Wildlife Inventory Plan
Alaska Maritime National Wildlife Refuge
Protocol #15

Version 1.4

Species: Pigeon guillemot, parakeet auklet, and horned puffin

Parameter: Population

PURPOSE

To monitor trends in the numbers of parakeet auklets, pigeon guillemots, and horned puffins attending water-based plots.

BREEDING BIOLOGY

Pigeon guillemots (*Cepphus columba*), parakeet auklets (*Aethia psittacula*), and horned puffins (*Fratercula corniculata*) are all crevice-nesting seabirds that breed on remote islands in Alaska . All three species are colonial, although pigeon guillemots are more diffuse than the others. All capture prey on shallow dives but foraging ranges and prey vary. During the breeding season, pigeon guillemots are nearshore piscivores, usually staying within a few kilometers of the colony. Parakeet auklets usually forage farther afield for a wide range of invertebrates and larval fish. Horned puffins may travel 50-100 km on foraging trips and eat a mix of invertebrates and fish (although they feed chicks only fish; Ewins 1993, Jones et al. 2001, Piatt and Kitaysky 2001).

Alaska supports the majority of the world's parakeet auklet and horned puffin populations, and about half of the pigeon guillemot breeding population. There is some evidence for declining horned puffin populations but in general there are few data for population trends for these three species. Food availability is likely the most important source of population regulation currently. Historically, introduced mammalian predators may have had significant impacts on populations along the Aleutian Islands (Ewins 1993, Jones et al. 2001, Piatt and Kitayski 2001).

Population indices are difficult to obtain for crevice-nesting seabirds (see Renner et al. 2006) because their nest sites are usually inaccessible. While counting birds socializing on the surface works for some other crevice-nesting seabird species (Renner et al. 2010), counting birds as they raft in nearshore waters is preferable for parakeet auklets, pigeon guillemots, and horned puffins. For parakeet auklets and pigeon guillemots, this is because they nest at lower densities than other alcids and do not have highly synchronized daily activity periods on the surface (e.g., Ewins 1993, Jones et al. 2001). For horned puffins, attendance on the water is much less variable than on land and thus provides a better monitoring index (Harding et al. 2005).

PROCEDURE

Populations of pigeon guillemots, parakeet auklets, and horned puffins are monitored by counting birds on the water. (An exception to this is St. Lazaria, where birds are counted on water, on land, or in the air). These counts are conducted from land-based observation points or from a skiff during circumnavigation surveys. This protocol describes procedures for counting from land-based observations, which are specifically designed for pigeon guillemots, parakeet auklets, and horned puffins. For skiff-based counts (St. Lazaria), refer to general Circumnavigation Protocol (#22).

***Data collection*.—**Counts are conducted from permanent locations overlooking a specific area of water (i.e., water index plots); the same plot(s) need to be counted every year. Depending on the monitoring site, there may be a single or multiple index plots counted. Counts only on clear, calm days when fog, rain, and wind are minimal (clear enough to see plots and wind <20 knots).

To count each plot, use binoculars or a spotting scope to scan plot area and count all birds within plot boundaries using a tally counter (click the tally counter for every bird you count so you don't have to keep track in your head). Repeat until you have two counts within 5% of each other. If you have separate plots, count all plots on the same day and record data for each plot separately (Figure 1). Aim for 5-10 replicate counts (varies by site, see island-specific details).

For each species, attendance on the water fluctuates markedly over the season, during the day, and sometimes based on tides and weather. Counts are conducted during time periods when count variability is minimal (see Table 1). For pigeon guillemots, birds should be counted in the early morning during incubation to early chick-rearing (Vermeer et al. 1993). For parakeet auklets, the best count window is early morning from mid-laying through hatching, which avoids high early-season variability and post-season declines (Hatch 2002). For horned puffins, optimal timing is the last 30 days of the incubation period, when daily variability in puffin attendance, numbers of non-breeders, and sensitivity to food availability are all lowest. Within that period, horned puffins should be counted during the daily peak attendance period, which differs from colony to colony (Hatch 2002, Harding et al. 2005).

Table 1. Guidelines for raft counts of pigeon guillemots, parakeet auklets, and horned puffins conducted at Alaska Maritime National Wildlife Refuge monitoring sites.

Species	Time of year	Time of day	# replicates
Pigeon guillemot	Incubation to early chick-rearing	Morning (0700-1000h ideal, 0700-1200h acceptable)	Varies by site
Parakeet auklet	Mid-laying through hatching	Morning (0700-0930h)	Varies by site
Horned puffin	Last 30 days of incubation	Varies by site	Varies by site

***Data analysis*.—**The daily total on each plot is calculated as the mean of two counts within 5%. When entering data into the computer, record ONLY those two counts that are within 5% that you will use to generate a mean value for each plot each day. Do not enter any counts that are not used (e.g., a third count not within 5% of the other two, or a count not completed because of fog) – otherwise it introduces potential for confusion in future years.

After you calculate the mean value for each plot each day, sum all plots for a daily count total (if you have multiple plots). Across all replicate counts in a year, calculate the mean, standard deviation, and maximum total count. When summarizing your data, if you realize that a count falls outside the count window, remove that count from the dataset.

We present whole numbers of birds in population data. Whether calculating a replicate count using two counts within 5% or the annual mean of replicate counts, round your value to the nearest whole bird (round up when $\geq$.5, round down when <.5)

Literature Cited

Ewins, P.J. 1993. Black oystercatcher (*Cepphus columba*). No. 49 *in* The Birds of North America (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

Harding, A.M.A., J.F. Piatt, G.V. Byrd, S.A. Hatch, N.B. Konyukhov, E.U. Golubova, and J.C. Williams. 2005. Variability in colony attendance of crevice-nesting horned puffins: implications for population monitoring. Journal of Wildlife Management 69:1279-1296.

Hatch, S.A. 2002. Activity patterns and monitoring numbers of horned puffins and parakeet auklets. Waterbirds 25:348-357.

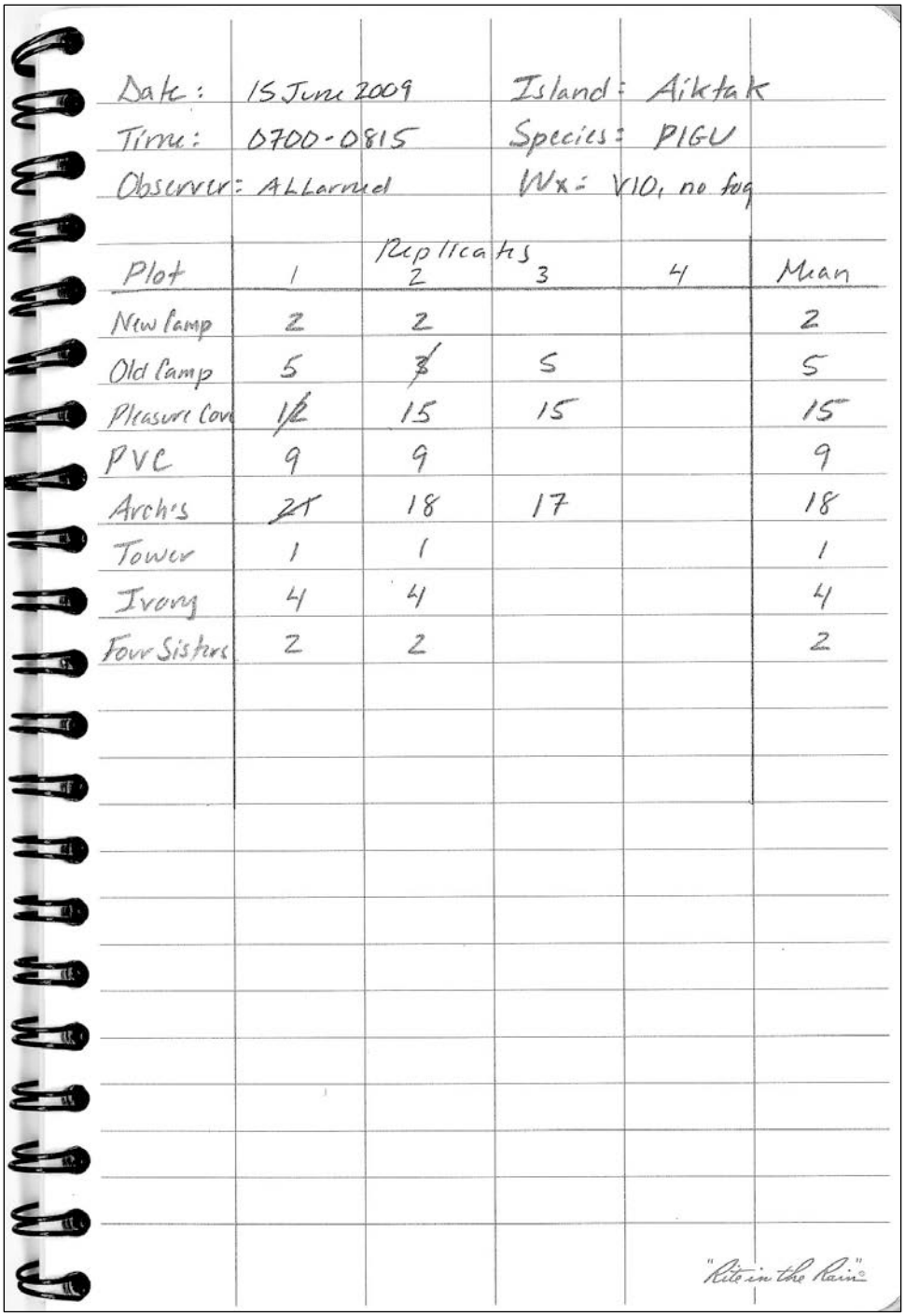
Jones, I.L., N.B. Konyukhov, J.C. Williams, and G.V. Byrd. 2001. Parakeet auklet (*Aethia psittacula*). No. 594 *in* The Birds of North America (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

Piatt, J.F. and A.S. Kitaysky. 2001. Horned puffin (*Fractercula corniculata*). No. 603 *in* The Birds of North America (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

Renner, H.M., M. Renner, J.H. Reynolds, A.M.A. Harding, I.L. Jones, D.B. Irons, and G.V. Byrd. 2006. Colony mapping: a new technique for monitoring crevice-nesting seabirds. Condor 108:423-434.

Renner, H.M., J.H. Reynolds, M. Sims, and M. Renner. 2010. Evaluating the power of surface attendance counts to detect long-term trends in populations of crevice-nesting auklets. Environmental Monitoring and Assessment. Online: DOI 10.1007/s10661-010-1664-4.

Vermeer, K., K.H. Morgan, and G.E.J. Smith. 1993. Colony attendance of pigeon guillemots as related to tide height and time of day. Colonial Waterbirds 16:1-8.



Date: 15 June 2009 Island: Aiktak
Time: 0700-0815 Species: PIGU
Observer: ALLarned Wx: V10, no fog

Plot	Replicates 1	2	3	4	Mean
New Camp	2	2			2
Old Camp	5	~~3~~	5		5
Pleasure Cove	~~1~~	15	15		15
PVC	9	9			9
Arch's	~~21~~	18	17		18
Tower	1	1			1
Ivory	4	4			4
Four Sisters	2	2			2

"Rite in the Rain"

Figure 1. Example of data notebook page for recording raft count data for pigeon guillemots, parakeet auklets, or horned puffins.

Attachment A. Aiktak Island specifics (includes Figure A1 and Tables A1-2)

PROCEDURE DETAILS SPECIFIC TO AIKTAK

At Aiktak, pigeon guillemots and horned puffins are counted on eight plots spread around the island (Figure A1). Plots do not cover the entire island: this provides an *index* of pigeon guillemot and horned puffin abundance and not a comprehensive survey of all birds around the island. It is important that the same plots are counted from the same observation points each year. Count plots only from specified observation points (marked with rebar poles in 2008 to eliminate confusion) and DO NOT expand boundaries or add additional areas to the survey simply because birds are present in other locations. If you have an opportunity to conduct an island circumnavigation (refer to Circumnavigation Protocol), this will provide an estimate of island-wide numbers.

For each species, aim for 5-7 complete raft counts during the appropriate times and count windows (Table A1). Use Aleutian Standard Time (AST) (1 hour earlier than Alaska Standard Time) for consistency across all years. All eight plots must be counted in the same day to form a complete replicate. Count days do not necessarily have to be spread out evenly during the count period (i.e., take advantage of any good weather days early in the count period if you have them!). Avoid double-counting birds that may drift from one plot to another while counting (this is commonly a problem between Ivory and Tower coves, for example); if there is a strong current, it may be helpful to count plots in the opposite direction of drift. Avoid days with large waves in the channel as those conditions make it difficult to see birds.

If timing in the current year seems particularly early or late, adjust your count window accordingly. This will be almost impossible to do for pigeon guillemots since no nests are monitored, but for horned puffins you can use nests monitored for productivity to help judge timing; in addition, stop counting when you begin observing horned puffin adults carrying fish, a sign chicks have begun hatching.

Although there is some overlap in time of year, note that counts for pigeon guillemots and horned puffins are conducted at very different times of day, so you cannot survey both species at the same time. Peak attendance of horned puffins on the water (and thus optimal times to count) varies from island to island; at Aiktak, all-day counts (0800-2000h) at Petrel Valley Cove, where the highest numbers of puffins raft, in 2008-2012 showed peak numbers of rafting birds generally occurred in the afternoon from 1500-1830h. (It is no longer necessary to conduct an all-day count at the beginning of the season unless you have reason to suspect a major shift in diurnal attendance patterns, such as seeing huge numbers of birds around the island in the morning but getting very few in your official afternoon counts).

Table A1. Details for raft counts of pigeon guillemots and horned puffins at Aiktak Island.

Species	Time of year	Time of day*	# replicates
Pigeon guillemot	Mid-incubation to early chick-rearing Early June to early July	0700-1000h ideal, 0700-1200h acceptable	5-7
Horned puffin	Last 30 days of incubation Late June to late July	1500-1830h	5-7

*Times are Aleutian Standard Time.

All observation points are marked with a permanent rebar stake with numeric engraved cap (Table A2). It is most efficient on Aiktak to separate plots and have each person visit and count half the plots simultaneously (with a crew of two, each person counts four plots). That way, it is easier to get a full count of all plots completed before the ever-threatening fog rolls in. In mid- to late May before the first count, visit all plot observations points together with plot photos and descriptions to ensure that each person is familiar with the plot boundaries. It is not necessary for the same person to count the same plots for all replicates (feel free to switch it up for variety). All plots can be viewed with binoculars (you should not need a spotting scope).

When looking at data, it is important to note that differences in timing exist between population counts of pigeon guillemots and horned puffins conducted from land-based observation points (this protocol) and boat-based circumnavigation surveys (see Circumnavigation Survey). Circumnavigation surveys at Aiktak are typically conducted during mid-July to mid-August, a time period that provides consistency with historic data and good opportunities to count murres from the water but is close to the end of or past the optimal count window for pigeon guillemots and horned puffins. In addition, boat-based surveys were sometimes conducted in the mornings and sometimes in the afternoons (e.g., Bechaver, and Gehrig 2011), in some years within the ideal count time for one species but never for both. Therefore, while each count method provides a valuable population index for pigeon guillemots and horned puffins, comparisons between the two count methods are not appropriate.

Literature Cited

Bechaver, C. A. and J. M. Gehrig. 2011. Biological monitoring at Aiktak Island, Alaska in 2011. U.S. Fish and Wildl. Serv. Rep., AMNWR 2011/12. Homer, Alaska.

Specific Requirements for Aiktak

Dates: *For pigeon guillemots*: mid-incubation to early chick-rearing (early June to early July).
For horned puffins: last 30 days of incubation (late June to late July).

Optimal sample size: 5-7 replicates for each species.

Time of day: *For pigeon guillemots*: 0700-1000h AST ideal, 0700-1200h AST acceptable.
For horned puffins: 1500-1830h AST.

Weather: Winds less than 20 knots, clear, minimal precipitation.

Equipment needed: Binoculars, two pairs of tally whackers, watch, plot photos (until you feel confident that you understand the plot boundary), Rite-in-the-Rain® notebook, two pencils.

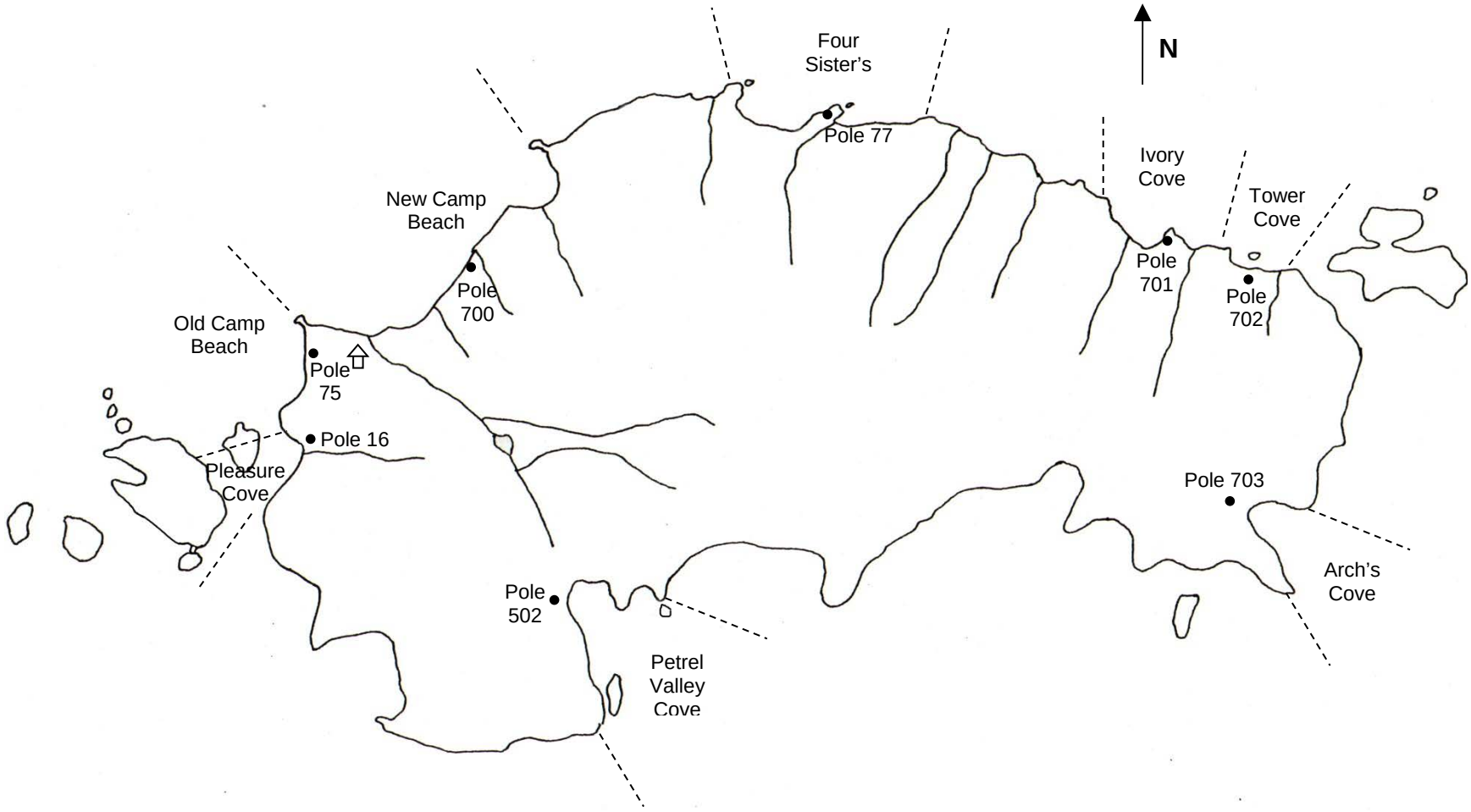


Figure A1. Location of pigeon guillemot and horned puffin land-based raft count plots at Aiktak Island. Dashed lines approximate count boundaries, dots show observation points.

Table A2. Description of pigeon guillemot and horned puffin land-based raft count plots at Aiktak Island.

Plot	Obs. Point	Description
Petrel Valley Cove	Several meters below Pole 502	Count all birds observed
Pleasure Cove	Pole 16	Count all birds observed to the left of Little West Island
Old Camp Beach	Pole 75	Count all birds observed between Little West Island and Guillemot Rock
New Camp Beach	Pole 700	Count all birds observed between Guillemot Rock on the left to as far as you can see on the right
Four Sister's	Pole 77	Count all birds observed, includes coves on either side of Four Sister's (in past years, each was counted separated but are now combined to avoid double-counting birds)
Ivory Cove	Pole 701	Count all birds observed to Tower Cove on the right, includes Ivory Cove to the left and a small unnamed cove to the right (in past years, each was counted separated but are now combined to avoid double-counting birds)
Tower Cove	Pole 702	Count all birds observed from unnamed cove east of Ivory Cove to the left to as far as you can see to the right
Arch's Cove	Pole 703	Count all birds observed

Attachment B. Chowiet Island specifics (includes Figures B1-6, Table B1, and Appendix B1)

PROCEDURE DETAILS SPECIFIC TO CHOWIET

At Chowiet, parakeet auklets and horned puffins are counted on a single plot at Landing Cove (Figures B1-6). For each species, count between 0700 and 0930h during the appropriate count windows (Table B1). If timing in the current year seems particularly early or late, adjust your count window accordingly. Use nests monitored for productivity to help judge timing; in addition, for horned puffins, stop counting when you begin observing adults carrying fish, a sign chicks have begun hatching. Aim for 10 replicate counts (on 10 different days), or as best as you can do based on work load priorities and weather. Count days do not necessarily have to be spread out evenly during the period (i.e., take advantage of good weather days early in the count period if you have them!). Total number of counts will depend on work load priorities, weather, etc.

Because count periods for both species overlap somewhat, you may count both species during some counts (i.e., mid-June to mid-July) and just a single species during some counts (i.e., only parakeet auklets in early June and only horned puffins in late July). In the past, counts have usually been conducted by one person each day (although it is possible for two people to count at the same time, with each counting a species). When counting both species on the same day, count them sequentially and not at the same time. First do a sweep of the plot and count the number of parakeet auklets seen on the water. Repeat until you have two counts within 5%. Then count horned puffins, repeating until you have two counts within 5%. Have both binoculars and a spotting scope handy just in case the weather makes it difficult to distinguish between species. When counting, keep everything (notebook, pencils, etc.) tied to you-- an infinitude of holes and cracks exists at the observation point for things to fall into!

Table B1. Details for raft counts of parakeet auklets and horned puffins at Chowiet Island.

Species	Time of year	Time of day	# replicates
Parakeet auklet	Mid-laying to hatching ~ 1 June to 15 July	0700-0930h	10
Horned puffin	Last 30 days of incubation Mid/late June to mid/late July	0700-0930h	10

Ideally record all count data in one rite-in-the-rain notebook (Figure B6) so that raw data can be located easily (during your field season but also possibly many years in the future - in past years, count data has been scattered among whichever notebook was handy that day, making it difficult to find afterwards). Back at the cabin (before using that field notebook for other work), electronically enter data into the Excel spreadsheet for all population counts for the current year (should be in Summary Data folder).

The boundaries of the Landing Cove plot have caused some confusion in past years. To facilitate counting and avoid double-counting birds, a system consisting of rebar stakes and rope cord was setup at the observation point in 2009 with refinements in 2011 and 2012 (see Appendix B1). At the beginning of the season, visit the observation point and check that rebar stakes and rope cord haven't been displaced over the winter and everything is properly calibrated.

Specific Requirements for Chowiet

Dates: *For parakeet auklets*: mid-laying through hatching period (~ 1 June to 15 July).
For horned puffins: last 30 days of incubation (mid- to late June to mid- to late July).
Optimal sample size: 10 replicates for each species.
Time of day: 0700-0930h.

Weather: Winds less than 20 knots, clear, minimal precipitation.
Equipment needed: Binoculars, spotting scope, two pairs of tally whackers, watch, Crazy Creek® chair, plot photos (until you feel confident that you understand the plot boundary), Rite-in-the-Rain® notebook, two pencils, warm clothes and rain gear.

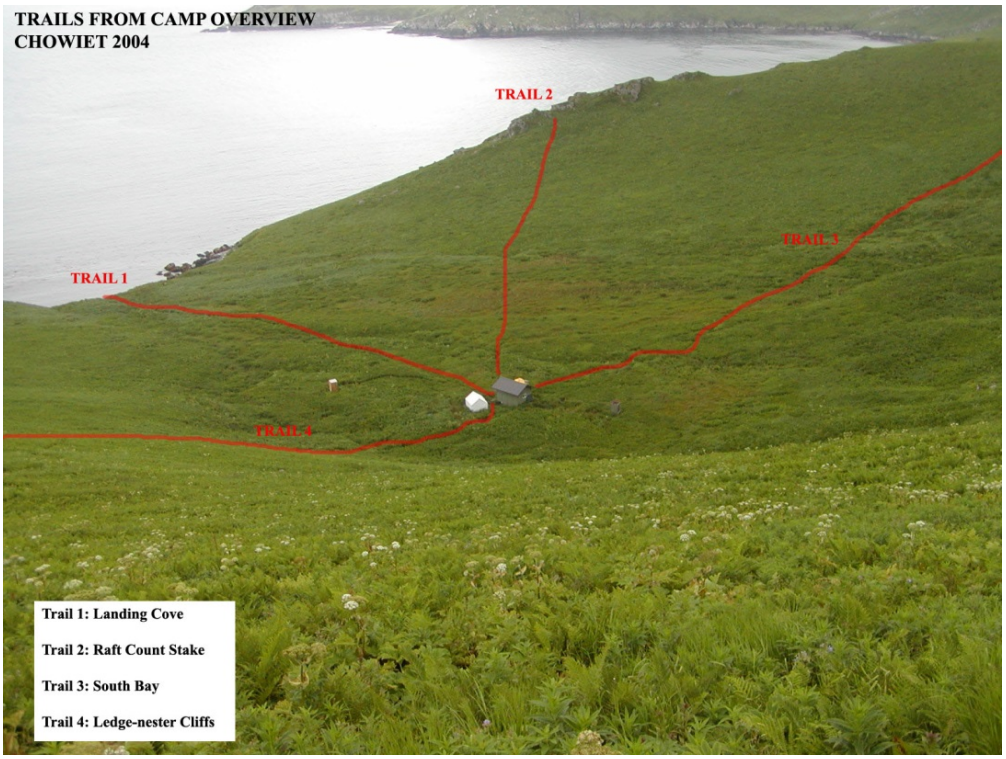


Figure B1. Overview of trail route from camp to raft count observation point on Chowiet Island (trail #2 in photo).

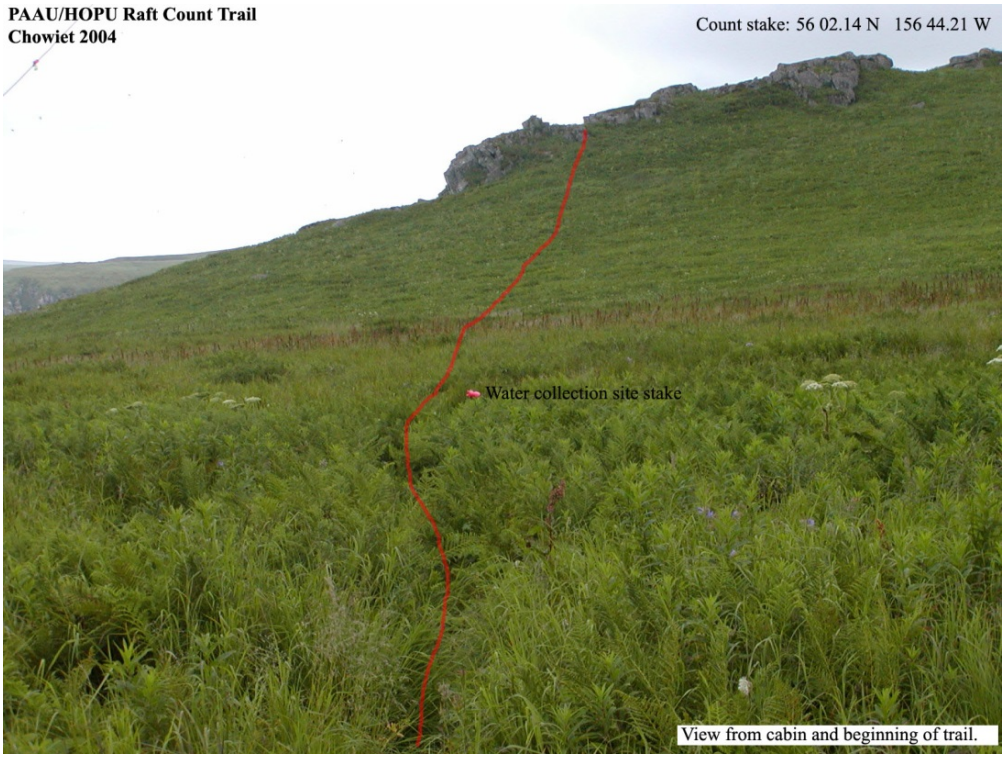


Figure B2. View of trail to raft count observation point from the cabin on Chowiet Island.

Figure B3. Landing Cove plot used for parakeet auklet and horned puffin raft counts at Chowiet Island. The red line approximates the outer boundary of the Landing Cove raft count area. The near boundary is the shoreline.

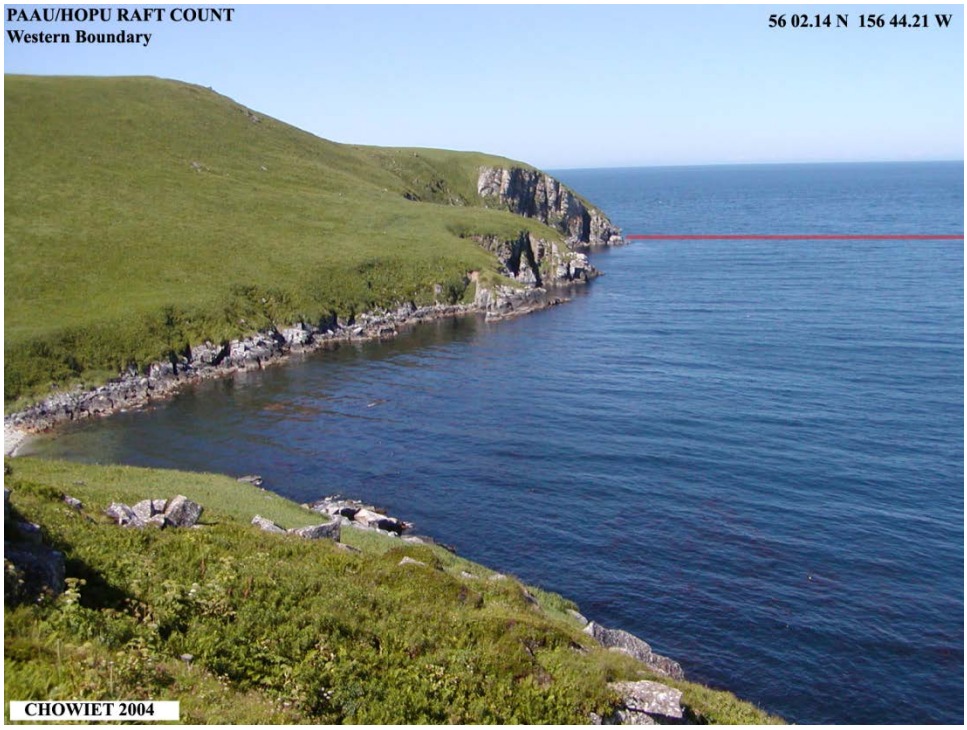


Figure B4. Western boundary of parakeet auklet and horned puffin raft count plot on Chowiet Island.

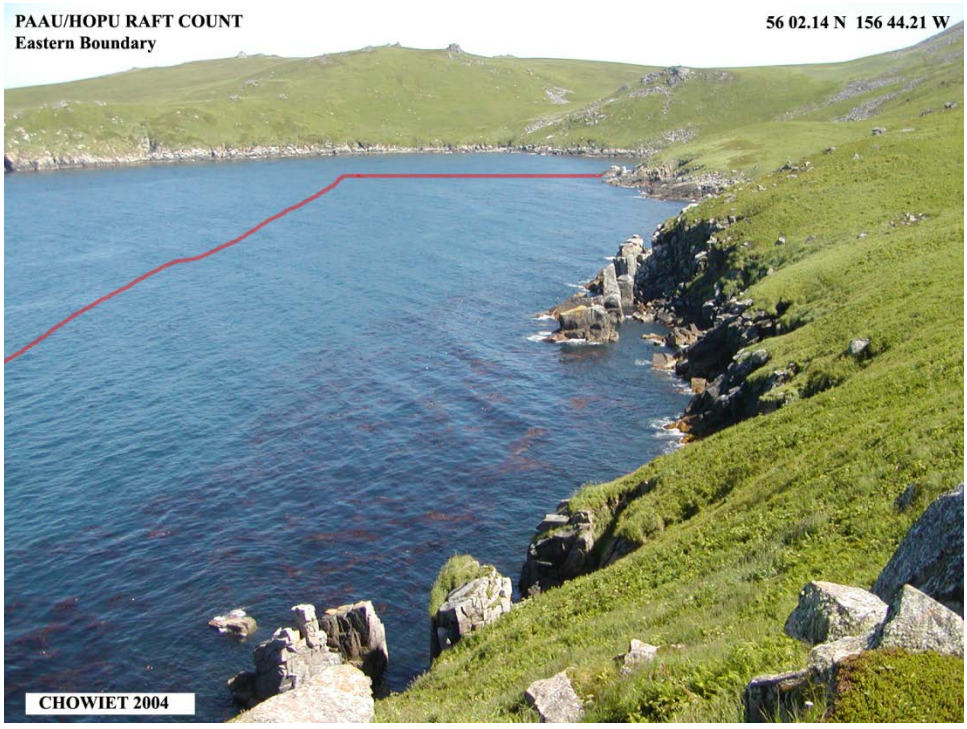
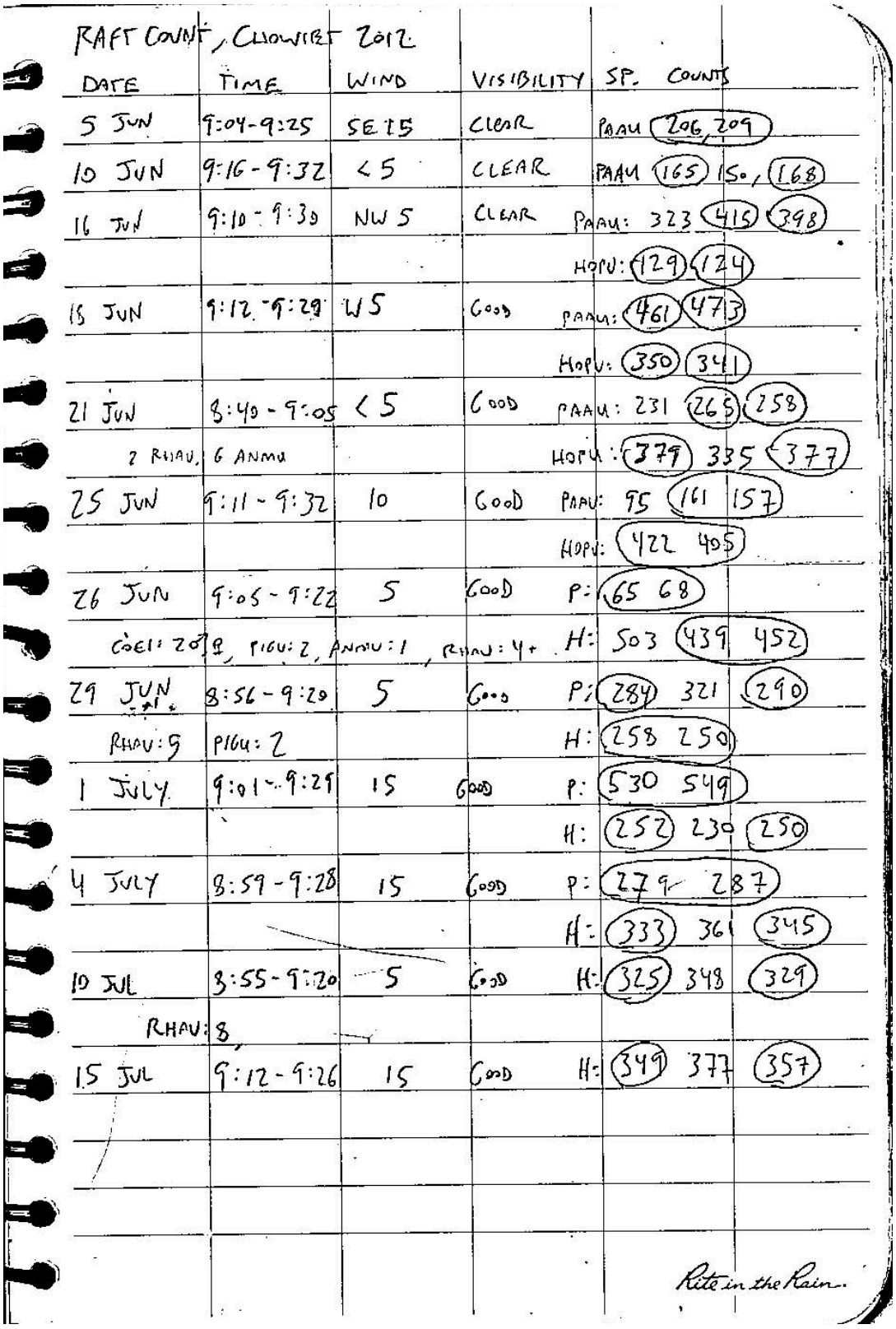


Figure B5. Eastern boundary of parakeet auklet and horned puffin raft count plot on Chowiet Island.



RAFT COUNT, CHOWIET 2012

DATE	TIME	WIND	VISIBILITY	SP. COUNTS
5 JUN	9:04-9:25	SE 15	CLEAR	PAAU (206, 209)
10 JUN	9:16-9:32	< 5	CLEAR	PAAU (165) 150, (168)
16 JUN	9:10-9:30	NW 5	CLEAR	PAAU: 323 (415) (398)
				HOPU: (129) (124)
18 JUN	9:12-9:29	W 5	GOOD	PAAU: (461) (473)
				HOPU: (350) (341)
21 JUN	8:40-9:05	< 5	GOOD	PAAU: 231 (265) (258)
2 RHAU, 6 ANMU				HOPU: (379) 335 (377)
25 JUN	9:11-9:32	10	GOOD	PAAU: 95 (161) (157)
				HOPU: (422) 405
26 JUN	9:05-9:22	5	GOOD	P: (65) 68
COEI: 20, PIGU: 2, ANMU: 1, RHAU: 4+				H: 503 (439) (452)
29 JUN	8:56-9:20	5	GOOD	P: (284) 321 (290)
RHAU: 9	PIGU: 2			H: (258) (250)
1 JULY	9:01-9:25	15	GOOD	P: (530) (549)
				H: (252) 230 (250)
4 JULY	8:59-9:28	15	GOOD	P: (279) (287)
				H: (333) 361 (345)
10 JUL	8:55-9:20	5	GOOD	H: (325) 348 (329)
RHAU: 8,				
15 JUL	9:12-9:26	15	GOOD	H: (349) 377 (357)

Rite in the Rain

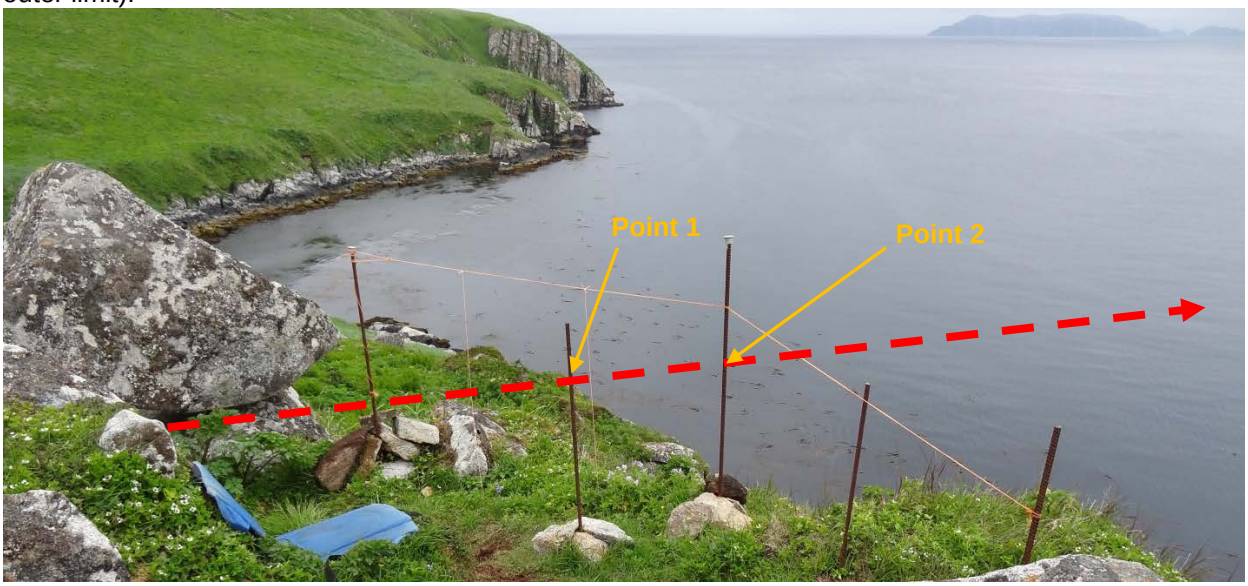
Figure B6. Example of data notebook page for recording raft count data for parakeet auklets and horned puffins on Chowiet Island.

APPENDIX B1. How to Count the Parakeet Auklet and Horned Puffin Raft Count Plot at Chowiet Island (2012 Setup)

To facilitate counting and avoid double-counting birds, a system consisting of rebar stakes and rope cord was setup at the observation point in 20009 and modified in 2011 and 2012. To count:

Raft count area overview. The red line approximates the outer boundary of the Landing Cove raft count area. The near boundary is the shoreline. This stake and cord setup was designed to make the original drawn line (upon which early surveys were based) easy to define and consistent among days and years.

1. This system is based on the observer being seated where the chair is positioned in the photo below with the head or neck pressed against the small rock behind the chair. Position yourself so that the top of the stake nearest you (Point 1) is aligned with the "crosshairs" formed by the outer central stake and the horizontal orange cord (Point 2). With these two points aligned, the outer limit of the count area is defined by the horizontal cord (where the line of sight through the cord hits the surface of the bay). It is important that the observer's head is very close to the rock when determining the placement of the outer limit of the count boundary (the line through Point 1 and Point 2 remains constant regardless of head placement, but since the front sighting stake is not used in determining the rest of the boundary, it is imperative that the observer's head remain properly placed to maintain the correct boundary when counting birds near the outer limit).



View from the chair when the sighting stake and cord crosshairs are aligned. The horizontal cord defines the outer limit of the count area. The lower horizontal cord and the rebar stake it attaches to on the right side were part of the 2009 system (when the observer sat in a different position) and was removed in 2012.

5. Now reposition yourself leaning forward so that the knot on the right stake lines up between the two rocks at the tip of Constant Colony, as shown below. The cord now forms the outer boundary of the Eastern portion.

A. 

B. 

6. If you are positioned correctly, you will have already counted everything to the left of the stake indicated by the arrow. Finish the count; don't forget to count the birds behind the boulder and below you. The stake on the left side of the frame was removed in 2012.

In 2012, two lengths of cord were tied to vertically subdivide the western end of the count area in an effort to make it easier to keep track of which birds had been counted. These cords are arbitrarily placed and can be moved or removed.

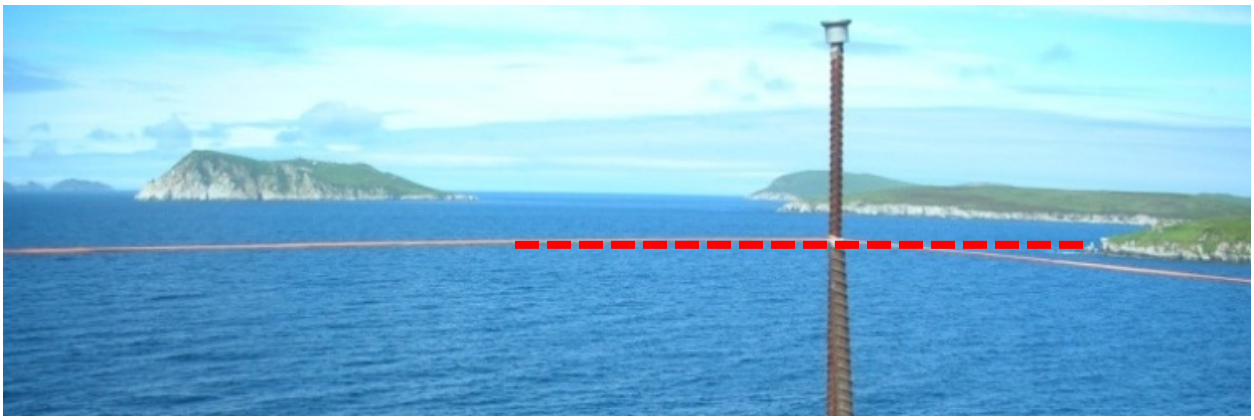
Calibration

Regularly check to ensure that the stakes and cords are properly positioned. The soil at the site is shallow and rebar could not be driven deep into the ground; the stake position is often held by stacked rocks, and the potential for shifting is high, especially over the winter.

Standing to the north (opposite side of the “seat”) of the central capped raft stake, ensure that the “crosshairs” formed by this stake and the cord line up with both the stake behind it and red mark on the rock. Make sure to reapply paint at the end of each season.

Ensure that the eastern stake is stuck in the indent in the side of the boulder, and that both the eastern and western stakes are standing vertically.

Adjust the left (western) half of the cord so that it is horizontal. When sitting in the seat with the crosshairs aligned, a continuation of the western line to the right should line up with the tip of the peninsula, as shown below.



Adjust the right (eastern) half of the cord so it forms a straight line connecting the spot where the left half is attached, and the tip of the Constant Colony peninsula on the right as shown below.

The short cord that cuts the western corner should be secured 5cm below where the upper cord is tied off, and 17cm out along the upper cord (just don't count anything past the tip of the cliff).

Attachment C. St. Lazaria Island specifics

PROCEDURE DETAILS SPECIFIC TO ST. LAZARIA

See Circumnavigation Survey Protocol (#22) for details on pigeon guillemot survey procedures at St. Lazaria Island.

Protocol Revision History Log

Revision Date	Changes made	New version #
April 2017	Added clarification in Aiktak section that time of day for raft counts refers to Aleutian Standard Time, fixed spacing issue in Table A2.	1.4
Oct-Dec 2015	Made minor clarifications to Aiktak section, minor typo in Chowiet section	1.3
April 2015	Added reference to Circumnavigation Protocol #22 for details of PIGU survey procedures at St. Lazaria	1.2
April 2014	Changed font to Arial, added revision history log, replaced revision date with version # on first page, added protocol # to first page, changed number format of tables and figures in island attachments, changed page number format to include protocol #, made minor grammatical edits, specified that mean values should be rounded to the nearest whole number	1.1
May 2013	Protocol developed in standardized format from historic protocols, includes Aiktak and Chowiet attachments	1.0