

Results of the 2017 Survey of the Reintroduced
Sea Otter Population in Washington State



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Introduction

The 2017 Washington sea otter survey was a collaborative effort between biologists and volunteers from the Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, The Seattle Aquarium, Point Defiance Zoo and Aquarium and Quinault Indian Nation (Appendix 1). The 2017 survey was conducted from 26 June – 29 June including an initial reconnaissance flight on 26 June that covered the area from the Columbia River to Port Angeles.

Methods

Aerial surveys covering the range of sea otters in Washington were conducted in WDFW's Partenavia P-68C-TC (N 357 PN) and included the coastal waters from just south of the mouth of the Columbia River at Tillamook Rock, OR (45.3852° N - 124.0184° W) to Cape Flattery, WA (48.3861° N - 124.7261° W) then east into the Strait of Juan de Fuca to Freshwater Bay (48.1432° N - 123.6089° W) just west of Port Angeles, WA). Aircraft followed the coastline about ¼ mile outside the break line covering kelp beds and nearshore rocks and reef. One reconnaissance flight was conducted on the day prior to the beginning of the aerial and ground surveys to cover the area described above in order to locate areas of sea otter concentrations. The survey flights covered coastal waters from just north of Grays Harbor, WA (47.2952° N - 124.2610° W) to Cape Flattery and then east in the Strait of Juan de Fuca to Freshwater Bay. Flights were flown at approximately 800' AGL with a lead observer in the front right seat and a backup observer/scribe in the back right seat. The primary observer was responsible for locating otters and directing the pilot; photographing otters with a digital camera (Nikon D100) equipped with an 85 – 200mm lens; counting (groups < 25 otters) or estimating (groups >25 otters); and

recording counts on a series of coastal kelp resources maps covering the area from Point Grenville to Bullman Beach. The secondary observer in the back right seat looked for otters, especially individuals or small groups near large groups, and recorded counts, locations and photo numbers on a flight log. For larger groups of otters, the aircraft circled the group to estimate numbers of otters and take digital photos. When weather conditions allow, up to two flights (passes) could be conducted each day for three days for a total of six passes. For safety purposes, Automatic Flight Following (AFF) was used to track real-time locations for the aircraft.

Ground observers conducted surveys using binoculars and spotting scopes from locations in Olympic National Park at Giants Graveyard, Cedar Creek, Yellowbanks, Sand Point, Duk Point (near Seafeld Creek) and Cape Alava beach trail, as well as on the Quinault Indian Nation inshore of Split and Willoughby Rocks and just south of the Queets River. A full count of the viewable area was conducted by ground observers within approximately 30 minutes of the aerial observations of the same location. Observations of adults (independent) and large or small pups (dependent) were recorded on a topo or aerial photo delineated with the viewable area during each count (noting visual obstructions and environmental conditions that limit visibility during the count). Ground observers also recorded weather conditions, behaviors, their assessment of the accuracy of the count and any potential disturbance (boats, kayaks, response to aircraft, predators, etc.) that occurred during the count. See Appendix 1 for list of participating ground observers.

Pups observed by ground counters or within digital images were distinguished from adults and classified as dependent based on their small size, woolly light brown pelage, and close association/orientation (generally resting on the chest) with an adult.

Groups of otters in digital images taken during the aerial surveys were independently counted by the authors and were compared for consistency. Image J 1.0 or 1.5 (<http://imagej.nih.gov/ij>) was utilized to count otters in the digital images (Appendix 2). Images with counts were viewed and analyzed collectively to reconcile differences. These aerial counts were then compared to ground counts and maps of the same locations to determine if otters were duplicated or missed by the aerial or ground observers. Once compared and differences reconciled to provide the most accurate count, this count was used for the location total. Counts of digital images were used when 1) ground counts were not available for a specific group of otters or 2) the count of digital images was deemed more accurate than the ground count (assessed by ground observers during the count). The final estimate for each flight consists of the most accurate aerial or ground count of larger groups; estimates of small groups or individuals made during the aerial survey and any individuals or small groups noted by ground observers but missed by aerial observers.

The annual estimate is the single high count from one pass of the survey area. When more than one flight/pass was available, the flight with the highest count and highest level of accuracy was used to represent the minimum population estimate. As a single count, this total does not have an associated variance or confidence limits. This estimate represents the minimum count over the potential range of this species in Washington because it is very difficult to account for individual animals or small groups off the flight path, outside of the survey area or those missed because they are underwater.

An average rate of population change and a 3-year running average were calculated for the period 1989 to 2017. The average rate of population change was calculated by finding the annual percent change using $(\text{year2}-\text{year1})/\text{year 1}$ and then calculating the average annual percent change. The 3-year running average uses the following formula: example to calculate year 3: $(\text{year 2}+\text{year 3}+\text{year 4})/3$.

Results and Discussion

The 2017 Washington sea otter survey was conducted from 26 June – 29 June including an initial reconnaissance flight on 26 June that covered nearshore sea otter habitat and coastal kelp beds from the Columbia River to Port Angeles. Following the initial 26 June aerial survey, we were able to complete two surveys of the south and north segments on 27 June; one mid-day survey of the north and south segment on 28 June; and one mid-morning survey of the north and south segments on 29 June. Aerial surveys covered nearshore waters, reefs and kelp beds from Point Grenville north to Cape Flattery then east along the Strait of Juan de Fuca to Freshwater Bay. Observation conditions were variable ranging from good to very good on all days. Ground observers had good to excellent conditions on all days.

The highest survey count for the 2017 Washington sea otter survey was 2,058 animals counted on the 29 June that included 439 otters in the north segment and 1,619 otters in the south segment (Table 1). The count includes 115 pups, 58 in the north segment and 57 in the south segment (Table 1). The 3-year running average is 1,753 otters. For comparative purposes, the 3-year running averages for the Washington sea otter population in 2015 and 2016 were 1,413 and 1,591 otters respectively.

During the 2017 surveys, the southernmost sea otter was observed 2 miles south of the South Jetty of Grays Harbor. The northernmost otters were observed just north of Anderson Point in Makah Bay. During the 27 and 28 June flights a small group (3 otters) was recorded in kelp beds east of Pillar Point near the old Silver King Resort marina. No otters were sighted at Tatoosh Island.

Survey results for 2017 indicate growth of the Washington sea otter population continues to remain positive (Figure 1). Overall, the average rate of growth for the Washington population is 9.5% ($R^2 = 0.8959$).

The distribution based on the 29 June count was 1,619 otters or 79% of Washington's sea otter population in the survey segment south of LaPush and 439 otters or 24% in the survey segment north of LaPush. This distribution is similar to recent distribution patterns with the majority of the population in the south segment (Figure 2). While the overall average population growth rate is 9.5%, the growth rate north of La Push continued to slow and has been negative 2 out of the last 5 years, which may indicate this portion of the range has reached its carrying capacity or some other factor or factors are inhibiting growth in this area. For comparison, the number of sea otters south of La Push has doubled in the last 5 years and there are more rafts of females with pups observed in the southern segment of the survey area. For example, in recent years rafts of otters

(including pups) have been recorded in the south survey area between Kalaloch and Willoughby Rock.

An extremely large raft of over 600 otters (Figure 3) was observed near North Rock on all surveys days. During this year's surveys, high numbers of otters were distributed in the area just outside the break to 2 miles offshore from near the mouth of Queets River to Kalaloch Rocks. At Destruction Island, a group of females with pups continues to use the west end of the island (Figure 4) but the large male group on the east end has not been present in recent surveys.

Our surveys did not cover waters east of Freshwater Bay, although we are aware of credible sightings of scattered individual sea otters in the San Juan Islands and Puget Sound in recent years. Most of these sightings have been of one or two animals, with the most recent reports from 2017 in south Puget Sound and eastern Strait of Juan de Fuca near Smith/Minor Islands. The small number of sea otters frequenting the inland waters would not add significantly to the population total. Similarly, we did not cover waters in Oregon where credible sightings (1-2 animals) have been reported in the past.

Acknowledgements

Without the help from the following individuals and agencies the 2017 Washington sea otter survey would not have been possible. Thanks to: Pilot Martin Kimbrel with Washington Department of Fish and Wildlife; Rite Bros. Aviation in Port Angeles; Anita McMillan with Washington Department of Fish and Wildlife; Caroline Hempstead and Amy Green with The Seattle Aquarium; Caryn Carter with Point Defiance Zoo and Aquarium; Jessie Hale with University of Washington; Andrew Annanie, Urijah Willis, and Franklin Pope with Quinault Indian Nation; and volunteers Terre Zorman, Ed Bowlby, Mary Sue Brancato, Mike Langley, and Pat McMahon.

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The Olympic National Park provided Scientific Research and Collecting Permit (OLYM-2017-SCI-0024) for access to ONP locations used by ground observers.

Cover photograph of sea otters hauled out at Destruction Island taken by Joseph Evenson with Washington Department of Fish and Wildlife.

Aerial photo of sea otter raft near North Rock taken by Steven Jeffries with Washington Department of Fish and Wildlife. Photo of sea otter raft at Destruction Island taken by Scott Pearson with Washington Department of Fish and Wildlife.

Table 1. Results of the 29 June 2017 survey of the Washington sea otter population (# of Adults = independent and # of large or small pups = Dependent).

<i>Location</i>	<i>Independent</i>	<i>Dependent</i>	<i>Total</i>
<u>SOUTH SURVEY SEGMENT</u>			
Willoughby Rock *	38	5	43
Kalaloch Area	481	0	481
Destruction Island	164	2	166
Diamond Rock	8	1	9
North Rock	663	28	691
Rock 443	41	6	47
Giants Graveyard*	165	16	181
<u>NORTH SURVEY SEGMENT</u>			
James Island	1	0	1
Cape Johnson	4	0	4
Bluff Pt	80	6	86
Sandy Island	3	0	3
Cedar Creek/Norwegian Memorial*	48	10	58
Yellowbanks *	36	5	41
Sandpoint*	136	31	167
Inshore of White Rock/Wedding Rock area	25	1	26
Ozette Island *	3	2	5
Ozette/Cape Alava/Bodelteh	26	0	26
S of Ozette River	3	1	4
Duk Pt	8	1	9
Anderson Point	10	0	10
Total	1943	115	2058

* locations where ground observers were stationed during survey flights

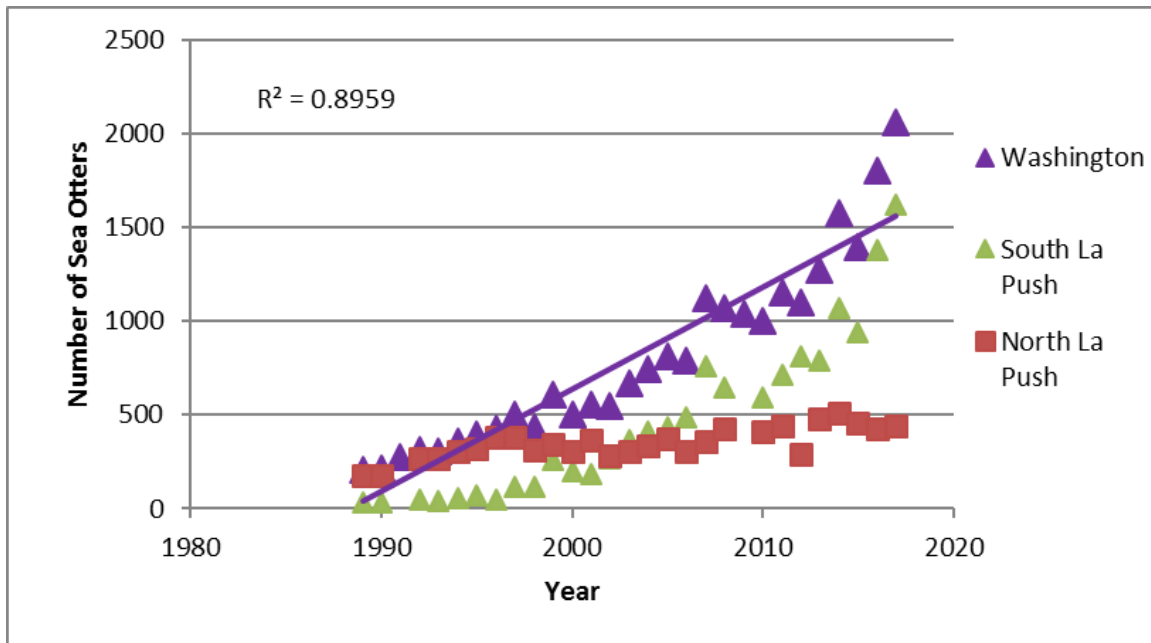


Figure 1. Growth patterns for Washington's sea otter population between 1989 and 2017.

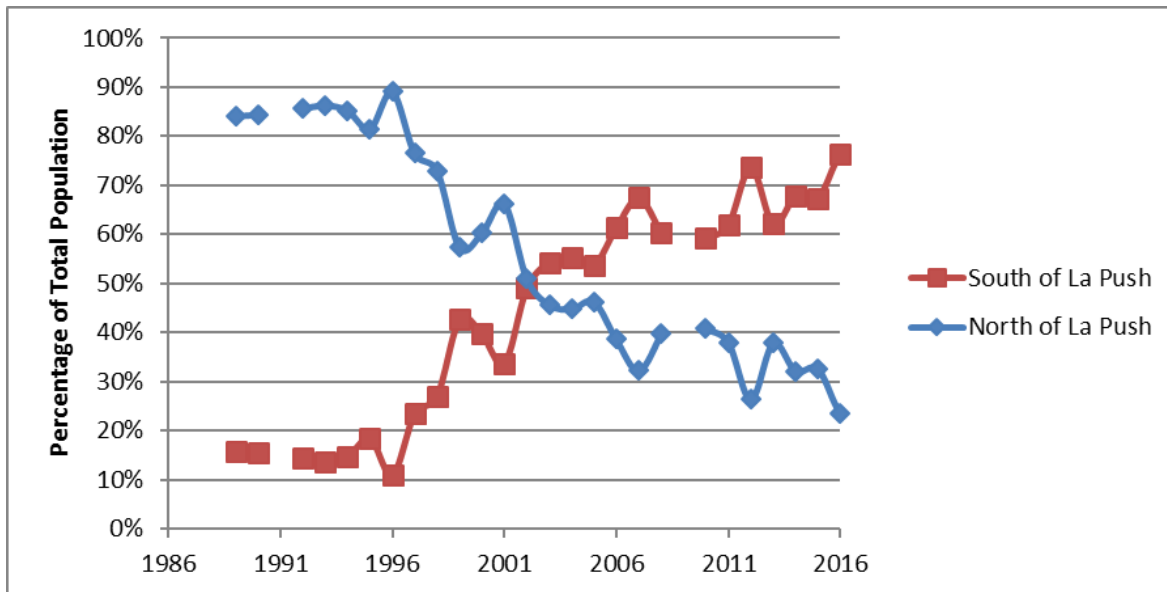


Figure 2. Comparative percentage of Washington sea otter population between the north and south survey segments, 1989-2017.



Figure 3. Raft with over 600 sea otters near North Rock on 29 June 2017 (Photo: Steven Jeffries, WDFW).



Figure 4. Sea otter raft on west end of Destruction Island, 29 June 2017 (Photo: Scott Pearson, WDFW).

Appendix 1. 2017 Washington Sea Otter Surveyors

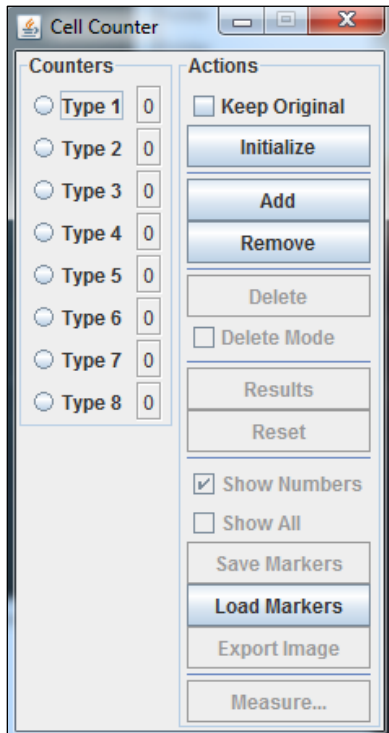
Ground Surveyors:	Affiliation
Anita McMillan	Washington Department of Fish and Wildlife
Caryn Carter	Point Defiance Zoo and Aquarium
Terre Zorman	Volunteer Point Defiance Zoo and Aquarium
Deanna Lynch	US Fish and Wildlife Service
Ed Bowlby	Volunteer
Mary Sue Brancato	Volunteer
Caroline Hempstead	The Seattle Aquarium
Amy Green	The Seattle Aquarium
Jessie Hale	University of Washington
Andrew Annanie	Quinault Indian Nation
Urijah Willis	Quinault Indian Nation
Franklin Pope	Quinault Indian Nation
Mike Langley	Volunteer
Airplane Surveyors:	
Steven Jeffries	Washington Department of Fish and Wildlife
Marty Kimbrel	Washington Department of Fish and Wildlife
Shelly Ament	Washington Department of Fish and Wildlife
Sue Thomas	U.S. Fish and Wildlife Service

Appendix 2.

Sea Otter Survey Photo Processing w/ Image J

We are using Image J for counting Sea Otters in aerial survey photos because it is a relatively simple, open source program developed by the National Institute for Health (www.nih.gov) for digital point counts. Since it was designed to count cells, it allows users to identify up to 10 attributes, marks those attributes on digital photos and provides a simple summary of the results. Below are the basic steps:

1. Download Image J from <http://imagej.nih.gov/ij/download.html>
 - a. If your computer already has Java, then download from the Platform Independent section.
 - b. Save Image J under desktop or your documents. Do not save under Programs or Applications as this will cause issues with Windows.
2. Download the Cell Counter Plug in from <https://imagej.nih.gov/ij/plugins/index.html>.
 - a. Save the cell counter under plugins, Analyze
3. Open Image J (run Application). This program opens in a small window showing just tool bars and a command line. Do not expand this menu.
4. To activate the Cell Counter, select Plugins→ Analyze→ Cell Counter (not Cell Counter Macro) to open.
5. To begin counting, open the image you want to work on, select Initialize in the Cell Counter menu which will create a working copy of the image.

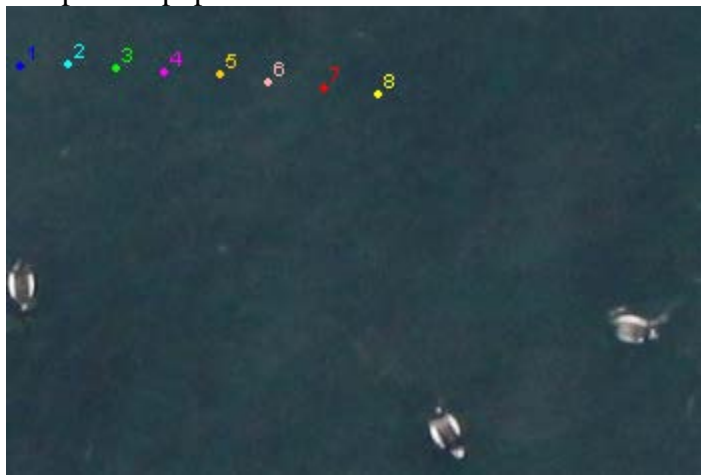


6. What the commands do:
 - a. <Add> - adds a counter type.
 - b. <Remove> - removes a counter type (although you cannot select which counter type to remove, rather it removes from the bottom).
 - c. <Delete> - Deletes counter objects you have placed on the image based on the Counter Type selected, and from the most recent back. This is a good tool if you decide to delete the last counter object you have just placed. I.e. it is basically "Undo"
 - d. <Delete Mode> - Use this if you want to delete multiple counter objects. It will delete the nearest object to the mouse pointer when you <left-click> on the image.

- e. <Results> A table of counts per Counter Type opens with the tallies per type.
- f. <Reset> - removes all counter objects on the screen.
- g. <Save Markers> - This will save an XML file of your markers. It should save them into the same folder that the images are stored in. You will want to save your markers after you have your count for the frame completed. This will save them for later review. When you save your file place your initials at the end of the file name.
- h. <Load Markers> - If you wish to review an image that has already been counted and a marker file saved for, then use this to open the XML file associated with the image. It will populate the image with markers from the XML file.
- i. <Export Image> - Will export a view of the image with markers
- j. <Measure> - Opens a table with the X,Y coordinates of each placed counter.

7. Counting an image

You will first need to select the Counter Type to use. For Sea Otter counts, use Type 2 to represent Adults and Type 4 to represent pups.



Mouse Controls:

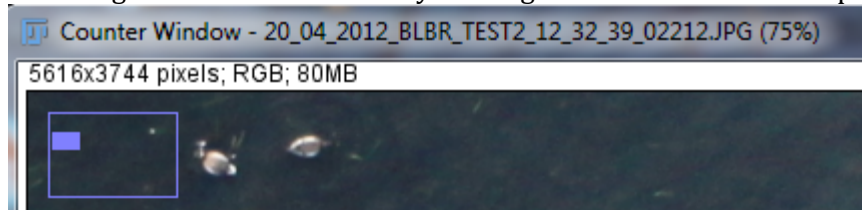
- <Point> The depressed button below the menu (in image below). Have this control selected when placing counter object on the image.



- <Magnify Glass> Select this when zooming in and out of the image.

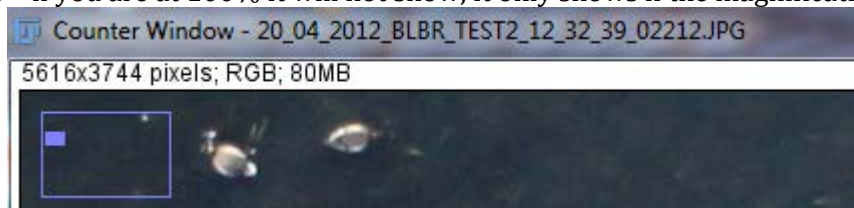


- It is best to count at 100% magnification. You can see your magnification level on the top-left




header on the image:

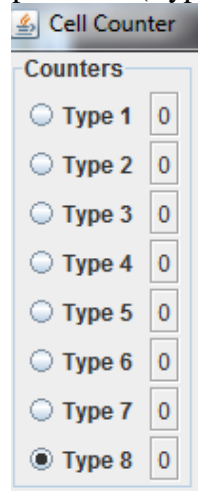
- One thing to note – if you are at 100% it will not show, it only shows if the magnification is



other than 100%

- You can also use the <-> key or <down arrow> to decrease magnification or the <+> key or <up arrow> to increase magnification.
- <Scrolling Tool> Use this to scroll the view around the image.
- 

To count otters select the Counter type preferred (Type 8 is selected in this view).



Turn off/uncheck “Show Numbers”.

Be sure that the <Point> or <MultiPoint> mouse control is selected. Left-click on the otter in the image, this will populate counter objects on the image while at the same time begin tallying the number of points.

8. Once counting is completed
 - a. Select results, move the results table to a location on top of the photo that does not obscure the otters
 - b. Open the snipping tool on your computer (not a part of Image J) and snip a photo of the image showing point counts and the summary table and save in a new jpeg. There is no other way to capture the points and the result table on one photo.
 - c. As a back up before you close anything; Save Markers (be sure to save it in the same place as the original photo). By doing this, you can reopen the original photo and reload all of the dots that you made. I.e. if things get messed up there is a backup. If this happens, open photo, initialize again, and “Load Markers”.