 (142)	0.19 (70)
2012	264	53	12	6/25	6/28	0.46 (± 0.09 SE)	0.27 (± 0.06 SE)	220	2.69 (710)	1.16 (305)	0.17 (46)
2013	200[g]	62	12	6/24	7/4	0.41 (± 0.09 SE)	0.24 (± 0.09 SE)	80	1.47 (275)	0.22 (40)	0.18 (33)
2014	156	51	12	6/29	7/3	0.23 (+ 0.13 SE)	0.17 (+ 0.11 SE)	75	1.37 (215)	0 (0)	0.16 (25)
2015	110	46	12	NA	NA	0.0 (± 0.0 SE)	0.0 (± 0.0 SE)	65	3.27 (360)	0 (0)	0.22 (24)

[a]Chicks hatched per eggs laid (mean among plots)
[b]Chicks fledged (≥15 days old) per eggs laid (mean among plots)
[c]Total # observed taken/total # observation hours
[d]Two adjacent plots (CR5 & CR6) were combined because of a low number of visible eggs to follow
[e]Two sets of adjacent plots (CR2 & CR3, CR5 & CR6) were combined because of a low number of visible eggs to follow
[f]Thick fog limited observations to very short time periods or prevented observations altogether during some days in July – much more so than in previous years.
[g]Observation hours for disturbance were lower (186 hours, 58 days) because a data book was lost in the field and could not be recovered.

Table 2. Preliminary summary metrics from studies of Brant's cormorants at the Yaquina Head colony, 2014

Year	# Nests	Median Hatch Date	Average Brood Size	Fledge Success[a]	Reproductive Success[b]
2008	71	7/8	2.38	0.23	0.55
2009	4	7/11	1.60	0.50	1.00
2010	47	6/30	1.51	0.17	0.25
2011	93	7/11	1.54	0.27	0.42
2012	33	7/20	1.15	0.16	0.18
2013	123	7/9	1.05	0.54	0.57
2014	60	7/3	1.87	0.45	0.72
2015	84	7/21	2.33	0.73	1.70

[a]Rate of hatchlings that fledged (≥25 days old)
[b]Chicks fledged (≥25 days old); mean among nests

Table 3. Preliminary summary metrics from studies of pelagic cormorants at the Yaquina Head colony, 2014

Year	# Nests	Median Hatch Date	Average Brood Size	Fledge Success[a]	Reproductive Success[b]
2008	20	7/08	1.80	0.44	0.84
2009	12	7/23	1.83	0.09	0.14
2010	26	7/21	1.52	0.28	0.35
2011	6	7/18	0.33	0.00	0.00
2012	16	7/20	2.63	0.40	1.06
2013	16	7/09	2.69	0.79	2.13
2014	34	7/3	2.29	0.53	1.21
2015	11	7/24	0.09	0.00	0.00

[a]Rate of hatchlings that fledged (>25 days old)
[b]Chicks fledged (≥25 days old); mean among nests

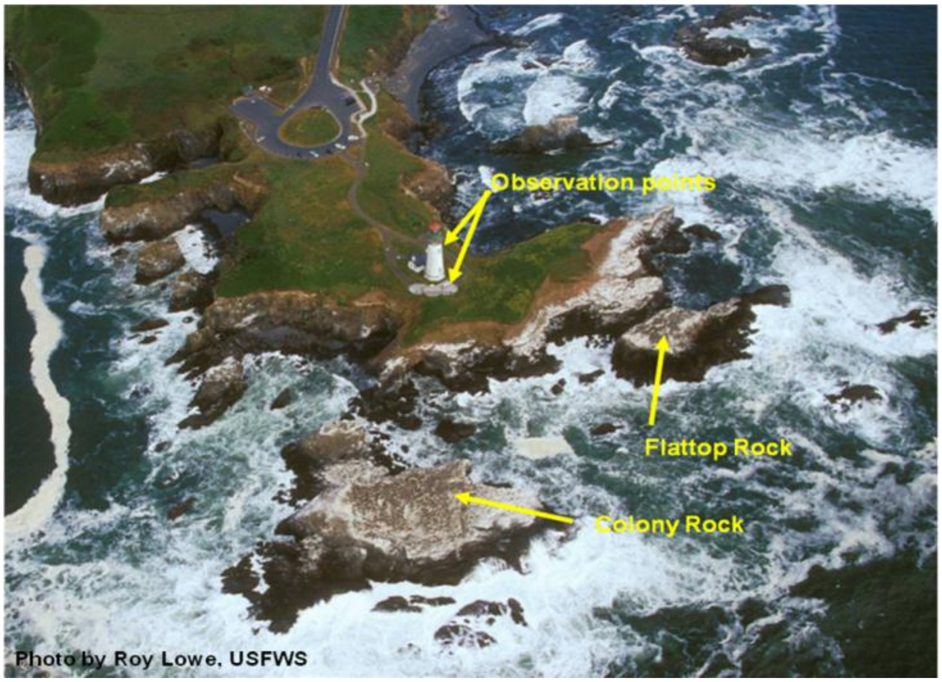

Figure 1. Study plots on Colony and Flattop Rocks.

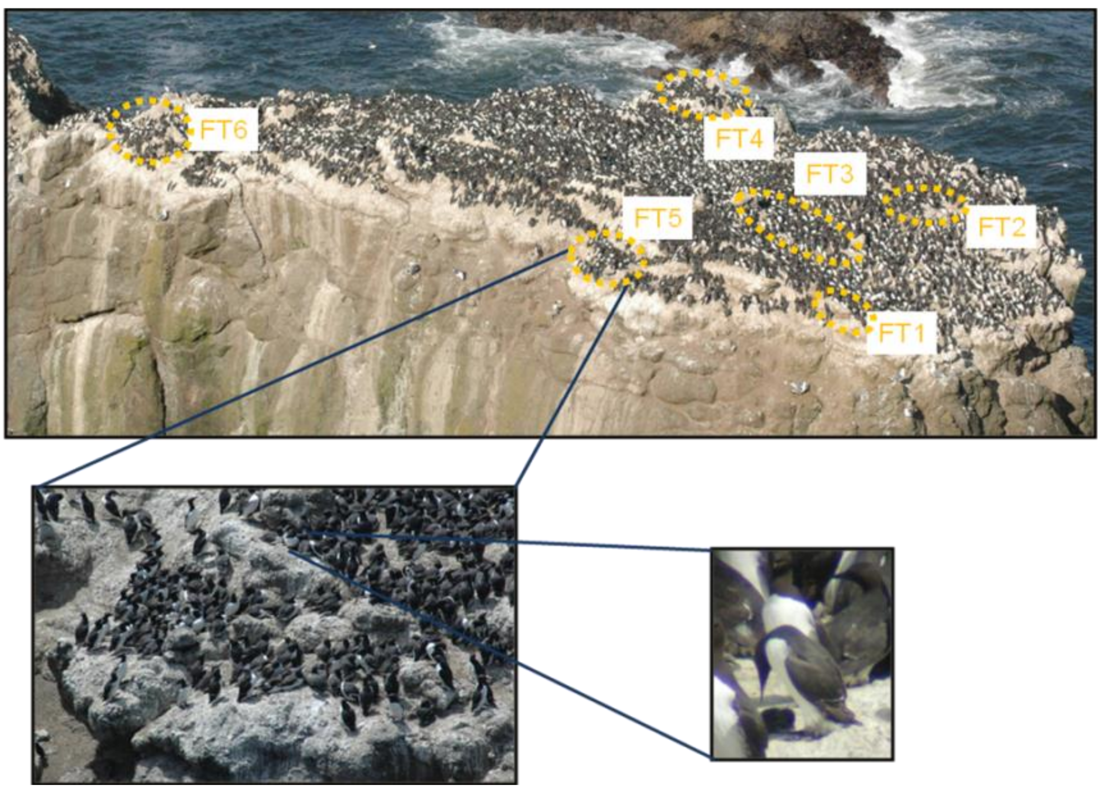

Figure 2. Close-up of Flattop Rock, plot #5, and an adult with a young chick

Figure 3. Digiscoping techniques for photographing and identifying forage fish delivered by adult murres to feed their chicks on the colony.

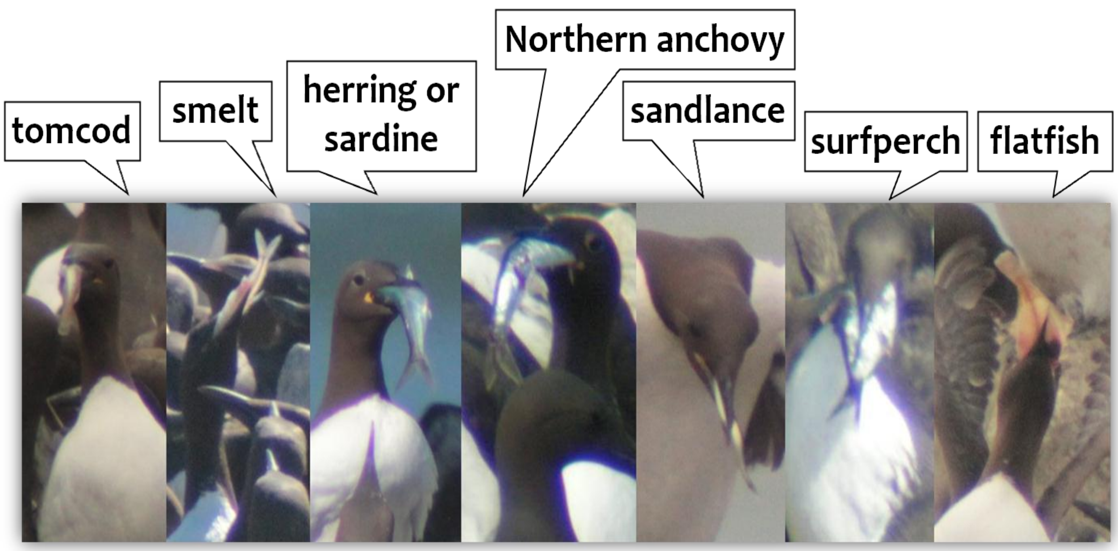

Figure 4. Prey photos taken from the observation deck at the base of the lighthouse.

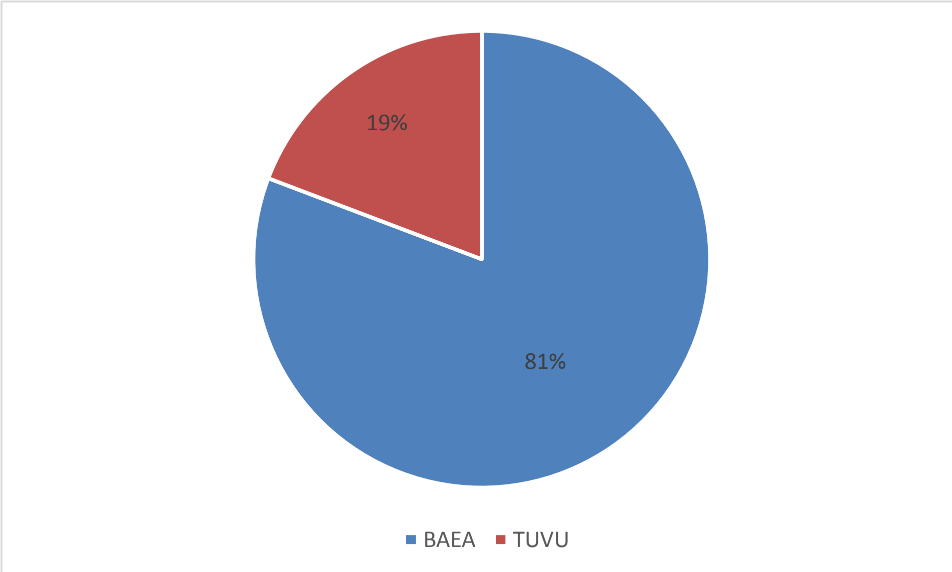

Figure 5. Identifiable sources of disturbance to Common Murres at Yaquina Head in 2015. A total of 65 disturbances were recorded, and the source of the disturbance was identified in 52 instances**.** Many of the disturbances in which the cause could not be determined were initiated before observers arrived in the morning, and were likely caused by eagles.

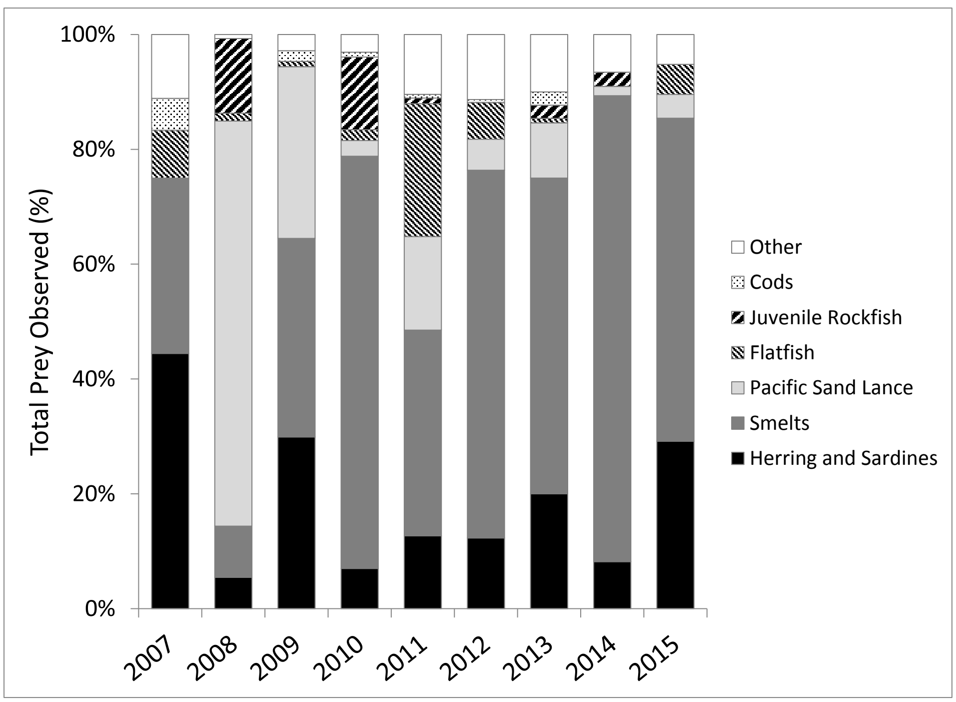

Figure 6. Diets of common murres (% occurrence) during 2007-2015. Diet in 2008 stands out as a remarkable year for sandlance, 2010 diets had a remarkably high percentage of smelts and unusually high amount of juvenile rockfish, 2011 is notable for an increased consumption of flatfish, and preliminary data show 2015 as another season dominated by smelt but with more herring than in recent years.