

Wildlife Inventory Plan  
 Alaska Maritime National Wildlife Refuge  
 Protocol #18

Version 1.4

Parameter: Survival

Species: Black-legged and red-legged kittiwakes, thick-billed murre

## PURPOSE

To estimate average overwinter survival rates for adult black-legged and red-legged kittiwakes and thick-billed murre. Survival estimates may be useful in determining causes of population change, as adult survival is a particularly sensitive parameter in population models of long-lived seabirds (Sæther and Bakke 2000, Schmutz 2009).

## BREEDING BIOLOGY

Kittiwakes (*Rissa brevirostris* and *R. tridactyla*) and murre (*Uria aalge* and *U. lomvia*) are long-lived piscivorous seabirds that nest on cliffs in dense colonies during the summer breeding season but spend the majority of the year at sea. For all of these species, knowledge of distribution during the non-breeding season is limited, although it is assumed that Alaskan birds shift slightly southward to occupy ice-free water in the southern Bering Sea, Gulf of Alaska, and northern Pacific south of the Aleutian Islands (Byrd and Williams 1993, Gaston and Hipfner 2000, Hatch et al. 2009, Orben unpubl. data).

Kittiwakes and murre may live up to 30 years; kittiwakes begin breeding at 3-5 years of age (Byrd and Williams 1993; Hatch et al. 1993, 2009), while thick-billed murre begin breeding at 5-6 years of age (Gaston and Hipfner 2000). Like many long-lived seabirds, annual adult survival rates are typically high for both kittiwakes and murre (over 90% for Alaskan populations). Sources of mortality are generally unknown but may include food shortages, predation, and human causes (e.g., oiling, drowning in fishing nests). Subsistence hunting occurs at some islands but current harvest numbers are small and not likely to influence populations (Byrd and Williams 1993, Gaston and Hipfner 2000, Hatch et al. 2009). For kittiwakes, most adult mortality generally occurs during the winter months (Aebischer and Coulson 1990).

During the breeding season, kittiwakes and murre are central place foragers and highly visible on their cliff nest sites and thus easily monitored. Red-legged and black-legged kittiwakes nest sympatrically on sea cliffs at the Pribilof Islands and Buldir Island in the Aleutians, and build nest structures on ledges with mud and vegetation. Thick-billed murre usually nest on narrow ledges of sheer cliffs amongst common murre and lay a single egg directly on the cliff ledges with no nest constructed. High fidelity to nest sites from one year to the next (Gaston and Hipfner 2000, Hatch et al. 2009) makes it possible to follow annual survival of individually-marked birds when they are attending the colony.

As with many pelagic bird species, attendance of both kittiwakes and murre at the colony varies throughout the breeding season. Birds begin attending cliffs early in the season before egg-laying, but attendance during the pre-laying period is highly variable from day to day (for kittiwakes, the pre-laying period may represent the peak numbers of birds during the season; Hatch and Hatch 1988). During incubation, daily attendance becomes more stable, with at least one member of each breeding pair in attendance at the nest site at all times. Murre (but not necessarily kittiwakes) exhibit a diurnal pattern of attendance during incubation, with two peaks and two lows during the day. Attendance remains relatively stable after hatching, although turnover of mates increases as they take turns feeding nestlings. As chicks begin fledging, numbers of adults attending the colony steadily and rapidly decrease and daily fluctuations in attendance may again become large (Hatch and Hatch 1988, Gaston and Hipfner 2000, Hatch et al. 2009).

## PROCEDURE

**Resighting.**— Resight banded birds in survival plots as often as you can during the early part of the breeding season, before birds lay eggs and initiate incubation (May through mid-June for kittiwakes, mid-June through early July for murre). Early in the season before birds begin incubating, resighting is particularly efficient because (a) bands are easier to see, and (b) there is generally a lot of turnover, with new birds showing up on the cliffs daily (including some that end up not breeding). Once birds begin incubating, resighting of bands becomes more difficult because birds' legs are hidden and they may sit unmoving for hours on end. Later in the season when chicks are larger and adult birds are standing around more, resighting again becomes more efficient, so make efforts to resight again late in the breeding season. For kittiwakes, failed breeders will often return to the colony to defend nest sites or loaf on the cliffs at the end of the season, making excellent opportunities for resighting.

There is no hard and fast rule for exactly how much time you will need to spend before you no longer see any new birds, as this can vary among sites, years, and observers. Use resighting efforts in prior years as a rough guide of what to aim for (see attachments for island-specific details) and track the cumulative number of birds seen over the season. (Keep in mind, however, that as more birds are banded, more resighting effort is needed to ensure all birds present are actually seen. Therefore, don't use resighting efforts from the first few years of a banding/resighting project to represent "ideal" resighting effort.) In theory, you need to continue resighting only until you are reasonably confident you have seen all birds present that year (e.g., you are no longer seeing new birds). However, because ledgenester attendance can be variable with high turnover over the course of the season (e.g., some birds are present only at the beginning or only at the end of the season), you need to put in resighting efforts throughout the entire season (or at least the beginning and end of the season). The exception is if you resight all birds banded on a particular plot, in which case you can stop resighting at that plot for the current year.

Some plots are observed from a single location, while others require observers to walk along a stretch of beach (see individual island details in Attachments B and C). In addition, some plots are also productivity plots, so you can record any resights during all productivity nest checks. Using 10x binoculars or zoomable (e.g., 15-45x or 15-60x) spotting scopes, read color bands of individuals you can see. Record the date, species, color band, plot, and productivity nest number if relevant. Also record the start and end times of every resighting session to keep track of when you see which birds and to calculate resighting effort. For resights recorded during the course of productivity checks or any other work, record your resighting effort as your best estimate of the amount of time spent scanning the plot for banded birds (as opposed to intensely watching singular or small groups of birds to see nest contents for productivity).

Kittiwakes and thick-billed murre are banded with *either* an engraved field-readable color band with numeric (e.g., 437) or alphanumeric (e.g., A1) values or a unique three-color band combination (see Table 1 and Figures 1 and 2). For numeric or alphanumeric bands, simply record the background color of the band and the numeric or alphanumeric value inscribed on it (e.g., Blue 632 or Red H5). For three color-band combinations, band combinations should be read and recorded as (1) left leg top to bottom, (2) right leg top to bottom. Although we care only about the color band combination itself, it is helpful to record the metal band as a placeholder to avoid confusion when recording and later transcribing data. Use the following codes for colors for band combinations:

BK	Black	O	Orange	Y	Yellow
DB	Dark blue	R	Red	m	metal band
DG	Dark green	W	White		

For example:

a bird with a metal and red band on the left, dark blue over white on the right = m/R DB/W

a bird with a metal and black band on the left, two orange bands on the right = m/BK O/O

It is extremely easy to misread or misrecord bands (especially reversing the order of color band combinations, or when field-readable bands are on upside-down), so use care when making observations. Only record the bands and band combinations that you are certain about and avoid the temptation to write down partial or "probably was" sightings; if a bird is present that year and you resight enough, you will almost certainly see the bird again. Look carefully at all bands to ensure they are the

color they first appear. Distinguishing colors in less-than-perfect lighting can sometimes be difficult. In addition, some bands can fade or become discolored over time, especially white bands that can become stained pinkish or light orange.

On rare occasions, you may see birds with damaged (or too muddy to read) color bands. Note the location of these birds so you can attempt to capture them at a later date. With the bird in hand, you can read the numbered metal band to identify the individual and replace the problem band.

At the end of the day (or at the very least, before you take your data notebook into the field again), enter the day's resight data (including hours of effort) in the electronic data file provided on your camp computer.

**Banding.**— Always have at least two people present when catching kittiwakes and murre (e.g., one to capture and one to retrieve birds, one to band and measure and one to record data) to expedite the process and cause less stress to the birds.

Birds should be captured for banding only later in the season when adults are on chicks. Never attempt to capture birds when still on eggs, as eggs are easily broken or kicked off the cliff (this is especially important for murre, who lay eggs directly on bare rock without any nest to contain the egg!). For kittiwakes, ideally aim to catch birds when chicks are medium to large-sized – when chicks are newly hatched, capturing adults may cause undue exposure to small chicks; when chicks are fledgling-sized, adults are more flighty and difficult to catch. For murre, similarly try to avoid catching adults with brand new chicks, but note you will have less flexibility in timing because murre chicks can fledge after just about 15 days, leaving a shorter window of capture time. Never catch birds on wet or excessively windy days when leaving chicks exposed in the nest for even short periods of time may be unsafe for them. Also be aware that at some locations (e.g., Buldir) aerial predators are common and keeping the adult off a nest will greatly increase the risk of nest predation.

Working underneath or at the top of cliffs is dangerous work and safety precautions should be taken at all times. When catching birds from below, *all* crew members should be wearing hard hats or climbing helmets at *all* times. Cliff habitat is often unstable and rocks can fall at any time; even a very small rock can cause substantial damage if it falls from high enough (this is not a theoretical issue – in 2010, a rock severely injured a researcher working under the cliffs at St George). Always be alert for the sounds of rocks falling (often small pebbles may be a precursor to a larger rock fall). Take extra care after heavy rain, when cliffs may be more unstable than usual. When catching birds from above, the capturer should be tied in to a secure anchor with a climbing harness. Always have someone else check your harness, knots, and anchor before you approach the edge. Use the climbing system for a safety back-up in case of a slip only: stay on top of the cliff and never hang over edge or climb down the cliff to capture birds. Beware overhanging tussocks or rocks that might look stable but could give way under your weight. When catching birds from either below or above, use your common sense and listen to your gut: if something “just feels” unsafe or wrong, it probably is. No data are worth endangering yourself or others.

**Capture:** Adult kittiwakes and murre are both captured with noose poles, 3 to 10 meter telescoping poles with monofilament nooses attached to the end used to “lasso” birds. Depending on the site, birds are caught either from the beach below nests or from the cliff tops above (Figure 3; see description of study plots in Attachments B and C). Always have at least two people present when catching kittiwakes and murre (one to capture and one to retrieve birds).

Approach birds slowly (when catching from above, it helps to hide behind vegetation if you can) and slowly extend the noose pole to the height of the selected nest by gradually pulling out the end sections of the pole. Place the noose over the bird's head. A gentle tugging action will close the noose. Once the bird is caught, avoid pulling the bird directly off the nest and possibly dislodging its chick. Rather, gently “fly” the bird off the nest and down to the ground (if catching from below) or up to the cliff top (if catching from above). Sometimes a gentle upward pull will induce the bird to fly from the nest; do not drag it off the nest. An assistant should be nearby to retrieve the bird immediately once it is on the ground.

To release a bird from the noose, grab the bird securely by the body and restrain the wings by folding them in against the body. It is important to do this as quickly as possible to prevent injury to the bird. Some birds will flap around and try to bite when captured, which can be intimidating when trying to restrain them (especially a murre, which can pack a hearty bite!). Therefore, it may be helpful for the

person retrieving the bird to wear fingerless gloves (or leather gloves for murre) to inspire bravery and thus be able to control birds quickly. Once the bird is safely restrained so it cannot struggle, remove the noose by hooking your finger between the noose and the bird's neck and pulling gently. Then place the bird in a bag (or straight jacket made from a sock with the toe cut off), close the opening tightly, and bring the bird to your banding station.

Many kittiwakes will regurgitate upon capture and handling, so make sure to have diet collection supplies ready and available (see diet collection protocol) to collect any samples chicks may decide to donate.

**Banding:** Set up your banding station well back from the cliff so you can work safely. When catching birds from below on beaches, you may be limited by how far you can get away from the cliff by tide; try to avoid banding birds when extremely high tides leave no place to process birds except right under the cliffs where rock falls can occur.

Try to keep each bird's captivity as brief as possible and work with just one bird at a time. Seabirds overheat easily, and if at any time during the banding process a bird's bare parts begin to feel warm or the bird looks dazed and begins panting, quickly finish what you are doing, even if it means not recording all the information, and release the bird as gently as you can.

**For kittiwakes:** Handling kittiwakes is easy if you read and explicitly follow the attached guide (Attachment A). Learn from and heed those who have suffered before you!

While the bird is still in the bag or straightjacket, weigh it to the nearest 5 g with a Pesola® scale. Once a bird has been weighed, birds are banded with a U.S. Fish and Wildlife Service metal band on the **right leg** and a uniquely coded alphanumeric or numeric plastic color band on the **left leg**.

Keep the bird in the bag or straight jacket, hold it snug against your body to prevent it from struggling, and extract the leg to be banded (extra care must be taken to ensure you are putting bands on the correct legs - it is easy to get this confused when the rest of the bird is still hidden in the bag!). Always apply metal bands before any color bands in case the bird becomes stressed and needs to be released early; the banding permit **requires** all color-banded birds to have an accompanying metal numbered band.

Black-legged kittiwakes use size 4A (for larger birds) or 4 (for smaller birds) bands; red-legged kittiwakes are smaller and should take size 4 or 3A bands (Renner et al. 2001). To open metal bands for kittiwake bands, use band spreaders or 90° retaining ring pliers to gently spread band ends open enough to slip bands over the bird's tarsus. Do this from both sides to open bands as evenly as possible. Then use needle nose pliers to gently pinch each end of bands closed, making sure bands are mostly round (Figure 4a). Overlap the ends a little (Figure 4b), then use the pliers to pinch and wiggle bands at the overlap (Figure 4c) until they pop shut and the ends are flush and tight. If bands overlap too much, use the spreaders to re-open. Some people prefer to compress bands laterally into an oval shape to better fit the bird's leg; this decision depends on the fit of bands.

Metal bands should be closed using pliers until the two ends are flush against each other. There should be no overlap and no gap wide enough that a fishing line or piece of netting could slip through (a good rule of thumb is the fingernail test: if you can fit your fingernail through the gap, it is too wide). Although you should band birds as quickly as possible to minimize handling time, be exacting and do not release birds with shoddy bands that may cause them harm!!!

Before applying alphanumeric bands, first check band combinations to make sure they cannot be misread if applied upside-down (i.e., 108 and 801) – do *not* use any such bands (this is usually more of a problem with numeric bands). To apply alphanumeric color bands, use band spreaders or 90° retaining ring pliers to gently spread bands just enough to slide bands onto the bird's leg. These bands can become brittle at cooler temperatures so care must be used not to overstretch them. To keep them warm and pliable, keep the bands tucked into a crew member's shirt (if day is warm and bands are only slightly brittle) or warm bands just before use in a thermos of hot water (if bands are very brittle). If bands are stretched out for too long, they will fail to return to their original shape, but a firm squeeze with the fingers can help mildly-stretched bands regain their form. For bands with engraved text oriented parallel to the length of the band, position bands on the bird so that the numbers can be read from *the foot towards the body*. For bands with engraved text oriented perpendicular to the length of the band, position bands with the bottom towards the foot, so that the text can be read right-side-up when the bird is standing. Spread a small amount of PVC cement (for red and yellow alphanumeric bands) under the overlapping ends of

bands and apply pressure to the joint for 10-15 seconds while the glue sets. Wipe off any excess glue and ensure bands can spin freely on the tarsus.

After banding, remove the bird from the bag and record the following additional data as time/bird stress levels allows (see Figure 5 and Attachment A):

- **Wing chord:** Measure the right wing from the bend in the wing to the tip of the longest primary using a 500-600 mm wing ruler. With the right wing resting naturally against the bird's body, slide the wing ruler under the wing and press the vertical stop gently against the wrist joint. Measure this distance to the nearest mm. Wing should be relaxed, not flattened.
- **Diagonal tarsus:** Hold bird's right leg so both the foot and tarsal joints are bent at right angles. Place the inner jaw of the calipers into the notch at the tarsal joint and slide the outer jaw until it contacts the end of the tarsus just where the foot bends. Measure this distance to the nearest 0.1 mm. Always measure the right leg.
- **Head-and-bill (also called total head):** Open the calipers so that the opening is wider than the length of the head and bill. Place one caliper jaw against the back of the head (make sure to include the small knob of bone at the base of the skull). Slide calipers closed until the other jaw just touches the tip of the bill. Record head-and-bill length to the nearest 0.1 mm.
- **Exposed culmen:** Open the calipers so that the opening is wider than the length of the bill. Place the outer caliper jaw against the base of the bill (base of cere or feathering). Slide the inner caliper jaw until it just contacts the tip of the bill. Record culmen length to the nearest 0.1 mm.
- **Bill depth:** Open the calipers so that the opening is wider than the depth of the bill. At the widest part of the bill, place jaws against the top and bottom of the bill and slide closed until just barely touching bill on each side. Make sure calipers remain perpendicular to the bill length. Record bill depth length to the nearest 0.1 mm.
- **Tail (tip to insertion point under tail coverts):** Slide ruler under tail feathers and measure from insertion of tail feathers to tip of tail. Record to the nearest 0.1 mm.

Record all information in Rite-in-the-Rain<sup>®</sup> data books. You MUST take measurements exactly as others to insure comparability of data. Make sure you hold the caliper correctly and that it is always zeroed if it is a dial type.

Before releasing a bird, double check the metal band number and color band code against what was recorded in the data notebook. Weigh the empty bird bag after the bird is released.

If you recapture birds banded in previous years, record all the information you normally record for newly-banded birds. Check the condition of all bands (metal and colors) and replace any that are worn or damaged. If you catch an adult bird that has only a metal band, add color bands. If you catch the same bird twice in the same year, you can just let it go.

At the end of the day (or at the very least, before you take your data notebook into the field again), enter the day's banding data in the electronic data file provided on your camp computer. At the end of the season when back in Homer, check with your biologist to ensure that banding data gets imported into Bandit and submitted to the Bird Banding Lab.

**For murre:** The key to handling murre is to hold them securely at all times (murre can dive 50-100m deep so you can hold them tightly) and to control the head (and thus the bill).

While the bird is still in the bag or straightjacket, weigh it to the nearest 5 g with a Pesola<sup>®</sup> scale. Once a bird has been weighed, birds are banded with a U.S. Fish and Wildlife Service metal band and a uniquely coded alphanumeric plastic color band. For murre, location of metal and color bands is *not* standardized but is based on which leg would provide the best resighting of the color band at that plot. Think about the resight observation location and the bird's orientation on the cliff and band the bird so that the color band will be on the leg facing the observer when resighting, rather than the metal band.

Keep the bird in the bag or straight jacket, hold it snugly against your body to prevent it from

struggling, and extract the leg to be banded (extra care must be taken to ensure you are putting bands on the correct legs - it is easy to get this confused when the rest of the bird is still hidden in the bag!). Always apply metal bands before any color bands in case the bird becomes stressed and needs to be released early; the banding permit **requires** all color-banded birds to have an accompanying metal numbered band.

Murres use size 6D bands, which are triangular-shaped, and come already opened. To close bands, use needle nose pliers to apply pressure to partially close bands (Figure 4d). Then change the angle of the pliers on the band and flatten the tab down until bands are closed (Figure 4e). If possible, overlap the ends a little by pushing the tab just under the squared crimp, then use the pliers to pinch and wiggle bands at the overlap until they pop shut and the ends are flush and tight. If bands overlap too much, use the band opening pliers to re-open.

Metal bands should be closed using pliers until the two ends are flush against each other. There should be no overlap and no gap wide enough that a fishing line or piece of netting could slip through (a good rule of thumb is the fingernail test: if you can fit your fingernail through the gap, it is too wide). Although you should band birds as quickly as possible to minimize handling time, be exacting and do not release birds with shoddy bands that may cause them harm!!!

Before applying alphanumeric bands, first check band combinations to make sure they cannot be misread if applied upside-down (i.e., 108 and 801) – do *not* use any such bands (this is usually more of a problem with numeric bands). To apply alphanumeric color bands, use band spreaders or 90° retaining ring pliers to gently spread bands just enough to slide bands onto the bird's leg. These bands can become brittle at cooler temperatures so care must be used not to overstretch them. To keep them warm and pliable, keep the bands tucked into a crew member's shirt (if day is warm and bands are only slightly brittle) or warm bands just before use in a thermos of hot water (if bands are very brittle). If bands are stretched out for too long, they will fail to return to their original shape, but a firm squeeze with the fingers can help mildly-stretched bands regain their form. For bands with engraved text oriented parallel to the length of the band, position bands on the bird so that the numbers can be read from *the foot towards the body*. For bands with engraved text oriented perpendicular to the length of the band, position bands with the bottom towards the foot, so that the text can be read right-side-up when the bird is standing. Spread a small amount of PVC cement (for red and yellow alphanumeric bands) under overlapping end of bands and apply pressure to the joint for 10-15 seconds while the glue sets. Wipe off any excess glue and ensure bands can spin freely on the tarsus.

After banding, record the following additional data as time/bird stress levels allows (see Figure 5):

- **Wing chord:** Measure the right wing from the bend in the wing to the tip of the longest primary using a 300 mm wing rule. With the right wing resting naturally against the bird's body, slide the wing ruler under the wing and press the vertical stop gently against the wrist joint. Measure this distance to the nearest mm. Wing should be relaxed, not flattened.
- **Diagonal tarsus:** Hold bird's right leg so both the foot and tarsal joints are bent at right angles. Place the inner jaw of the calipers into the notch at the tarsal joint and slide the outer jaw until it contacts the end of the tarsus just where the foot bends. Measure this distance to the nearest 0.1 mm. Always measure the right leg.
- **Head-and-bill (also called total head):** Open the calipers so that the opening is wider than the length of the head and bill. Place one caliper jaw against the back of the head (make sure to include the small knob of bone at the base of the skull). Slide calipers closed until the other jaw just touches the tip of the bill. Record head-and-bill length to the nearest 0.1 mm.
- **Exposed culmen:** Open the calipers so that the opening is wider than the length of the bill. Place the outer caliper jaw against the base of the bill (base of cere or feathering). Slide the inner caliper jaw until it just contacts the tip of the bill. Record bill depth length to the nearest 0.1 mm.
- **Bill depth:** Open the calipers so that the opening is wider than the depth of the bill. At the widest part of the bill, place jaws against the top and bottom of the bill and slide closed until just barely touching bill on each side. Make sure calipers remain perpendicular to the bill

length. Record culmen length to the nearest 0.1 mm.

Record all information in Rite-in-the-Rain<sup>®</sup> data books. You MUST take measurements exactly as others to insure comparability of data. Make sure you hold the caliper correctly and that it is always zeroed if it is a dial type.

Before releasing a bird, double check the metal band number and color band code against what was recorded in the data notebook. Weigh the empty bird bag or straight jacket after the bird is released.

If you recapture birds banded in previous years, record all the information you normally record for newly-banded birds. Check the condition of all bands (metal and colors) and replace any that are worn or damaged. To remove metal bands, use band spreaders to open bands enough to slip off the tarsus; to remove color bands, carefully cut bands off with small scissors (or use band spreaders to open and remove if glue seal is broken). If you catch an adult bird that has only a metal band, add color bands. If you catch the same bird twice in the same year, you can just let him go.

At the end of the day (or at the very least, before you take your data notebook into the field again), enter the day's banding data in the electronic data file provided on your camp computer. At the end of the season when back in Homer, check with your biologist to ensure that banding data gets imported into Bandit and submitted to the Bird Banding Lab.

#### *Additional safety considerations for handling birds*

Monitor the condition of birds you are handling at all times and look for signs of injury or stress (e.g., panting, droopy eyelids, appearing dazed, shivering). If a bird starts having problems, release it immediately. If you encounter a bird that appears diseased (e.g., avian pox), take care to prevent spreading to other birds at the colony. Destroy the bird bag used with that bird (do not reuse with other birds) and clean all measuring and banding instruments with 70% ethanol.

**Data analysis.**— Estimates of survival are based on the assumption that birds return to the same nest site or area of the cliff each year. For kittiwakes and murrelets, we catch only birds on chicks so we know that they are residents to the plot in the capture year; therefore (in contrast to auklets) we do not need to resight birds post-capture to include them in our sample.

The resight datasheet on your computer contains a list of all birds ever banded. From the raw resight data that you entered after every day, tally the number of times each bird was seen during the season. These totals should be entered in the tables for resight history on your computer and in the report. Generally, a bird needs to be resighted only once to be counted as "seen" for the year.

We summarize survival data by calculating apparent annual survival (true survival estimates are made irregularly in the Program MARK, but require detailed model fitting based on the question at hand.) Apparent survival is the ratio of the number of birds resighted in the current year to the number of birds alive the previous summer. Birds banded in the current year aren't included in any survival calculations until next year. To summarize survival data, you will use resight history to calculate:

No. birds banded in cohort year: essentially the sample size of banded birds and equals the sum of all birds banded in a year.

No. birds resighted in each year: how many birds you physically resighted (saw once) in the current year, broken up into each cohort year.

Birds seen in current year (A): the sum, across all cohorts, of birds you physically resighted in the current year, NOT INCLUDING birds you banded and resighted that year. This becomes your numerator in your estimate of apparent annual survival.

Birds potentially alive in previous year (B): the number of birds alive at the end of the prior season and thus potentially resightable going in to the current year. This includes the sum of (1) all birds resighted in the *prior* year, (2) any birds not resighted in the prior year but resighted in the *current* year and thus known to have been alive in the prior year (but just missed somehow), and (3) the number of new birds banded in the *prior* year (remember, only those resighted once afterwards are included). This becomes your denominator in your estimate of

apparent annual survival.

Apparent annual survival (A/B): equals the number of birds seen in current year (A) divided by the number of birds potentially alive in the current year (B).

For the most part, you will enter and calculate values only for your current year. The exception is if you resight birds that had never been resighted before, bringing new birds into the sample. When this occurs, fill in the bird's resight history in any past years (which would have been blank) with 0's back to the year it was banded, and for whatever year the bird was banded, add this bird to the "Number of birds banded in cohort year". Since you know now that this bird had been alive in previous years but just had not been resighted, you will have to adjust "Birds potentially alive in previous year (B)" and "Apparent annual survival (A/B)" for whatever past years are applicable.

Only birds with unique color bands or combinations can be used in survival estimates, so birds with metal bands only, birds missing bands, or birds with duplicate band combinations are not included in final survival calculations. For birds that were banded previously with a metal band only and then recaptured and given color bands in later years, consider the year banded or cohort year to be the year the bird was banded with color bands (and not the earlier year when it was banded with metal only).

Also summarize your annual resighting effort by calculating the total number of resight days, the average number of hours per day resighted, and the total number of hours spent resighting.

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- Sæther, B.E. and Ø. Bakke. 2000. Avian life history variation and the contribution of demographic traits to the population growth rate. *Ecology* 81:642-653.
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**Specific Requirements for Kittiwakes****Resighting**

Dates: As often as possible before eggs are laid (as soon as you arrive in May through early June) and again when chicks are large (late July through August). For plots that are also productivity plots, record resights during all productivity checks throughout the season.

Optimal sample size: Record every banded bird you see; we attempt to maintain a banded population of about 200 birds.

Time of day: Anytime.

Weather: Any type of weather in which bands are visible; resighting from cliff tops may be difficult in windy conditions.

Equipment needed: Binoculars, spotting scope, tripod/monopod, Rite-in-the-Rain® notebook, two pencils, lens cleaning cloth, warm clothes and extra layers, hand warmers, snacks and thermos full of hot drink, watch, crazy creek chair.

**Banding**

Dates: When birds are on large chicks, late July and August.

Optimal sample size: We attempt to maintain a banded population of about 200 birds (see Tables 2 and 4). Use the number of birds resighted in the current year as a judge of how many you need to band to keep the population up at that number.

Time of day: Anytime.

Weather: Avoid wet or excessively windy conditions.

Equipment needed: Noose pole, helmets (capture from below) or climbing gear (capture from above), tackle box with banding supplies (size 4A or 4 metal USFWS bands for BLKI, 3A for RLKI, size 4 alphanumeric or numeric color bands, needle-nosed pliers, reversing pliers, 500 g Pesola® scale, 300 g Pesola® scale, 100 g Pesola® scale, calipers, 500-600 mm wing rule, ruler, band cement or glue), bird bags and/or straight jackets, Rite-in-the-Rain® notebook, two pencils, food collection supplies in case any birds regurgitate (see diet collection protocol), gloves for bird retriever (optional), thermos with hot water (optional).

**Specific Requirements for Murres****Resighting**

Dates: As often as possible before eggs are laid (whenever murres start attending cliffs in June through early July) and again when chicks are large (mid- to late August). For plots that are also productivity plots, record resights during all productivity checks throughout the season.

Optimal sample size: Record every banded bird you see; we attempt to maintain a banded population of about 200 birds.

Time of day: Anytime.

Weather: Any type of weather in which bands are visible; resighting from cliff tops may be difficult in windy conditions.

Equipment needed: Binoculars, spotting scope, tripod/monopod, Rite-in-the-Rain® notebook, two pencils, lens cleaning cloth, warm clothes and extra layers, hand warmers, snacks and thermos full of hot drink, watch, crazy creek chair.

**Banding**

Dates: When birds are on chicks, typically August.

Optimal sample size: We attempt to maintain a banded population of about 200 birds (see Tables 2 and 4). Use the number of birds resighted in the current year as a judge of how many you need to band to keep the population up at that number.

Time of day: Anytime.

Weather: Avoid wet or excessively windy conditions.

Equipment needed: Noose pole, helmets (capture from below) or climbing gear (capture from above), tackle box with banding supplies (size 6D metal USFWS bands, size 6 field-readable color bands, needle-nosed pliers, large reversing pliers, 2500 g Pesola® scale, 1000 g Pesola® scale, 100 g Pesola® scale, calipers, 300 mm wing rule, band cement or glue), bird bags and/or straight jackets, Rite-in-the-Rain® notebook, two pencils, gloves for bird retriever (optional), thermos with hot water (optional).



### **Numeric**

Here, blue band with white text "409"

Record as: Blue 409

(note, this band is actually upside down which is BAD!! Text should be oriented from **foot up to body**)



### **Alphanumeric**

Here, red band with white text "J2"

Record as: Red J2



### **Three-band color combination**

Here, left leg white over dark blue, right leg metal over red

Record as: W/DB – m/R

Figure 1. Three types of kittiwake banding schemes currently in use on the Alaska Maritime National Wildlife Refuge.



Figure 2. Two types of murre banding schemes currently in use on the Alaska Maritime National Wildlife Refuge.

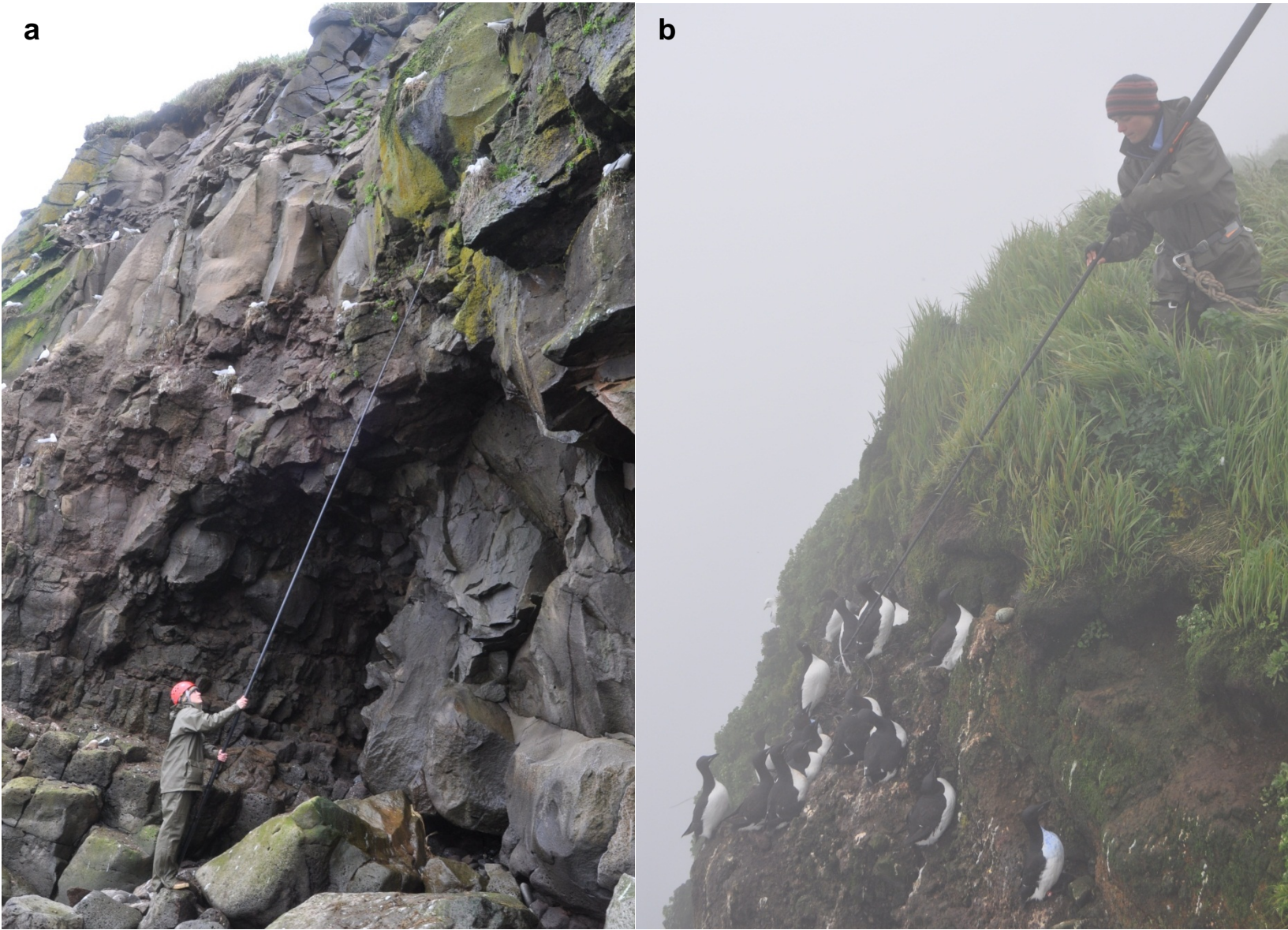


Figure 3. Capturing birds by noosepole from (a) below and (b) above.

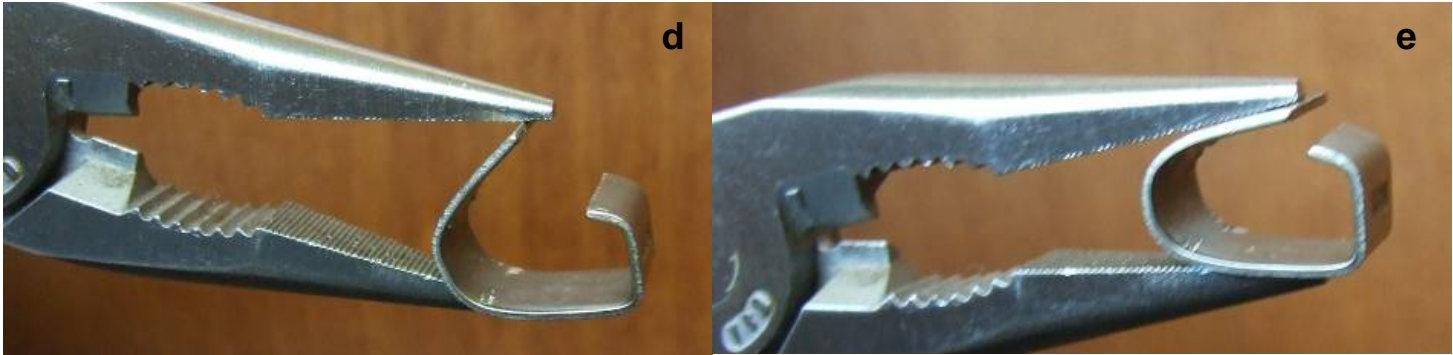
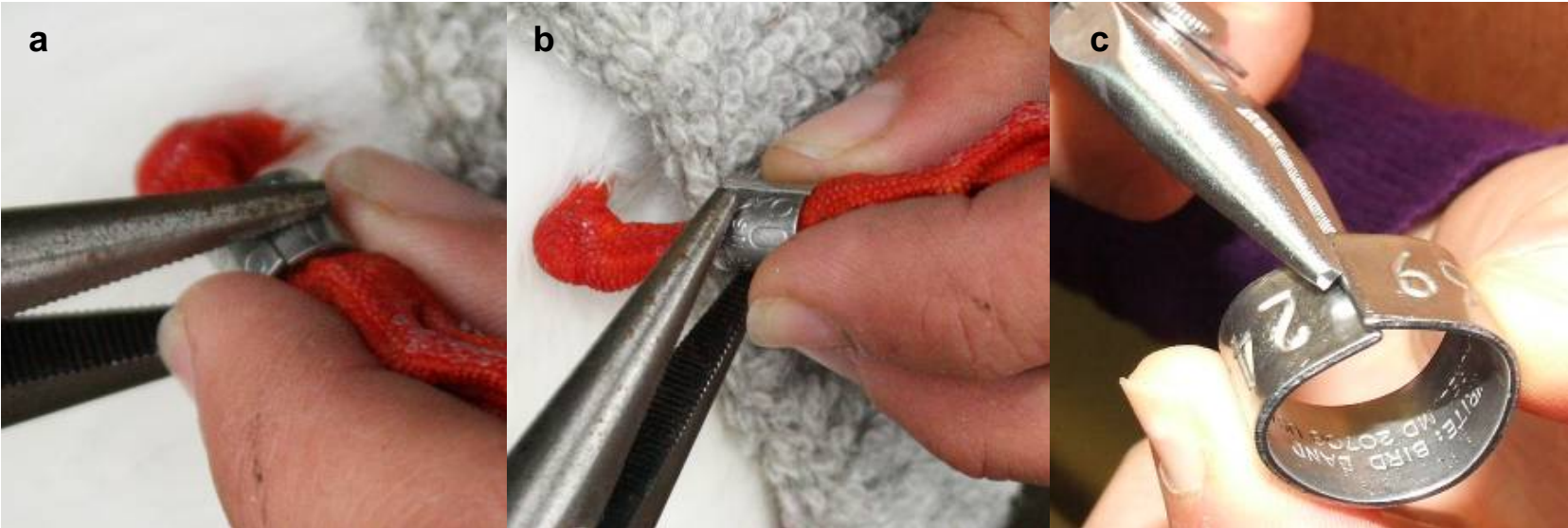
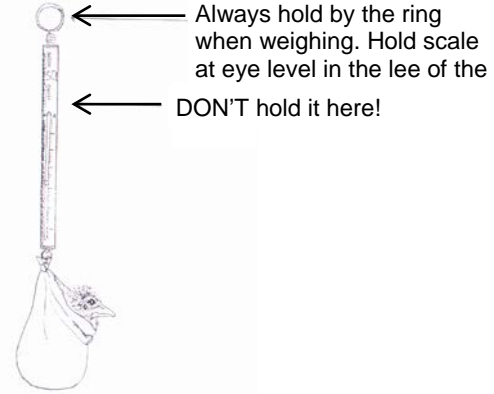
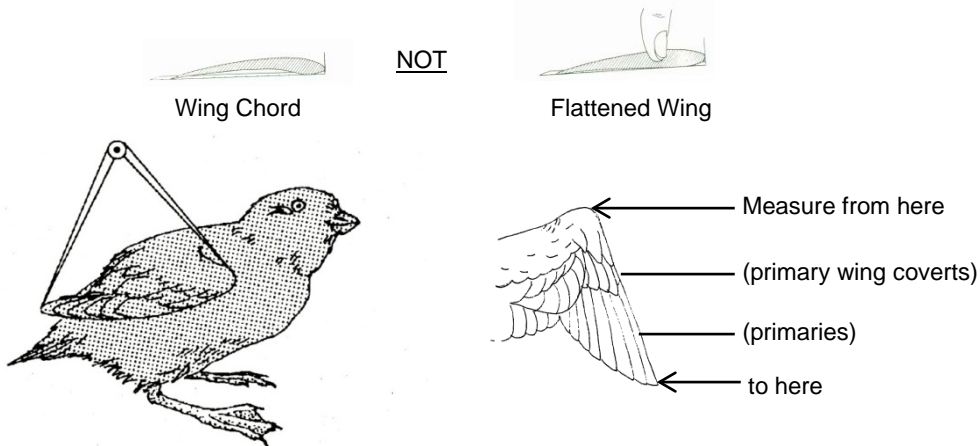


Figure 4. Pictures of metal bands for (a-c) kittiwakes and (d-e) murrens.

**Mass** - Weigh birds using a Pesola® scale. Weigh the bag and bird and then the bag separately at end. Check bag occasionally for dryness.



**Wing chord** - holding the wing next to the body and using a metal ruler with a stop, measure to the furthest feather tip possible. Always measure the right wing.



**Diagonal tarsus** - length between the intertarsal joint and the distal end of the last leg scale before the toes emerge. Always measure the right leg.

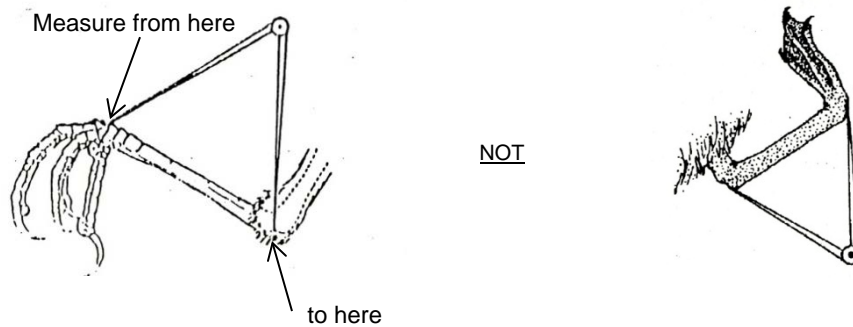
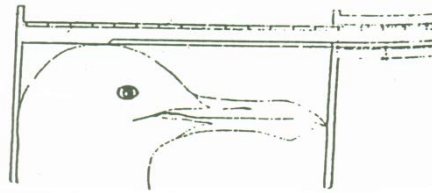
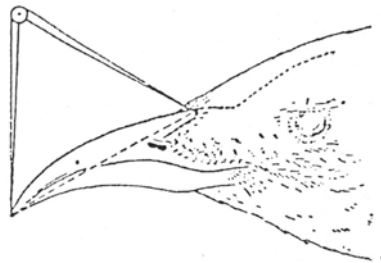
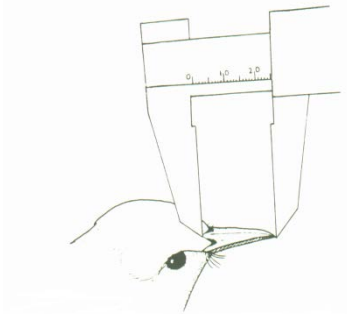


Figure 5. Diagram of kittiwake and murre measurements taken on the Alaska Maritime National Wildlife Refuge.

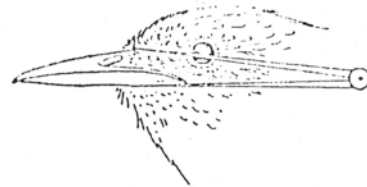
**Head-and-bill (total head)** - distance from the tip of the bill to the posterior edge of the head.



**Exposed culmen** - distance between the bill's tip and the edge of the feathering at the base.



**Bill depth** - distance between the bill's top and base, at the widest point.



**Tail length (kittiwakes only)** – distance from the insertion of tail feathers to tip of tail.

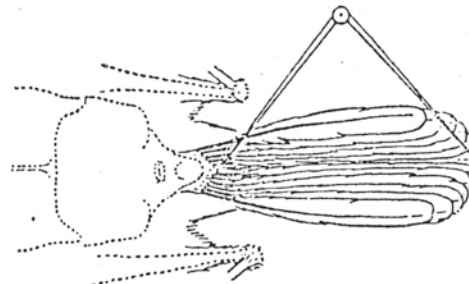
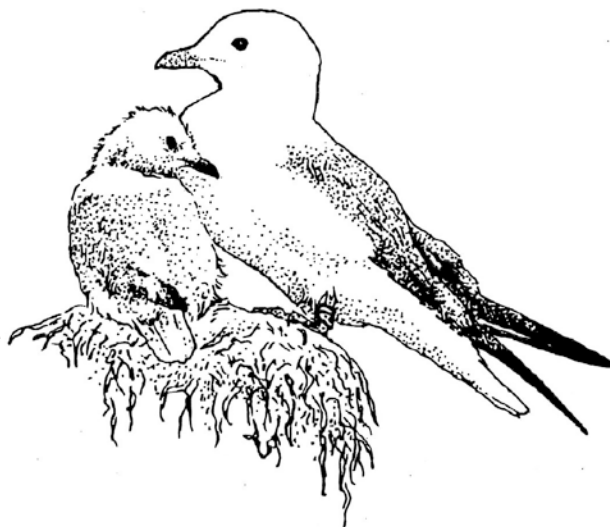


Figure 5 (continued). Diagram of kittiwake and murre measurements taken on the Alaska Maritime National Wildlife Refuge.

Attachment A. A primer on how to handle, measure, and band kittiwakes.

## How to handle, measure, and band kittiwakes

### A primer



U.S. Fish and Wildlife Service  
Alaska Maritime National Wildlife Refuge  
Aleutian Islands Unit  
P.O. Box 5251  
Adak, Alaska  
99546



The following photographs will assist you in handling, measuring, and banding kittiwakes. Standardization of techniques is important if we are to make comparisons of measurements between years. Take measurements of the birds you band and record them on the data sheet. Record diagonal tarsus, tail (tip to insertion point under tail coverts), exposed culmen, bill depth, non-flattened wing chord, mass to nearest 5 g, and head-bill length. Make sure you hold the caliper perpendicular to the axis of measurement and that it is always zeroed if it is a dial type. Get comfortable. Sit on a large flat rock or in a Crazy Creek chair to take the measurements. The more comfortable you are making the measurements, the better your precision. Handle birds firmly, yet gently. If they sense someone mollycoddling them, they will escape.

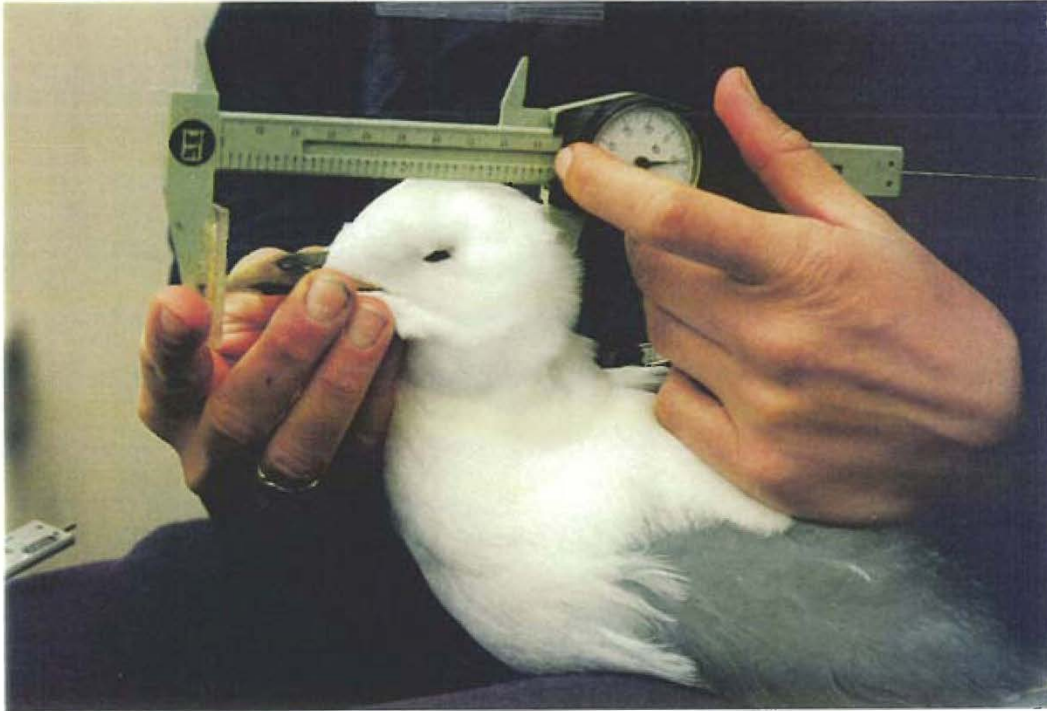


Cradle the bird in your left arm, resting its breast against your left leg, your left hand around the bird's neck. Extend its feet to the rear so that it can't push up off of you. Hold the bird firmly in place by resting your left arm on top of the bird. If the bird feels it is completely restrained, it will (usually) struggle less. Holding the bird's bill between your index and middle finger will save you from getting pecked.



Slide your left hand under the left wing and around the body. Measure the wing chord and place your left hand on top of the bird again. Keep your arm firmly on top of the bird and restrain the wings by pressing it between your left arm and body.





Measure the birds total head (Top), bill depth (Bottom), and exposed culmen (next page) by holding its head with your left hand and measuring with the calipers using the other hand.





Exposed culmen side view (above) and top view (below)

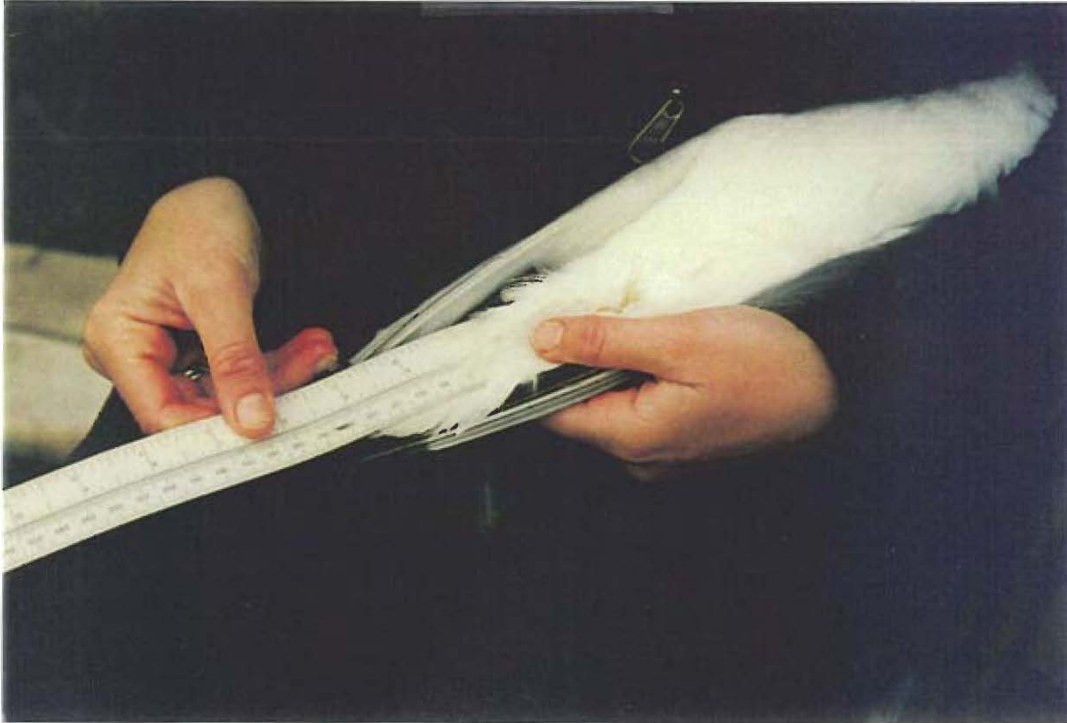


(photo1) Now, reach your right hand over the top of the bird and grasp it from above, holding the wing tips in the arch between thumb and forefinger, extend your thumb and fingers around and under the bird, just forward of the birds legs. Close your hands by touching your thumb and forefingers firmly under the bird. The bird should now have its wings pinioned in your palm and it should be restrained from using its legs by your fingers. (photo 2) Now, turn the bird over by raising your right hand and rotating your wrist to the right.

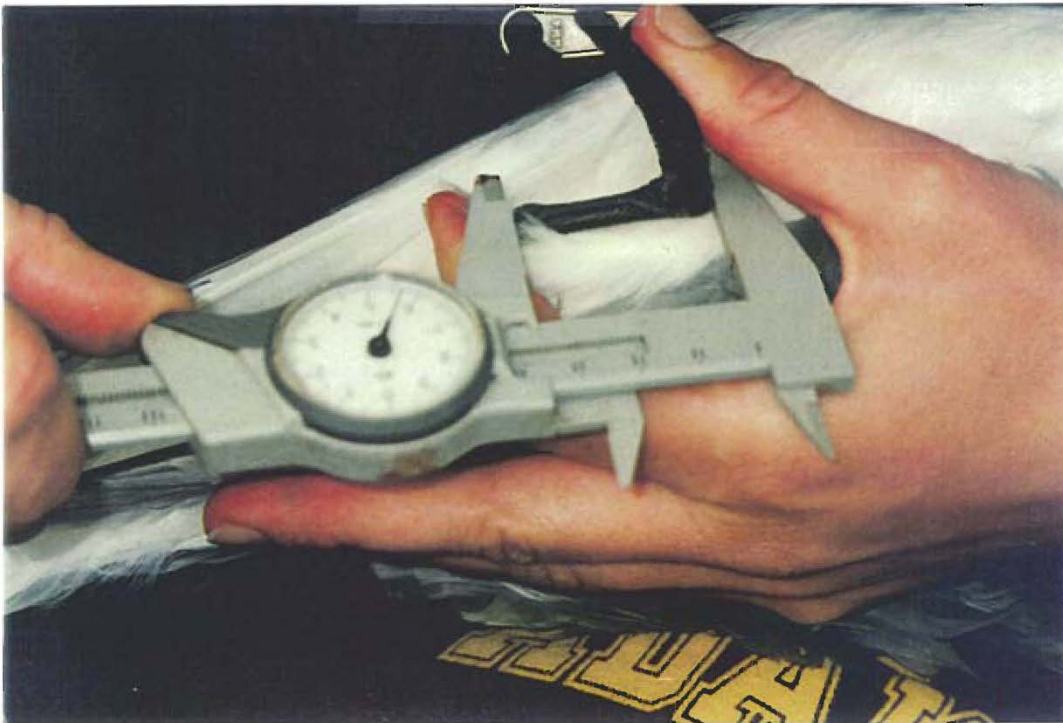


Place the now upside down birds head firmly between your left arm and body, resting its back against your left leg. Make sure the birds head is secure and that it cannot see you. Press the bird between your left arm, leg and body firmly. Do not let the bird push against you with its feet.





You can now take the measurements of tail (above), and diagonal tarsus (below) with your right hand.



Place a stainless steel USFWS band on the right leg. Use needle nose pliers to gently close the band by pinching it on opposite sides of the opening.



When the band is nearly closed, rotate the band 90° placing the opening directly on the pliers. Gently apply pressure to close the opening completely and compress the band laterally into an oval. This shape will better fit the shape of the birds leg (below).



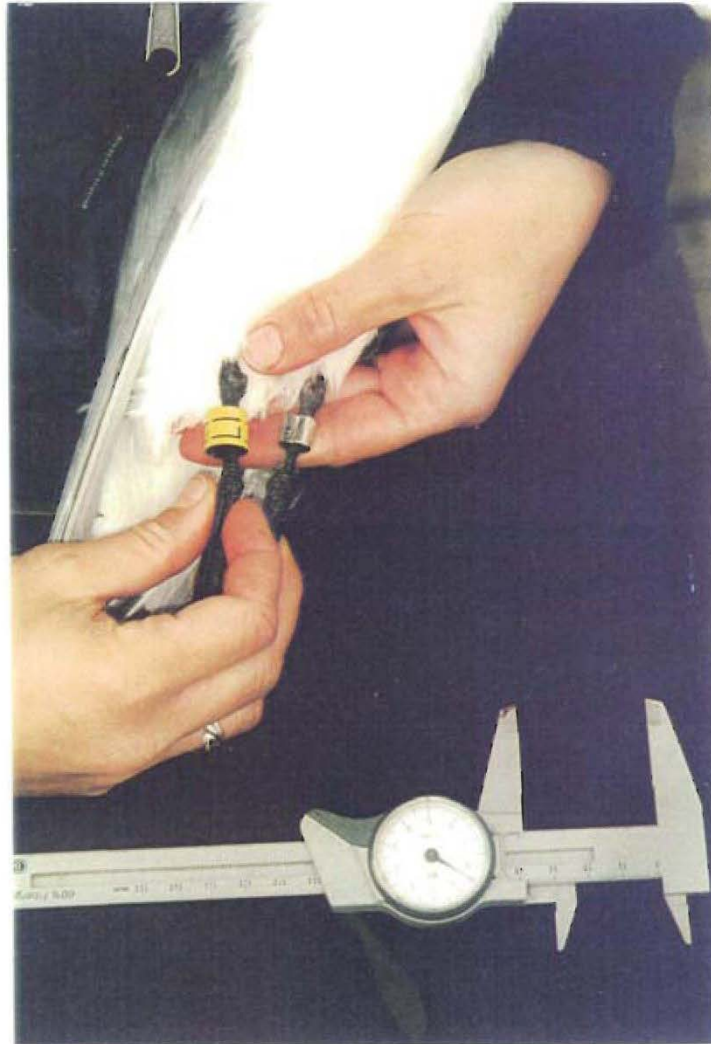
Next, warm a plastic band by placing it in warm/hot water or in your mouth for several minutes. This will soften the band and allow you to open it without (hopefully) breaking or fracturing it. Remove the band from the water or your mouth and open the band using reversing pliers just enough to slip one end onto the tarsus.



When opening the plastic band, do not open it too far. Rotate the band onto the tarsus quickly to avoid "springing" the band. Cement the band shut by gluing under the overlapping ends.



Confirm that the bands were put on to be read from the birds feet upward, recheck that you have taken all measurements. Smooth down the birds feathers and then release the bird by releasing your grip and letting it fly away.



**Looks Great!** All data in the notebook - *let her go!*



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

**PROCEDURE DETAILS SPECIFIC TO BULDIR**

Black-legged and red-legged kittiwakes are the only species for which FWS crews will do survival banding and resighting. Least and crested auklets are banded and resighted as well but that work is done by a crew from Memorial University. Kittiwakes included in the survival dataset on Buldir have been banded with alphanumeric and numeric bands as well as three-band color combinations (Table A1; see Figure 1).

Table A1. Types of bands used on survival birds at Buldir Island.

Species	Band Color	Code Color	Years
<b>Black-legged kittiwake</b>			
Numeric/Alphanumeric	Green	White	1988-1992
Numeric/Alphanumeric	Red	White	1993-2007
Numeric/Alphanumeric	Yellow	Black	1989-1998
Three-band color combination	various	n/a	2008-Present
<b>Red-legged kittiwake</b>			
Numeric	Blue	White	1988-2000
Alphanumeric	Green	White	1988-1993
Alphanumeric	Red	White	1988-2006
Numeric/Alphanumeric	Yellow	Black	1993-1998
Three-band color combination	various	n/a	2007-Present

Kittiwake survival on Buldir is monitored from the beach solely within the population plots at Kittiwake Lane (KWL). To get to these plots, hike east from Main Camp along the north beach toward East Cape. This is a ninety minute to two hour hike over boulders and loose cobbles. The boundaries of 15 plots are marked at the base of the cliffs. The most recent set of population plot photos can be helpful in determining these boundaries in instances when a painted marking has worn off or become obscured. These photos can be found in the “Photos/Maps: Pop Counts” binder as well as on the camp laptop. For the purposes of banding and resighting, each plot is divided into sub-plots A, B, and C. These are approximate and vertically divide the larger plots roughly into thirds from east to west. When either banding or resighting a bird, be sure to record the band color(s) and code (if any), the plot number and sub-plot letter in which the bird is located, whether the bird has made a breeding attempt in the current season, the band color(s) and code (if any) of the bird’s mate (if not banded, record NB), sex, and the height and distance from the edge of the plot. The breeding status can be determined by the presence of a nest, egg, chick, or observed copulation. Sex is determined through morphological measurements (i.e., the males are larger than females), observed copulation (male on top), or food-begging display/courtship feeding (females beg, males feed) A summary of all the data to be recorded is outlined in Table A2.

The cliffs of Buldir are comprised of rocks embedded in dirt and are very susceptible to erosion and rockfalls. It is very important to always wear a hard hat and stay alert whenever walking to/from or working at KWL. It is tempting to listen to music to make the walk seem to pass more quickly but wearing earphones is not recommended as you will often hear rockfalls and slides before you see them. When walking between Main Camp and KWL, be sure to pause at the leading edge of any slides and check for activity before continuing. While banding and resighting do not sit or set up your banding station at the mouth of any gully as rockfalls can occur without warning. The cliffs become more active following heavy rains so be flexible in your scheduling of work at KWL to avoid these times. The hazards of working under cliffs can be unpredictable but by remaining aware, using common sense and minimizing your time in high-risk areas you will drastically reduce your exposure to any danger.

Table A2. Information to be recorded when banding or resighting kittiwakes at Buldir Island.

Datasheet heading	Description	Example of how to record data
R Leg	Band color/code on right leg	Y E9, R
L Leg	Band color/code on left leg	G 64, W/O
SEC	Plot where bird was banded/ resighted	7, 10, 9, etc.
SUB	Sub-plot where bird was banded/resighted	A, B or C
Breeding	Breeding attempt in the current year?	Y, N or U
Mate	Band color/code of bird's mate	R 27, DB R/BK, NB (not banded)
Sex	Sex, if it can be determined	F, M or U
Ht/dist	Height/distance of bird from edge of plot	10/5R, 4/10L
Notes	Additional information	Female by copulation, band upside down

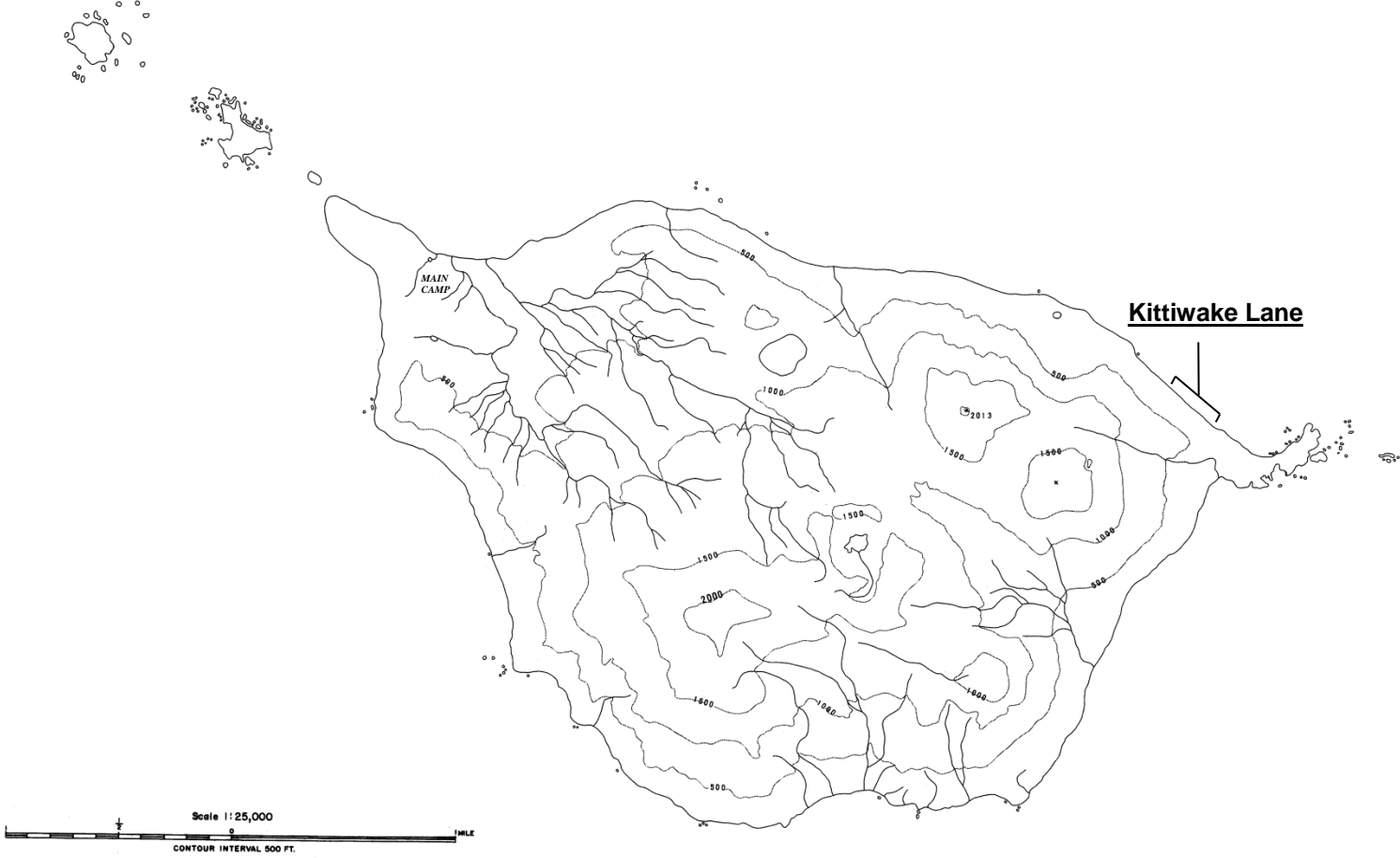


Figure A1. Location of kittiwake survival plots at Buldir Island.

## Attachment B. St. George Island specifics (includes Figures B1-17 and Tables B1-5)

**PROCEDURE DETAILS SPECIFIC TO ST. GEORGE**

Birds included in the survival dataset on St. George are banded with alphanumeric and numeric bands and three-band color combinations (Table B1; see Figures 1-2).

Table B1. Types of bands used on survival birds at St. George Island.

Species	Colors	Years
Black-legged kittiwakes		
Alphanumeric	Red	2009-present
Numeric	Blue	1992-2007
Three-band color combination	various	2008
Red-legged kittiwakes		
Numeric	Blue	1992-present
Thick-billed murre		
Alphanumeric	Red	2009-present
Three-band color combination	various	2008

On St. George, you may notice additional kittiwakes with single color bands or five-color combinations (Figure B1). These birds were banded as part of other studies from the 1970's though 1990's (Kildaw 1997) and are not included in our survival database, so you do not need to record them (if you have the time and would like to jot down these bands, you can keep record the date, location, and band combination in a separate datasheet and send them to Dean Kildaw at the end of the season at [dkildaw@alaska.edu](mailto:dkildaw@alaska.edu)). Beware that some birds with five-color combinations have lost color bands and so may look like the three-color band combination birds you *do* need to resight – this can be very confusing. If you record a three-color band combination and then do not find it in the resight database, it is possible that is the reason. One hint is the location of the metal band – all five-color band combination birds were banded as chicks and as such have metal bands on the left leg, while three-color band combination birds in the current survival database were all banded as adults with metal bands on the right leg. If you capture one of these alternate birds while banding, you can remove the old color bands and reband them with a new band from the current banding scheme to bring them into the survival dataset.

On St. George since 1993, placement of the metal band is intended to indicate the age of the bird at banding, in which birds banded as chicks (known-age birds) are banded with metal on the left leg, and birds banded as adults are banded with metal on the right leg. The idea behind this scheme was to allow researchers to know immediately which birds were known-age birds. Prior to 1993, however, birds were banded on both legs indiscriminately. In addition, it is likely that occasional birds were banded on the wrong legs.

Ledgenester survival on St. George is monitored on five kittiwake plots and three thick-billed murre plots. Recent banding and resighting efforts are detailed in Tables B2-3. For plot locations, see Figures B2-A13 and Table B4 for kittiwakes and Figures B14-17 and Table B5 for murre. In a population count year, do any banding after and not before the plot/area has been counted that day to avoid disturbing birds and biasing the count.

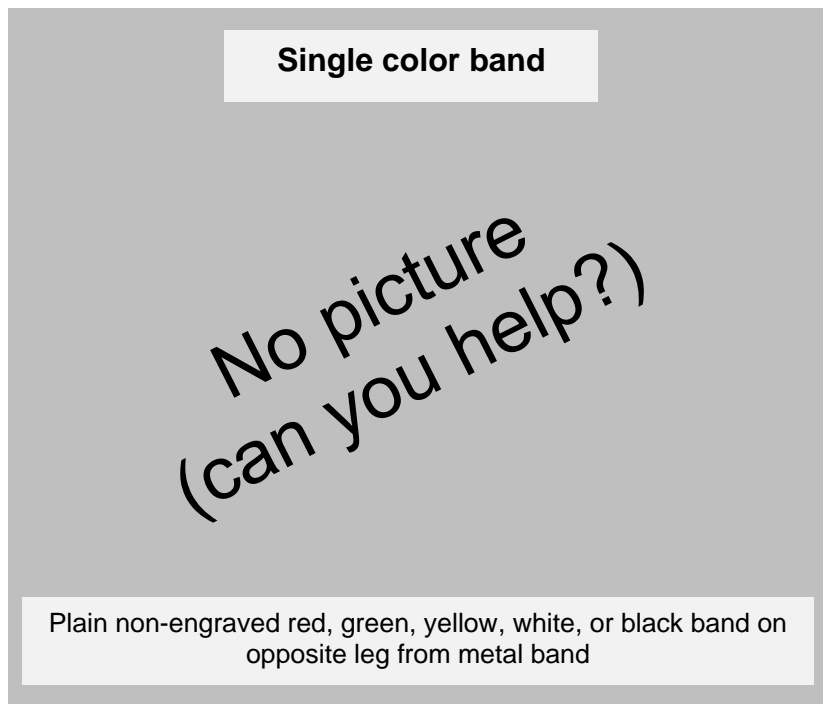


Figure B1. Two types of kittiwake banding schemes no longer used at St. George Island. These birds are not in the resight database and do not need to be recorded when observed.

Table B2. Numbers of banded birds present on survival plots at St. George Island as of end of season 2010. Values include all birds banded 2008-2010 and any birds banded prior to 2008 that were resighted in 2010.

Species	Number banded
Red-legged kittiwake	
High Bluffs 70	27
High Bluffs H1/H2	73
Rosy Finch	34
Total	134
Black-legged kittiwake	
Rosy Finch	71
Village 58A	24
Village 58C	40
Total	135
Thick-billed murre	
High Bluffs 65	31
Zapadni 74	32
Red Bluffs 30	19
Total	82

A number of survival plots on St. George are also used for productivity. Do not band birds in a plot in the same year you monitor that plot for productivity, as banding may disturb your productivity birds. For the following plots, we recommend a rotating schedule of banding, in which the plot is used for productivity for 2-3 years and then skipped for a year so that a mass of birds can be banded there:

#### Red-legged kittiwakes

- Survival Plot High Bluffs 70 - Overlaps entirely with Productivity Plot High Bluffs 70; cannot band and do productivity in the same year.
- Survival Plot High Bluffs H1/H2 - H2 overlaps with Productivity Plot High Bluffs 92; capturing in the H1 section of the plot should be okay as long as crews watch for potential disturbance.

#### Thick-billed murre

- Survival Plot High Bluffs 65 - Overlaps entirely with Productivity Plot High Bluffs 65; cannot band and do productivity in the same year.
- Survival Plot Zapadni 74 - Survival plot is on the opposite cliff face from Productivity Plot Zapadni 74 but is too close for banding to occur without disturbing the productivity plot; cannot band and do productivity in the same year.

#### Literature Cited

Kildaw, S.D. 1997. Kittiwake banding on St. George Island, Alaska: past, present, and future. U.S. Fish and Wildl. Serv. Rep., AMNWR 97/24. Homer, Alaska.

Table B3. Resighting efforts for kittiwake and murre survival at St. George Island 2006-2010.

	2006	2007	2008	2009	2010
<b>Black-legged kittiwakes</b>					
Resighting effort					
Days	16	8	11	19	22
Hours	n/a	n/a	29.2	28.7	62.3
Resighting dates					
First	21 May	18 May	19 May	21 May	17 May
Last	21 Aug	31 May	27 Aug	30 Jul	20 Aug
<b>Red-legged kittiwakes</b>					
Resighting effort					
Days	26	25	26	22	24
Hours	68.7	n/a	n/a	32.8	53.0
Resighting dates					
First	21 May	18 May	16 May	19 May	19 May
Last	31 Aug	26 Jul	27 Aug	4 Sep	23 Aug
<b>Thick-billed murre</b>					
Resighting effort					
Days	-	-	-	10	14
Hours	-	-	-	37.0	58.0
Resighting dates					
First	-	-	-	6 Jun	3 Jun
Last	-	-	-	16 Aug	14 Aug

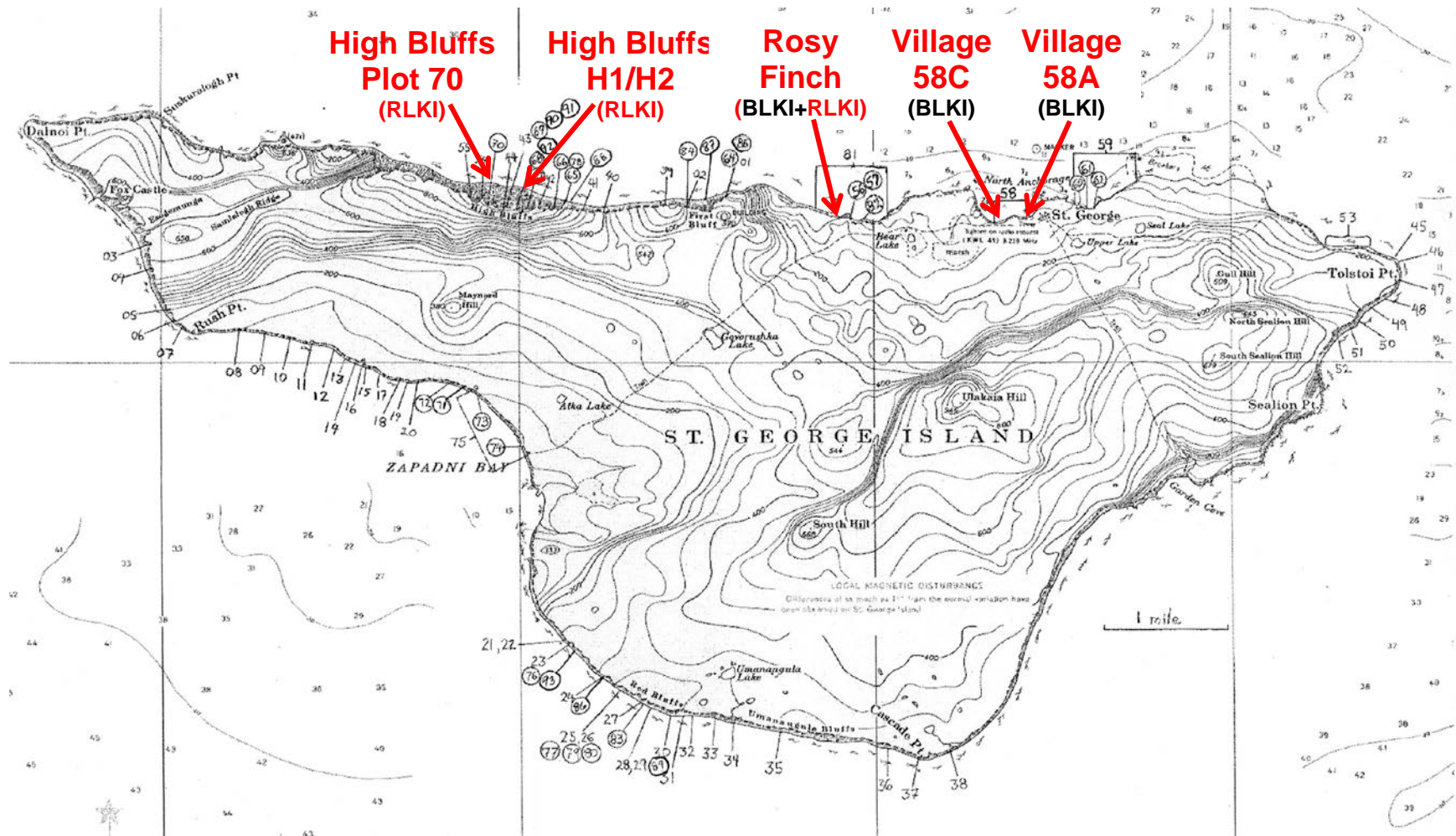


Figure B2. Map of black-legged kittiwake survival plots at St. George Island.



Table B4. St. George Island survival plots for kittiwakes.

Plot	Species	Notes
High Bluffs Plot 70	RLKI	Single observation point from stake for Plot 70. Plot is very close to observation point. Also productivity Plot 70. Capture and resight from <i>above</i> cliffs.
High Bluffs H1 and H2 (near Plot 68)	RLKI	Far view from the observation point for plot 67 (you'll need a spotting scope and a calm day). For closer views, you can view from observation point for plot 92. You can also climb down the ridge immediately below the rebar stake for 68 as far as is safe to view H2. H1 is in productivity Plot 92. Capture and resight from <i>above</i> cliffs.
Rosy Finch	RLKI+BLKI	Walk along beach in both directions from the roped climb-down gully. The banded birds stretch from the west at "Sea Urchin point" (a rocky outcropping tough to clamber around except at low tide, from which you can see Staraya beach) to the east at a broad amphitheater-like cove (not past the productivity plots). Check for bands as far as you can find kittiwake nests. It is not worth trying to resight at Rosy Finch unless the tide is under 0.0 and the sea is calm, and it's best to take advantage of -0.3 and lower tides. Going at lower tides allows a good viewing angle on birds higher up the cliff. Capture and resight from <i>below</i> cliffs.
Village 58A (Population Plot 58A)	BLKI	Beach section just under town store, from start of cliffs on east end to large boulders at west end. Access from east end near Washhouse. Walk along beach to resight. Possible at all tides but lower tides allows a better viewing angle for birds higher up the cliff. Capture and resight from <i>below</i> cliffs.
Village 58C (Population Plot 58C)	BLKI	Beach section west of Village 58A plot, accessed either by scrambling over rocks at end of Village 58A plot or by rope. Rope marks east end of plot, from there walk west until cliffs end (and seal colony begins). Capture and resight from <i>below</i> cliffs.



Figure B3. St. George Island kittiwake survival plot - High Bluffs Plot 70. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly (be careful when peering too far over the cliff!).

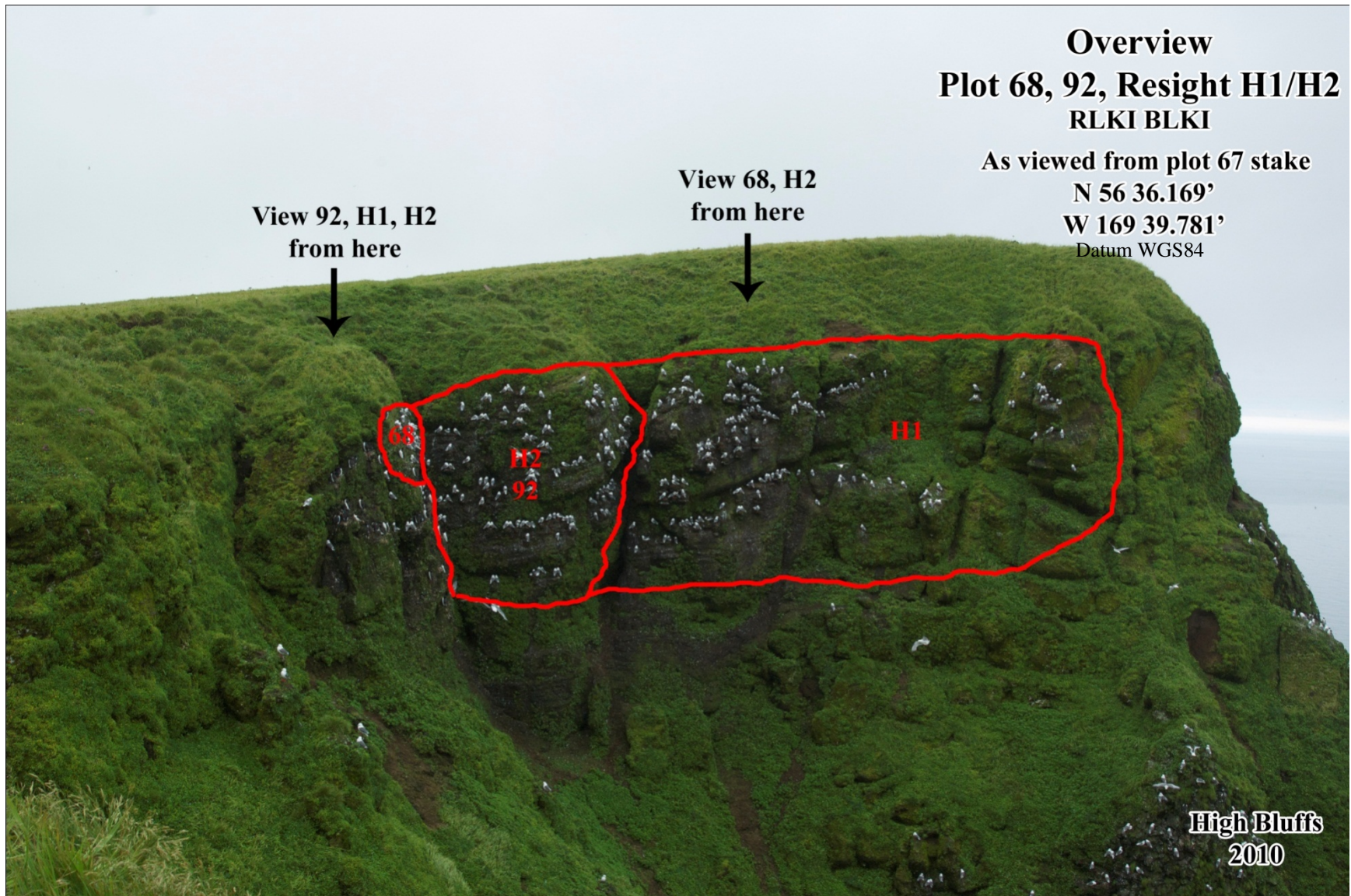


Figure B4. St. George Island kittiwake survival plot - High Bluffs H1/H2. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

## Access to Rosy Finch Survival Plot



**Rosy Finch Rope Access**  
**N 56.60180°**  
**W 169.59808°**  
Datum WGS84



Figure B5. St. George Island kittiwake survival plot - Rosy Finch (Access to Rosy Finch Beach).

## Rosy Finch Survival Plot

View looking east from rope

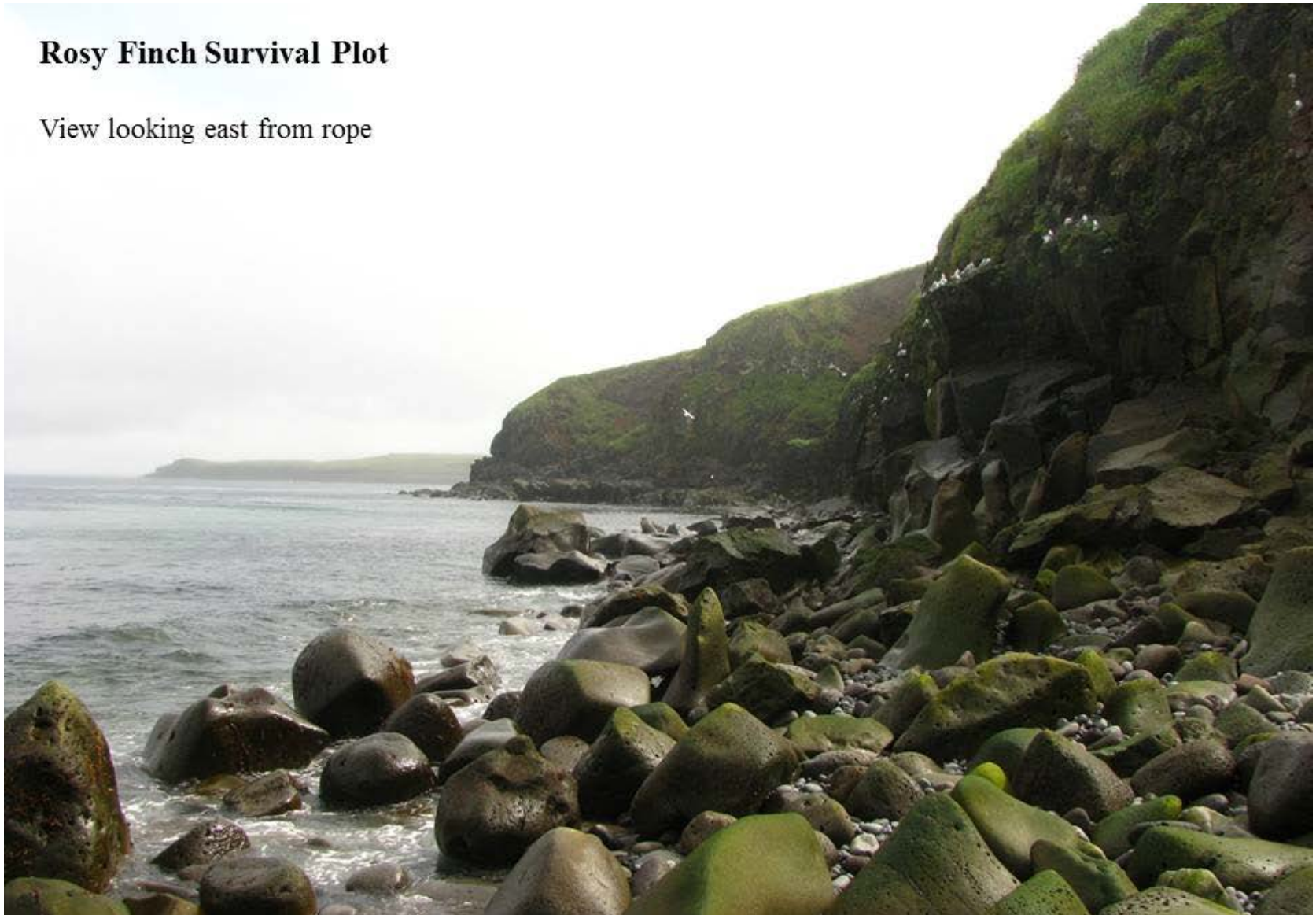


Figure B6. St. George Island kittiwake survival plot - Rosy Finch.



Figure B7. St. George Island kittiwake survival plot - Rosy Finch.

## Village 58A Survival Plot

View from east end access, looking west

Red line indicate plot boundary



Figure B8. St. George Island kittiwake survival plot – Village 58A. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

## Village 58A Survival Plot

View from west end, looking east

Red line indicate plot boundary



Figure B9. St. George Island kittiwake survival plot – Village 58A. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.





## **Parking and Rope Access for Village 58C Survival Plot**

### **Village 58C Parking**

**N 56.60070°**

**W 169.55743°**

Datum WGS84

### **Village 58C Rope Access**

**N 56.60107°**

**W 169.55701°**

Datum WGS84



Figure B10. St. George Island kittiwake survival plot – Village 58C (Rope Access).

## Village 58C Survival Plot

View from east, looking west

Red line indicate plot boundary

Rope access



Figure B11. St. George Island kittiwake survival plot – Village 58C. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

## Village 58C Survival Plot

View from mid-way down beach, looking east



Figure B12. St. George Island kittiwake survival plot – Village 58C. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.



Figure B13. St. George Island kittiwake survival plot – Village 58C. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

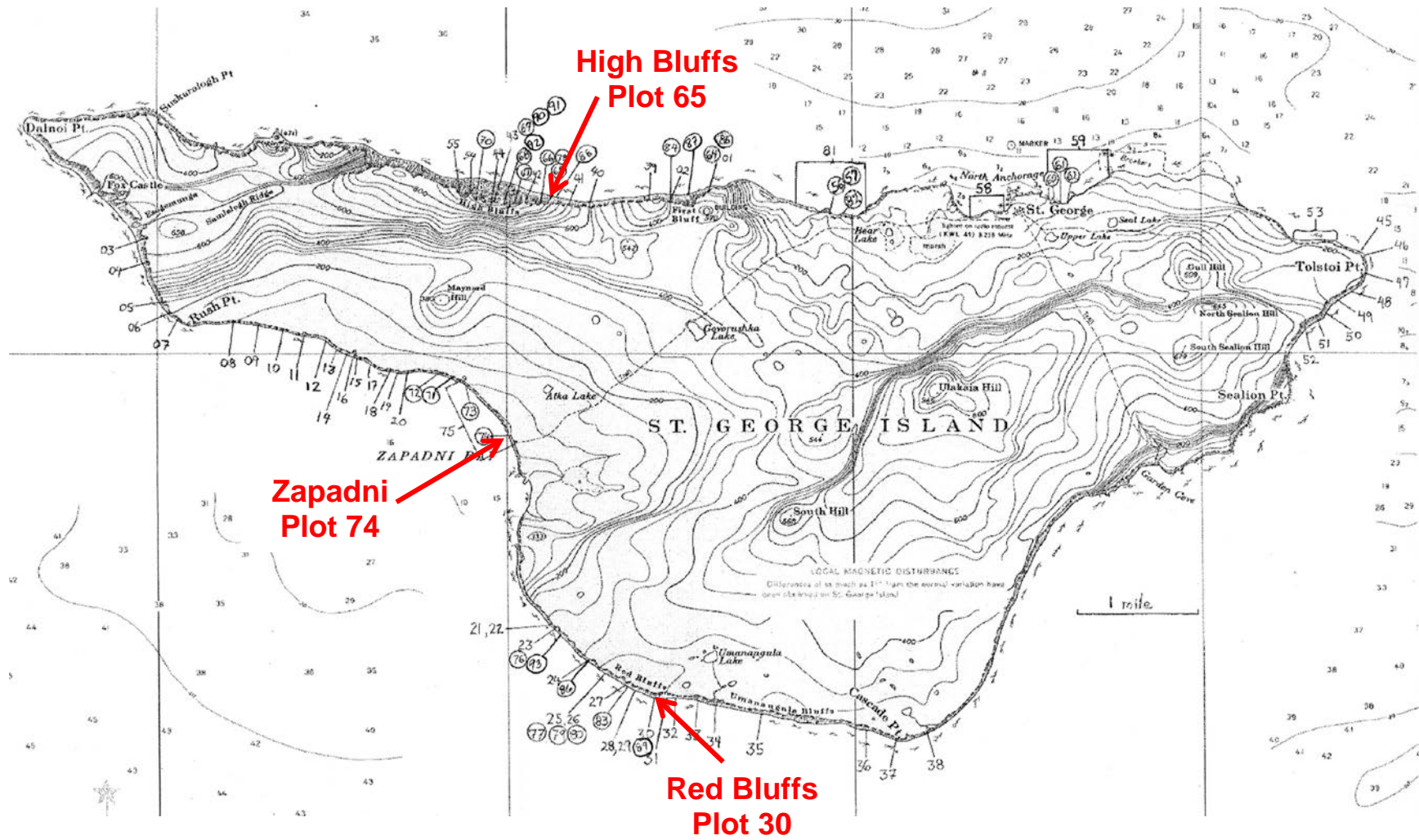


Figure B14. Map of thick-billed murre survival plots at St. George Island.

Table B5. St. George Island survival plots for thick-billed murre.

Plot	Species	Notes
High Bluffs Plot 65	TBMU	Single observation point from stake for Plot 65. Plot is very close to observation point. Also productivity Plot 65. Capture and resight from <i>above</i> cliffs.
Zapadni Plot 74	TBMU	Single observation point <i>opposite</i> stake for productivity Plot 74 (survival plot on opposite cliff face than productivity plot). Capture and resight from <i>above</i> cliffs.
Red Bluffs Plot 30	TBMU	Single observation point from stake for Plots 89/30. Survival plot includes just the upper tiers of birds that are within noose-pole range. Part of population Plot 30 (to right of productivity Plot 89). Capture and resight from <i>above</i> cliffs.

## High Bluffs Plot 65

View from Plot 65  
observation stake  
N 56.60290°  
W 169.65849°  
Datum WGS84



Figure B15. St. George Island thick-billed murre survival plot – High Bluffs Plot 65. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

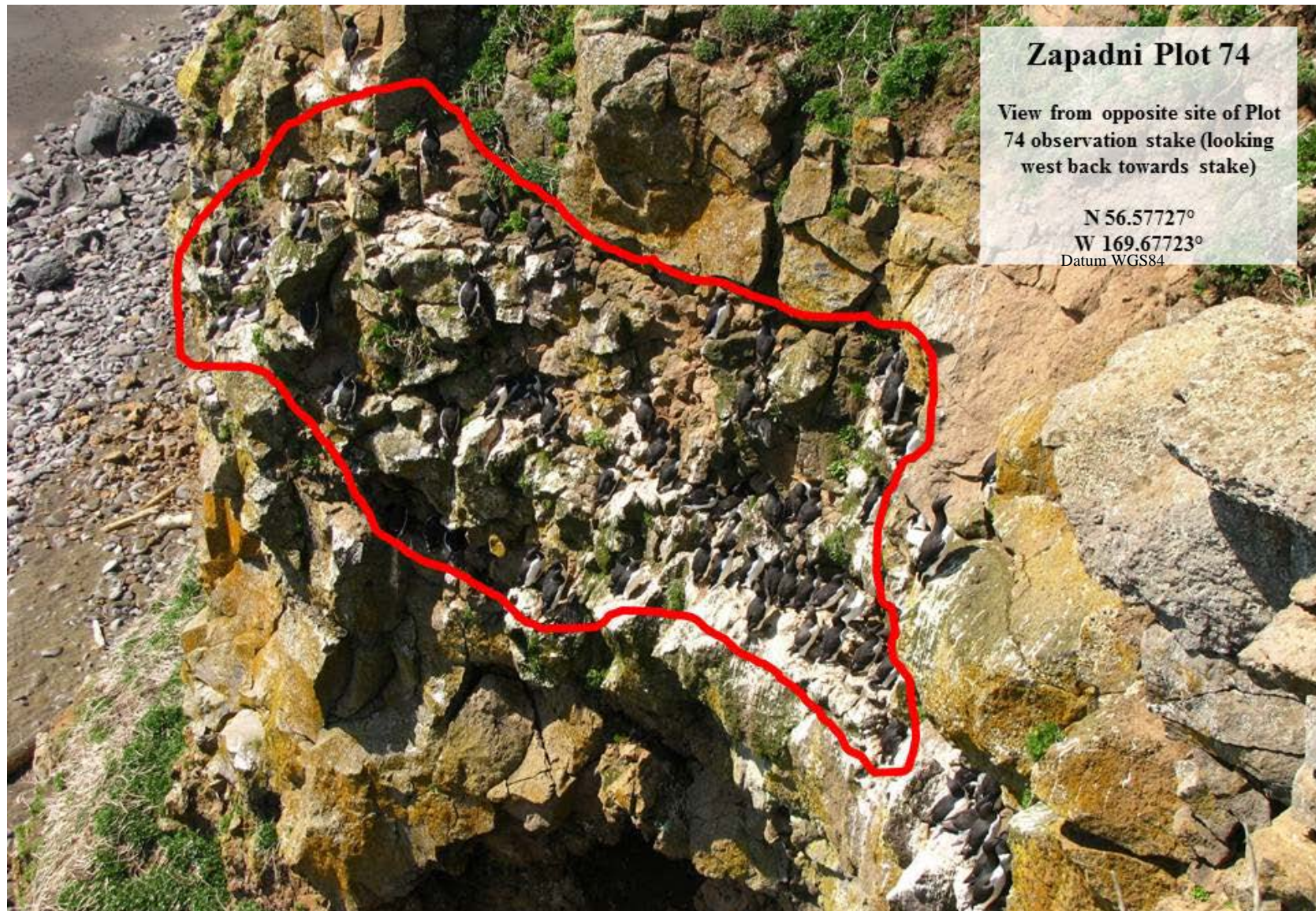


Figure B16. St. George Island thick-billed murre survival plot – Zapadni Plot 74. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.



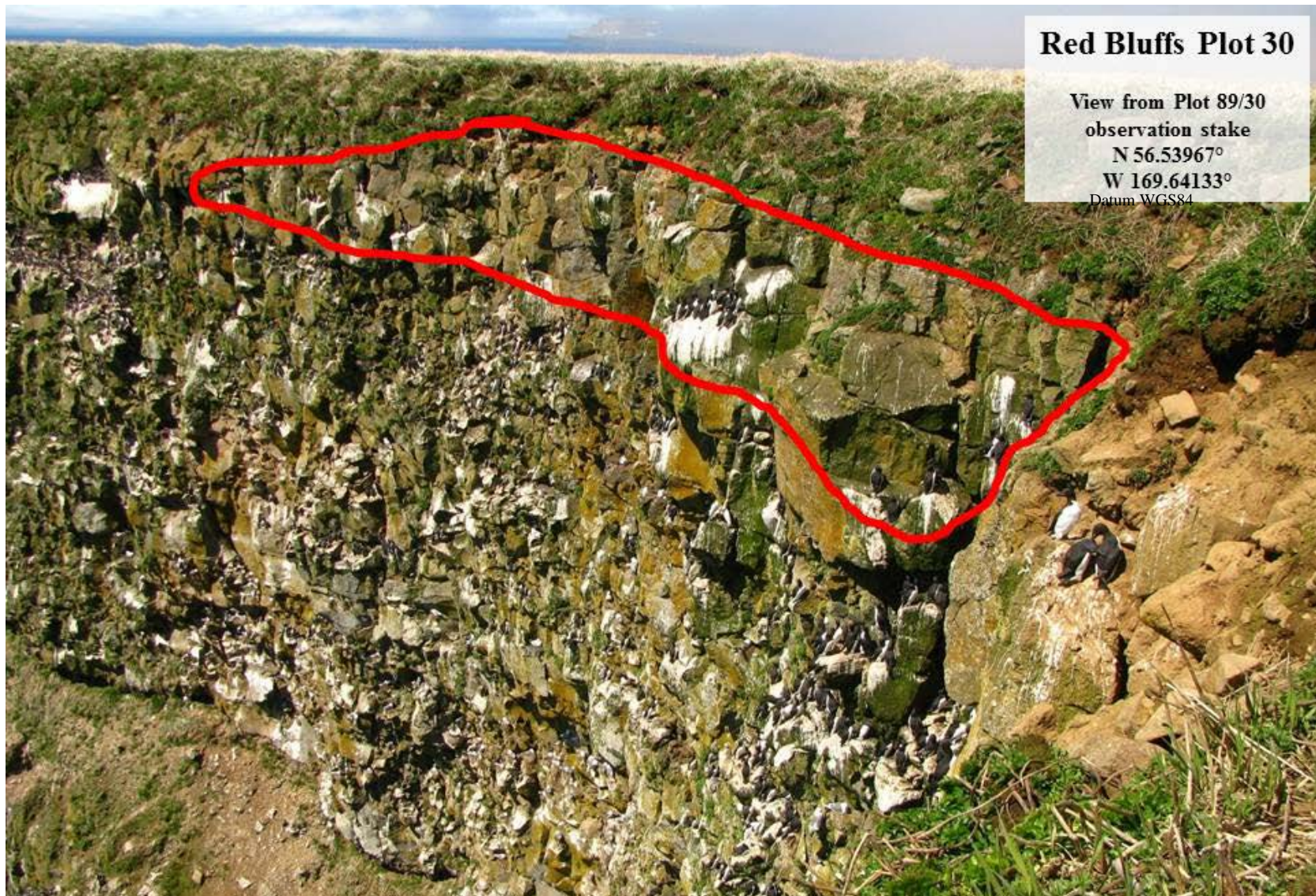


Figure B17. St. George Island thick-billed murre survival plot – Red Bluffs Plot 30. Note that plot boundaries are for initial banding only; when resighting, scan outside line for birds that may have moved slightly.

## Attachment C. St. Paul Island specifics (includes Figures C1-9 and Tables C1-5)

**PROCEDURE DETAILS SPECIFIC TO ST. PAUL**

Birds included in the survival dataset on St. Paul are banded with alphanumeric bands and three-band color combinations (Table C1; see Figure 1 and 2). Ledge­nester survival on St. Paul is monitored on four kittiwake plots and four thick-billed murre plots. Recent banding and resighting efforts are detailed in Tables B5-6. For plot locations, see Figures C1-4 and Table C4 for kittiwakes and Figures C5-9 and Table C5 for murre. In a population count year, do any banding after and not before the plot/area has been counted that day to avoid disturbing birds and biasing the count.

Table C1. Types of bands used on survival birds on St. Paul Island.

Species	Colors	Years
Black-legged kittiwakes		
Alphanumeric	Yellow	2009-present
Three-band color combination	various	2008
Thick-billed murre		
Alphanumeric	Yellow	2009-present
Three-band color combination	various	2008

Table C2. Numbers of banded birds present on survival plots at St. Paul Island as of 2010. Values include all birds banded 2008-2010 and any birds banded prior to 2008 that were resighted in 2010.

Species	Number banded
Black-legged kittiwake	
Southwest Point	52
Tsamana	35
Tsamana North	5
Total	92
Thick-billed murre	
Zapadni 84	8
Zapadni Dip	19
Past Zapadni Dip	7
Tolstoi	15
Total	49

Table C3. Resighting efforts for kittiwake and murre survival at St. Paul Island 2009-2010.

	2009	2010
<b>Black-legged kittiwakes</b>		
Resighting effort		
Days	16	14
Hours	n/a	46.0
Resighting dates		
First	10 Jun	8 Jun
Last	8 Jul	18 Jul
<b>Thick-billed murre</b>		
Resighting effort		
Days	4	11
Hours	n/a	18.9
Resighting dates		
First	15 Jun	5 Jun
Last	19 Jun	16 Aug



Table C4. St. Paul Island survival plots for black-legged kittiwakes.

Plot	Species	Notes
Southwest Point	BLKI	Park about halfway between the end of the road and the gate on the High Bluffs trail. Walk down to the beach where it is safe to do so and head north until you reach the first group of kittiwakes that are low enough to be captured. There are three clusters of birds as you walk northward with a few marked individuals in between so scan all kittiwakes for bands along this stretch of beach. High tides with heavy surf can restrict access to the farthest group of birds so you may have to plan to resight those birds at lower tides during stormy weather. The cliffs in this area are particularly active so helmets should be worn at all times. Capture and resight from <i>below</i> cliffs.
Tsamana	BLKI	Beach access is located along the High Bluffs trail just north of Rush Hill, approximately four miles north of Southwest Point. The cliffs mostly taper off in this area before rising slightly again. Once on the beach, walk south (left), past the point and continue onto a large lava outcropping. The survival plot is along these cliffs but does not extend beyond the end of the outcropping. Access to Tsamana is good in all conditions except particularly large seas out of the northwest. Capture and resight from <i>below</i> cliffs.
Tsamana North (also called Northwest Point; called Tsamana-B in cormorant banding protocol)	BLKI	Beach access is the same as for Tsamana. To reach this plot, head north (right) for approximately ½ km. This group of birds is visible from the beach access point. Capture and resight from <i>below</i> cliffs.

### Southwest Point Survival Plot



**Far group:**  
N 57.16883°  
W 170.41983°  
Datum WGS84

**Intermediate group:**  
N 57.16881°  
W 170.41961°  
Datum WGS84

**Main group:**  
N 57.16842°  
W 170.41922°  
Datum WGS84

Figure C2. St. Paul Island black-legged kittiwake survival plot – Southwest Point.

### Tsamana Survival Plot



Figure C3. St. Paul Island black-legged kittiwake survival plot – Tsamana.

## Tsamana North Survival Plot



Figure C4. St. Paul Island black-legged kittiwake survival plot – Tsamana North (also called Northwest Point).

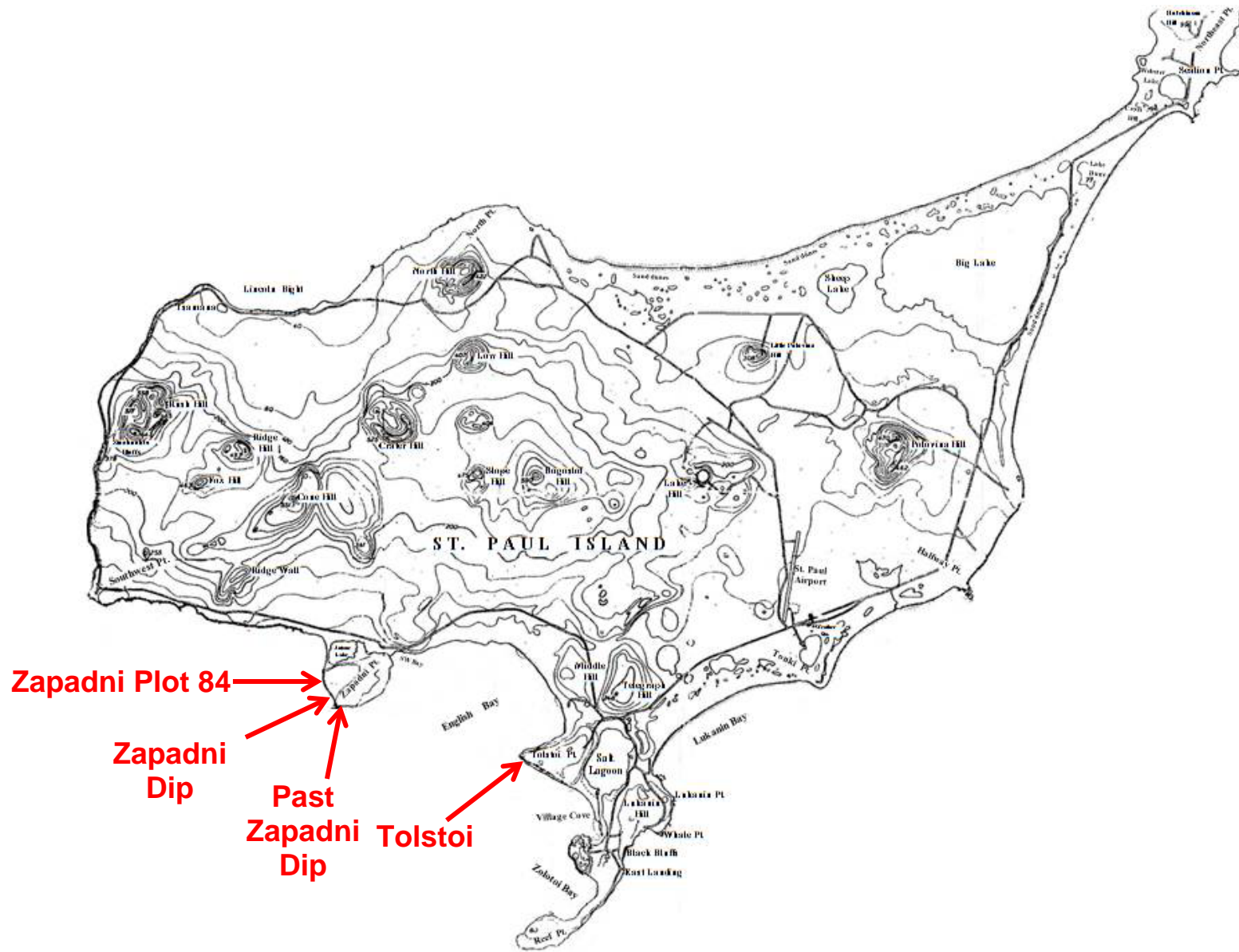


Figure C5. Map of thick-billed murre survival plots at St. Paul Island.



Table C5. St. Paul Island survival plots for thick-billed murre.

Plot	Species	Notes
Zapadni 84	TBMU	Single observation point just downhill from stake for Plot 84. In 2009, all birds were banded on a single ledge directly ahead of the observation point. Capture and resight from <i>above</i> cliffs.
Zapadni Dip	TBMU	Single observation point located past productivity plot 104 where the terrain drops dramatically. Capture from <i>above</i> cliffs but resight from within the dip.
Zapadni Past Dip	TBMU	This plot can be reached by continuing along the cliff edge and climbing up out of the dip. Continue past a broad, grassy area and look for a rebar to the right of the trail before it begins to descend again on the way to plot 89. Banded birds can be seen by looking down from the notch in the cliff edge to the seaward side of the rebar. This area is occasionally visited by young male fur seals so be aware so as not to surprise them. Capture and resight from <i>above</i> cliffs.
Tolstoi	TBMU	Follow the directions to Tolstoi productivity plots. Banded birds can be resighted from the observation point for plot 90L (looking west) and from approximately 100m farther west along the trail (looking east). Capture and resight from <i>above</i> cliffs. Captures in this plot are made from a steep dirt slope above the cliff and require a proper multi-point anchor and climbing gear to stabilize yourself. <b>Do not attempt any captures here if you don't feel confident in your ability to build a safe anchor.</b>



Figure C6. St. Paul Island thick-billed murre survival plot – Zapadni Plot 84.

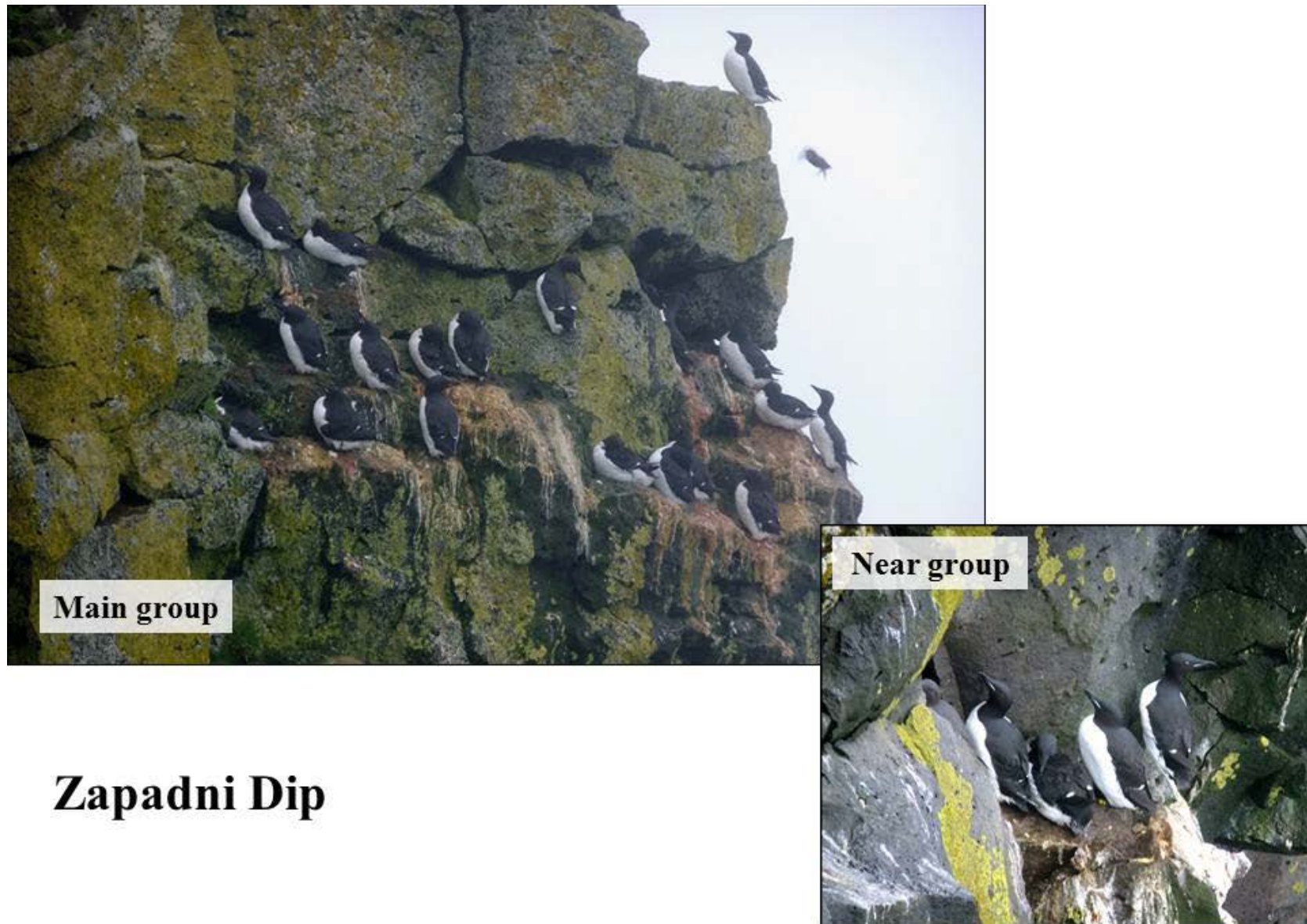


Figure C7. St. Paul Island thick-billed murre survival plot – Zapadni Dip.

## Past Zapadni Dip

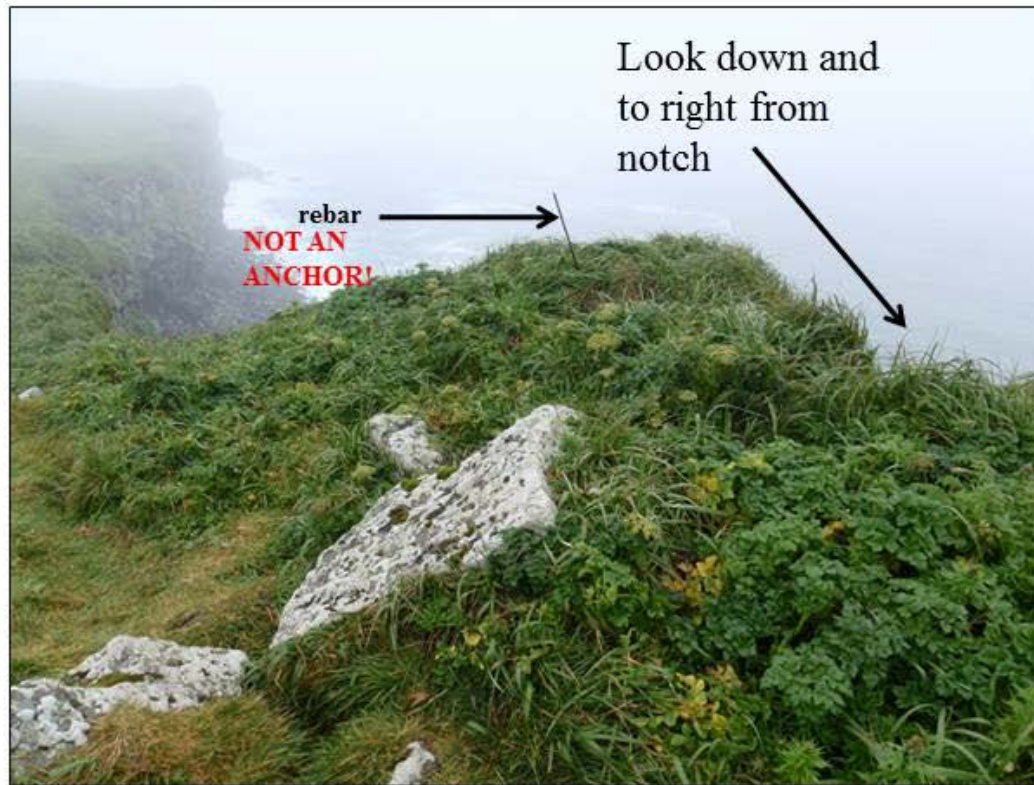


Figure C8. St. Paul Island thick-billed murre survival plot – Past Zapadni Dip.

## **Tolstoi**

Between plot 110 and 90L

Looking east from trail, west of plot 90L



Figure C9. St. Paul Island thick-billed murre survival plot – Tolstoi.

**Protocol Revision History Log**

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Revision Date	Changes made	New version #
March 2016	Fixed typo in St. George table title	1.4
April 2015	Made several minor changes and additions per IACUC	1.3
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, ordered island attachments alphabetically, changed page number format to include protocol #, reordered some tables in St. George and St. Paul attachments, made minor grammatical edits	1.2
May 2012	Buldir attachment added	1.1
May 2011	Protocol developed in standardized format from historic protocols, includes St. George and St. Paul attachments	1.0

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