

Wildlife Inventory Plan
Alaska Maritime National Wildlife Refuge
Protocol #5

Version 1.4

Parameter: Productivity and phenology

Species: Glaucous-winged gull

PURPOSE

To estimate annual productivity and phenology and examine trends in these parameters across years and sites. Seabird reproductive parameters can serve as indicators of change in the marine ecosystem (Cairns 1987, Montevecchi 1993).

BREEDING BIOLOGY

Glaucous-winged gulls nest primarily in open vegetated areas with some nesting cover, but some nesting occurs on sand beaches, cliffs, and talus. Nest may be found from sea level to over 350m in elevation. Timing of breeding varies among years and across the Aleutian Islands, Alaska Peninsula, and Gulf of Alaska colonies but nest-building usually begins in May, incubation lasts from mid- to late May to July, and chicks fledge from late July through August. Glaucous-winged gulls usually lay up to three eggs (in rare occurrences nests with four eggs have been documented). Chicks fledge at 37-53 days of age. As with other gull species, young glaucous-winged gulls progress through various phases of immature plumage before obtaining breeding plumage in their third summer (Verbeek 1993).

PROCEDURE

Data collection.—Gull productivity and phenology are monitored by following individually numbered nests at 3-7 day intervals (varies across site due to work-loads, see island-specific details for more information) through chick hatching. Once chicks hatch and become mobile (usually around two days old; Patten 1974), they can hide incredibly well in vegetation and rocks and eventually move far distances from their original nests. Therefore, following fate of chicks from individual nests post-hatch is futile, so productivity is only monitored through hatching.

At the beginning of the gull breeding season (ideally once nests have been built but before any eggs are laid), individually mark a sample of nests to follow throughout the season. **It is important to begin monitoring nests before eggs are laid** to get estimates of initial breeding effort and laying success. **A nest is defined as any structure (scrape or nest bowl) to which vegetation has been added in the current year.** Nests on beaches can be numbered using paint pens or spraypaint on nearby rocks. Nests in vegetated areas can be marked with individually-numbered pin flags. Gulls can occasionally pull up flags and vegetation often grows rank over the season, making nests more difficult to find in vegetated areas, so it is helpful to also sketch a rough map of nest locations in a field notebook and supplement flags with paint on rocks where possible (Figures 1 and 2). Mapping nests will also minimize time spent wandering around the colony searching for nests and causing disturbance. Where feasible, place flags some distance away to reduce the chances that a gull will remove it (this may not be possible at dense colonies).

At some sites, a subset of nests are chosen to follow, whereas at other sites, all nests in a given plot or area are followed each year (see island-specific details for sample size guidelines and plot locations). Glaucous-winged gull laying can be asynchronous, so if only a subsample of nests are followed, do not select all nests on the first visit, as this may bias results towards the early nesters.

On each visit, walk carefully through the colony and attempt to determine the status of all nest sites and record it in a field notebook using the appropriate standardized code (see attached list; Figure

3). Chicks can move several meters from the nest soon after hatching and can be very difficult to find. Once eggs hatch, carefully search vegetation around immediate area for chicks and membranes (freshly hatched eggshells or fresh eggshell linings). Do not include chicks or membranes not obviously associated with a specific nest (e.g., chicks found more than 2m from a nest and membranes found more than 1m from a nest).

Once chicks are present, WATCH WHERE YOU PUT YOUR FEET when moving through the colony - they often hide in the thick vegetation, and squashing a chick can really ruin your day! Also, avoid checking productivity during heavy rain once chicks hatch, as your intrusion will flush adults off chicks, exposing them to inclement weather.

Adult gulls often defend nests by diving at intruders, so don't be surprised if you are attacked while checking nests. Gulls frequently dive-bomb suspected threats, raining guano down on or even physically hitting intruders. Gulls can have excellent aim with their guano; if this is a problem at your colony, consider wearing raingear for protection. If gulls get particularly aggressive, it can be helpful to wear a helmet or put a flag on the top of your head (they tend to aim for the highest spot when attacking).

At each nest, record only what you saw and be sure to use the standardized codes *exactly* as instructed (see pages 5-6 to 5-8). You may want to describe every detail and feel limited by the standardized list of codes and modifiers available. However, lengthy text explanations and comments tend to cause confusion later and cannot be interpreted by the database used to summarize the data. Choose a code then and there and stick with it - as the field biologist, you are the only person who can make a decision about what you saw that day. If you absolutely must record additional information about a nest, you can enter text in the comments section of the data spreadsheet, but keep in mind that this text is not used in any data summary so it should not contain any information pertinent to how the reproductive success data should be interpreted.

If you see an egg or a chick, there are a few cases when you will need to record additional modifiers that provide more detailed information about the nest status (list of standardized code modifiers). For eggs, record if you see an old egg clearly from last year (Ely), a broken, crushed, or otherwise dead egg (Ed), an egg ejected from the nest (Ej), or an egg pipping just before hatch (Ep; Figure 4). Similarly, for chicks, record if you see a chick in the actual act of hatching (Co), a chick still wet from having recently hatched (Cw), or dead chick (Cd).

For gulls, there are some important rules for using codes:

- It is not necessary to record the presence of adult birds at the nest. Walking through a gull colony to check nests will inevitably flush all adults from nests. Therefore, codes for adult birds (B) are not used in gull productivity monitoring.
- Because it can be difficult to find chicks once they hatch, freshly-hatched eggshells or fresh eggshell linings (called membranes; Figures 4a and 5) left behind in or near the nest are used as evidence of successful hatch in gulls. These are coded "M". Make sure to distinguish between a successfully hatched eggshell (usually shell bits held together by rubbery membrane) and eggshell fragments from a crushed or preyed-upon egg. If you find eggshells/membranes, try to determine how many eggs they came from.
- The use of the membrane (M) code for gulls excludes the use of a modifier for eggshells (sh) used in monitoring of other species.

You should aim to see and record a "known" status egg, chick, membrane or nothing for each nest each visit. However, if the nest contents are unknown for some reason, record an unknown status (U) and make a concerted effort to confirm the status of that nest on the next visit. It is particularly important to minimize unknown nest status codes around expected laying or hatching dates, and too many or untimely unknown statuses may cause the nest to be discarded from analysis.

Before leaving each nest, check to see that your recorded status makes sense based on what you saw last time (e.g., if you had a chick last visit, you shouldn't have an egg this visit). Data strings that don't make sense will have to be discarded. Before leaving each plot each day, check to see you have a status recorded for every nest. 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 plot data in the electronic data file provided.

Once all eggs in a nest have either hatched or failed, it is no longer necessary to continue

checking that nest. At the end of the season, make sure all flags used to mark nests are removed.

Gulls whose nests fail early in incubation may relay in the same nest. If you have a nest that fails at the egg stage and then new eggs are laid, consider it a relay. It is important to identify relays because we do not consider them independent reproductive efforts – ultimately we care if a breeding pair is successful over a season, not necessarily how many nests they needed to get there. Therefore, if a pair relays and the second nest is successful, we call the pair “successful” for the season and don’t count the relay nest. This affects your count of initial nests: if you had 5 nests, they all failed and all relayed, and then all 5 hatched chicks, in the end you would have 5 successful nests for the season, *not* 10 nests, of which only half were successful. For your data record, you should record relays on the same line in your data notebook and computer spreadsheet as the initial nest:

Julian Date	150	155	160	165	170	175	180	185	190	195	200	205
Nest 1	E3	E3	N	N	N	E	E3	E3	E3	C3		

AND NOT

Julian Date	150	155	160	165	170	175	180	185	190	195	200	205
Nest 1	E3	E3	N	N	N	N	N	N	N	N	N	N
Nest 2						E	E3	E3	E3	C3		

Data analysis.—Calculations for phenology and productivity parameters for gulls have not yet been automated in an Access database, so analysis needs to be conducted by field crews.

Phenology: For multiple-egg species such as gulls, calculate a single lay date and a single hatch date for each nest based on the FIRST egg in a nest to be laid and to hatch. Dates for egg laying and chick hatching are calculated using the Julian date midpoint between applicable nest checks (*in leap years, be sure to use a leap year-specific Julian date calendar!*). The lay date is assumed to be the midpoint between the last date when no egg was present and the first date when an egg was confirmed to be present. The hatch date is the midpoint between the last time an egg was confirmed to be present and the first time a chick or membrane was confirmed to be present. If the midpoint falls between two days, by convention we use the EVEN Julian date.

Occasionally, data may provide more exact information on laying and hatching dates. If you observe an event occurring (e.g., the actual egg laying or hatching) during your visit, use the day of the observation as the date the event occurred and not the midpoint between observations. Similarly, if a piped egg is observed, assume it will hatch the following day. If a wet chick is seen, assume it hatched that day.

Not all nest sites are included in phenology calculations; we require confirmed visualization of the empty nest site, egg, or chick/membrane (e.g., no U’s) less than or equal to 7 days apart for that site to be used. For gulls, most nests will have known statuses but weather or other obstacles may sometimes increase check intervals too much to use in phenology calculations. In addition, *do NOT include relays in chronology calculations.*

For example:

Julian Dates:	150	153	156	159	162	165	168	178	Hatch date
Nest 1	E3	E3	E3	E3	C3				160
Nest 2	E3	E3	E3	E3	E2C	C3			160
Nest 3	E3	E3	E3	E3	E2Ep	C3			163 (pipped egg)
Nest 4	E3	E3	E3	E2Cw	C3				159 (wet chick)
Nest 5	E3	N	N	E3	E3	E3	C3		Not used, relay
Nest 6	E3	E3	E3	E3	E3	E3	E3	C3	Not used, >7d interval

From your nests, calculate mean, first, and last lay and hatch dates. If birds have already begun laying eggs at the first visit, do not calculate a mean lay date and record the date of first lay as < the date of first nest check.

Productivity: For gulls, success is calculated as the number of known fate nest sites that hatched a chick (success measures beyond hatching are not calculated). Because gull chicks are mobile so soon after hatching and nests are visited only every 3-7 days, it is possible to miss seeing a chick; therefore a membrane (M) is used as evidence that a chick hatched and is treated as equivalent to a chick (C) code. If a nest “fails”, we keep track of what stage this happens (pre-laying or egg period). By convention, if an egg dies while pipping, the egg did not hatch (egg failure). If a chick is partially out of the shell when it dies or if it dies immediately after hatching, it is still considered a successful hatch (it just happened to die later, but for gulls we do not follow chick fate after hatching). Pipped egg (Ep) is not enough to indicate hatch occurred; chick or membrane is needed at next visit after Ep to confirm hatch.

For each nest, count the maximum number of eggs and chicks/membranes ever observed. If the nest contains a combination of chicks and membranes, use the minimum number of combined chicks and membranes (membranes may belong to the same chicks you observe). For example:

N N N N N N = 0 eggs, 0 chicks
 N N N E2 E N = 2 eggs, 0 chicks
 N E2 E3 E3 EC2 C3 = 3 eggs, 3 chicks
 N E2 E3 E3 EM2 M3 = 3 eggs, 3 chicks
 N E2 E2 Ep2 C2 = 2 eggs, 2 chicks
 N E2 E2 Ep2 N = 2 eggs, 0 chicks
 N E2 E3 E2Ep CdM2 = 3 eggs, 2 chicks (chick/membrane may be from same egg)
 N E2 E3 E3 M2C = 3 eggs, 2 chicks (chick/membrane may be from same egg)
 N E2 E3 E3 MC2 = 3 eggs, 2 chicks (chick/membrane may be from same egg)
 N E2 E3 E3 M3C3 = 3 eggs, 3 chicks

If you cannot determine the fate of a nest for any reason (the flag was lost partway through the season, or nest statuses don't make sense [goes from egg to chicks back to eggs], or there are too many unknown codes so you don't know if eggs hatched or not, etc.), discard that entire nest from analysis. If you destroy a nest during the season (e.g., accidentally stepping on eggs), discard that entire nest from analysis.

After determining a fate of each nest, calculate the following parameters. If your site has distinct plots, do calculations separately for each plot:

- Total nest starts (A) – number of known-fate active nest sites monitored
- Nest sites with eggs (B) – number of nest sites containing any eggs
- Total eggs (C) – number of eggs seen (the sum of the highest egg count from every nest)
- Nest sites with chick (D) – number of nest sites containing any chicks/membranes
- Total chicks (E) – number of chicks seen (the sum of the highest chick/membrane count from every nest)

From the above values, calculate the following summary parameters:

- Laying success (B/A)
- Mean clutch size (C/B)
- Mean brood size (E/D)
- Nesting success (D/B)
- Hatching success (E/C)
- Proportion of nest sites with chicks (D/A)
- Chicks / nest start (E/A)

If your site has distinct plots, calculate standard deviations of summary parameters based on cluster sampling by plot using ratio estimator spreadsheets.

Literature Cited

- Cairns, D.K. 1987. Seabirds as indicators of marine food supplies. *Biological Oceanography* 5:261-271.
- Montevecchi W.A. 1993 Birds as indicators of change in marine prey stocks. Pp. 217-266 *in* *Birds as Monitors of Environmental Change* (R.W. Furness and D.J. Greenwood, Eds.) London: Chapman and Hall.
- Patten, S.M., Jr. 1974. Breeding ecology of the glaucous-winged gull (*Larus glaucescens*) in Glacier Bay, Alaska. MS thesis, Univ. Washington, Seattle.
- Verbeek, N.A.M. 1993. Glaucous-winged gull (*Larus glaucescens*). No. 59 *in* *The Birds of North America* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

Standardized Productivity Codes: List of Productivity Codes (GULLS)

Always use CAPITAL LETTERS for productivity codes

See list of "Important Rules to Follow" for more details on correct use

E Egg	Egg present, with no adult. Use numbers and/or "+" to indicate more than one (e.g., E2+ = at least two eggs) Use standardized modifiers to describe special egg status (e.g., Ed = dead egg)
M Membrane (oystercatchers, gulls, ancient murrelets only)	Freshly-hatched eggshell/membrane present Use numbers and/or "+" to indicate more than one (e.g., M2+ = at least two membranes)
C Chick	Chick present, with no adult. Use numbers and/or "+" to indicate more than one (e.g., C2+ = at least two chicks) Use standardized modifiers to describe special egg status (e.g., Cd = dead chick)
U Unknown	Nest site with nothing clearly visible. Seldom used - only when the observer is not sure of the nest contents (e.g., cliff nest site obscured by fog or other birds, crevice nest site offering a poor, incomplete view, etc). If an observer records "U" many times, especially at crucial times (hatch and fledge), the nest site may not be included in analysis.
N Nest	Empty nest site. Used when an egg or chick that was in the nest has been lost and no adult is present. For kittiwakes, this code indicates that a nest structure from the current year is physically present, either before eggs are laid or after the nest fails.
NN No Nest	(Kittiwakes, gulls, cormorants only) Used when a kittiwake nest that had been active in the current year disappears. Use this code when no nest material is present, <u>regardless</u> of the presence of an adult bird (if a bird is standing at the old site and no nest material remains, use NN and not B). Do not use this code at the beginning of the season before a nest is built at a site.
NC Not Checked	Used between the previous and current check, when a site was not checked (e.g., it was skipped on purpose) or could not be found on that date. This code does not have to be used at the very beginning or end of the season before checks begin or after checks end for a particular nest.

Standardized Productivity Codes: List of Modifiers

Always use lowercase letters for modifiers!

See list of "Important Rules to Follow" for more details on correct use

Modifiers to egg status codes

- Eo Egg lay observed** Observer sees egg being laid; used only when event was actually observed, not simply suspected lay
- Ep Egg pipped** Hole in egg, sometimes chick bill poking through; hatch date determined to be following day. Note: do **not** use for eggs just starred (localized cracks in shell resulting from chick's chipping action, often occurs before egg is pipped)
- Ed Egg dead** Egg is obviously damaged or broken
- Ej Egg ejected** Egg once in a nest ejected outside the nest cup
- Ely Egg last year** Egg assumed to be from last year from appearance or other evidence

Modifiers to chick status codes

- Co Chick hatch** Observer sees chick hatch; used only when event was actually observed, not for pipping **observed** eggs, observations of newly-hatched wet chicks, or other reasons leading to suspected "probable" hatch. Do not combine Co modifier with Cw (see below) if you observe a hatching event that results in a wet chick; simply use Co to indicate hatch and not Cow/Cwo
- Cw Chick wet** Newly-hatched wet chick observed; indicates chick hatched that day but hatching event was not actually observed
- Cd Chick dead** Chick actually observed dead (not simply disappeared from nest)
- Cf Chick fledged** Chick actually observed in the act of flying (or jumping for murre) from the nest; very rare!

Additional clues to nest fate

- sh eggshells** Presence of fresh eggshell fragments in the nest. Used ONLY with Bird Unknown or Unknown status codes (BUsh or Ush) to give more information about potential hatch; there is no need to use with known status codes (such as C or N)
- poop poop** Presence of fresh poop in or at the entrance of the nest. Used ONLY with Unknown status code (Upoop) to give more information about potential presence of a chick; there is no need to use with known-status codes (such as C or N)
- call chick calling** Chick heard calling but not actually observed. Used ONLY with Bird Unknown or Unknown status codes (BUcall or Ucall) to give more information about potential presence of a chick; not appropriate to use with known-status codes (such as C or N)

Standardized Productivity Codes: Important Rules to Follow

Use capital letters for basic productivity codes and lowercase letters for modifiers. Do not use superscripts or subscripts for any modifiers. Do not put spaces between any characters.

Use numbers to indicate quantities of birds, eggs, or chicks greater than one (do NOT use 1 to indicate single numbers). Numbers should always go AFTER the code that the number describes.

e.g., B2E means two adult birds with a single egg

BE2 means a single adult bird with two eggs

Use a plus sign (+) when you can see at least some but not all nest contents in multiple-egg clutches. As with numbers, the plus sign should always go AFTER the letter code (and when more than one, also after the number) that is being described.

e.g., BE+ means an adult bird and at least one egg were observed but entire nest contents could not be seen to determine if there was anything more

BE2+ means an adult bird and at least two eggs were observed but entire nest contents could not be seen to determine if there was anything more

Some codes and modifiers can be combined when appropriate as long as order (see below) is maintained. For instance, with multiple-egg species, if one egg hatches before another so that there is an adult bird present with both an egg and a chick, enter BEC.

The specific order in which these codes and modifiers are used is VERY IMPORTANT. The codes BEC and BCE, or BE2+ and BE+2, may mean the same thing to us but they are NOT the same to the computer database. Follow these rules for the correct order of codes and modifiers:

(1) Always write codes in the order of **adult - egg - membrane - chick**.

e.g., BE and not EB, EMC and not ECM, M2C and not CM2

(2) When adding modifiers (numbers, letters, or symbols that give more information), always follow the order of: main productivity code - letter modifier - number - plus sign

e.g., BEp2+ for adult bird with at least two pipped eggs

BE2Cd for adult bird with two eggs and one dead chick

B2E+Cd for two adult birds with at least one egg and one dead chick

****NOTE**** These standardized codes and modifiers should be used for ALL species, even those that we are still summarizing by hand this year (e.g., storm-petrels, cormorants, oystercatchers, gulls, ancient murrelets). The ultimate goal in future years is to use the database to summarize productivity data for all species and the more consistent we can make the data now, the easier it will be to make that transition.



Figure 1. Photos showing gull nests marked with (a) numbered flags and (b) paint on nearby rocks.



Figure 2. Example plot maps showing glaucous-winged gull nest locations.

Aiktak 2011		Productivity																
Nest	Plot	Spp	5/29	6/2	6/5	6/9	6/12	6/15	6/18	6/22	6/28	7/3	7/6	7/9	7/12	7/16	7/20	
1	41	GWGU	E3	E3	E3	E2	E2	N	N	N								
2	41		E3	E3	E3	E3	E3	E3	E2	E2	E2	C2						
3	41		E2	E3	E3	E3	E3	E3	E3	EpE2	EC2	C3						
4	41		E	E3	N	N	N											
5	41		N	E2	E3	E3	Ed	N	N	N								
6	41		N	E	E	E	E	E	E	E	E	E	Cd					
7	41		N	E2	E2	E2	E2	E2	E2	Ep2	C2							
8	41		N	E	E2	E3	E3	E3	E3	E3	E3	EpE2	C2Cw					
9	41		N	N	E	E2	E2	E2	E2	E2	E2	E2	E2	M2	N	N		
10	41	✓	N	N	E	E2	E2	E2	E2	E2	E2	EC	EC	E	E	E	E	

Figure 3. Example of data notebook page for recording gull productivity data.

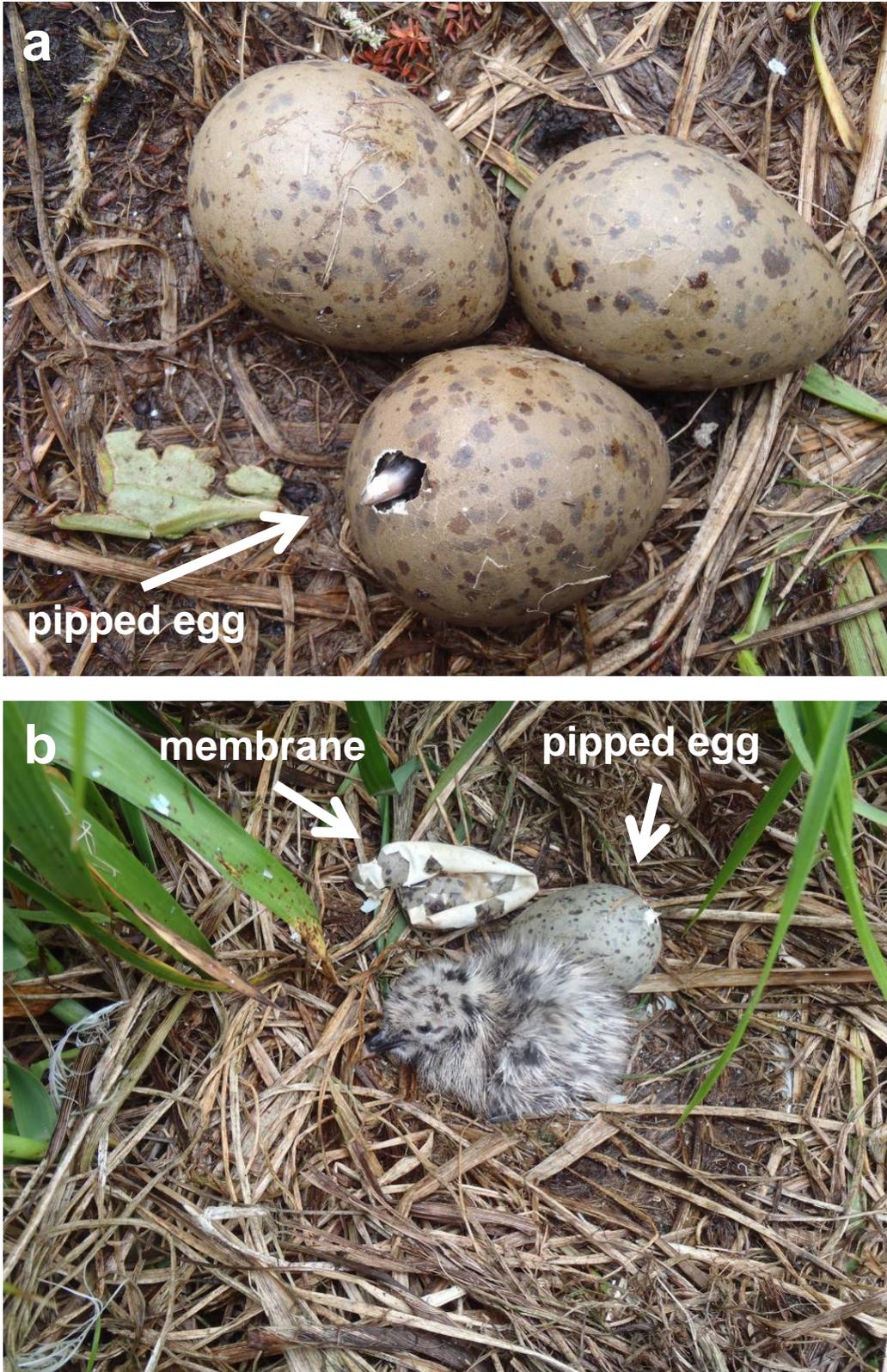


Figure 4. Photos showing (a) pipped egg and (b) a chick, pipped egg, and eggshell membrane.



Figure 5. Photos showing remains of eggshell membranes in nest.

Attachment A. Aiktak Island specifics (includes Figure A1)

PROCEDURE DETAILS SPECIFIC TO AIKTAK

At Aiktak, gulls nest in scattered subcolonies across the island and on adjacent offshore islets, with the highest concentrations on Gull Mountain and the Southwest Slope. Non-breeding adults and subadults often congregate in several “clubs” on rocky ledges and beaches along the shoreline. Nest-building usually begins in mid- to late May. Egg-laying at Aiktak can be highly variable between years but generally begins in early to mid- June. In some years, laying is asynchronous, with birds still laying far into July. Chick fledging usually occurs throughout August.

Productivity and phenology data are collected in four plots (A-D) on Gull Mountain, which are marked by poles 40, 41, 42, and 43, respectively (Figure A1). Plot boundaries are fluid because nest locations and densities change from year to year. There is no specific limit to how far from the pole you should look: in poor breeding years, you may have to search wider distances from the center poles to attain your sample size, but in good years you will be able to find enough nests without going far. One person should monitor the same nests/plots throughout the entire season, so assign plots equally at the beginning of the season and stick with the assignments (with two people in camp, each person does two plots).

Begin searching the plots for nests in late May, before the onset of egg laying, which historically has occurred first near pole 42. Aim for a final sample size of 50 nests in each plot. Glaucous-winged gulls on Aiktak tend to lay asynchronously over several weeks, so attempt to mark 10-20 new nests each visit to spread your sample across the range of lay dates (it is okay if some of your nests already have eggs; however, you cannot start monitoring nests that already have chicks). Mark nests with uniquely-numbered flags (it is helpful to number flags in camp, as writing on damp flags is difficult). To eliminate confusion, try to use unique nest numbers rather than repeat numbers in each plot (for example, you can assign 1-100 to one plot, 101-200 to the next, etc). The vegetation on Gull Mountain will explode as the season progresses so it is helpful to sketch a rough map of nest locations in your field notebook. Keep in mind that once umbels of angelica / puchki start blooming they look very similar to gull heads and are easily confused because eventually only the heads of gulls stick slightly above vegetation.

As nests are added to your sample, continue to check every 3 days until clutch size is complete. After clutch completion, you can spread nests checks out to every 5-7 days until just before eggs are expected to hatch (based on a 27-day incubation period), then increase check frequency again to every 3 days. Frequent checks around the expected hatch date are vital both for accurate hatch dates and to detect chicks, as chicks become mobile after just two days and can move far from the nest, making nest fate difficult to determine.

In years of poor breeding success, some gulls may lay late, so continue to check nests without eggs until you are sure that all laying is complete (two weeks past the last recorded lay is probably safe).

Specific Requirements for Aiktak

Dates: Begin searching for nests in late May or as soon as possible if deployed earlier to the island (some years laying is early), continue to monitor nests until all hatch (usually mid- to late July).

Optimal sample size: 200

Time of day: Any time.

Weather: Any weather (once chicks hatch, avoid flushing birds from nests in heavy rain).

Equipment needed: Rite-in-the-Rain[®] notebook with map of plots, flags, two permanent markers, two pencils.

Additional optional equipment: Raingear (for guano protection), helmets or flags to put in hats.

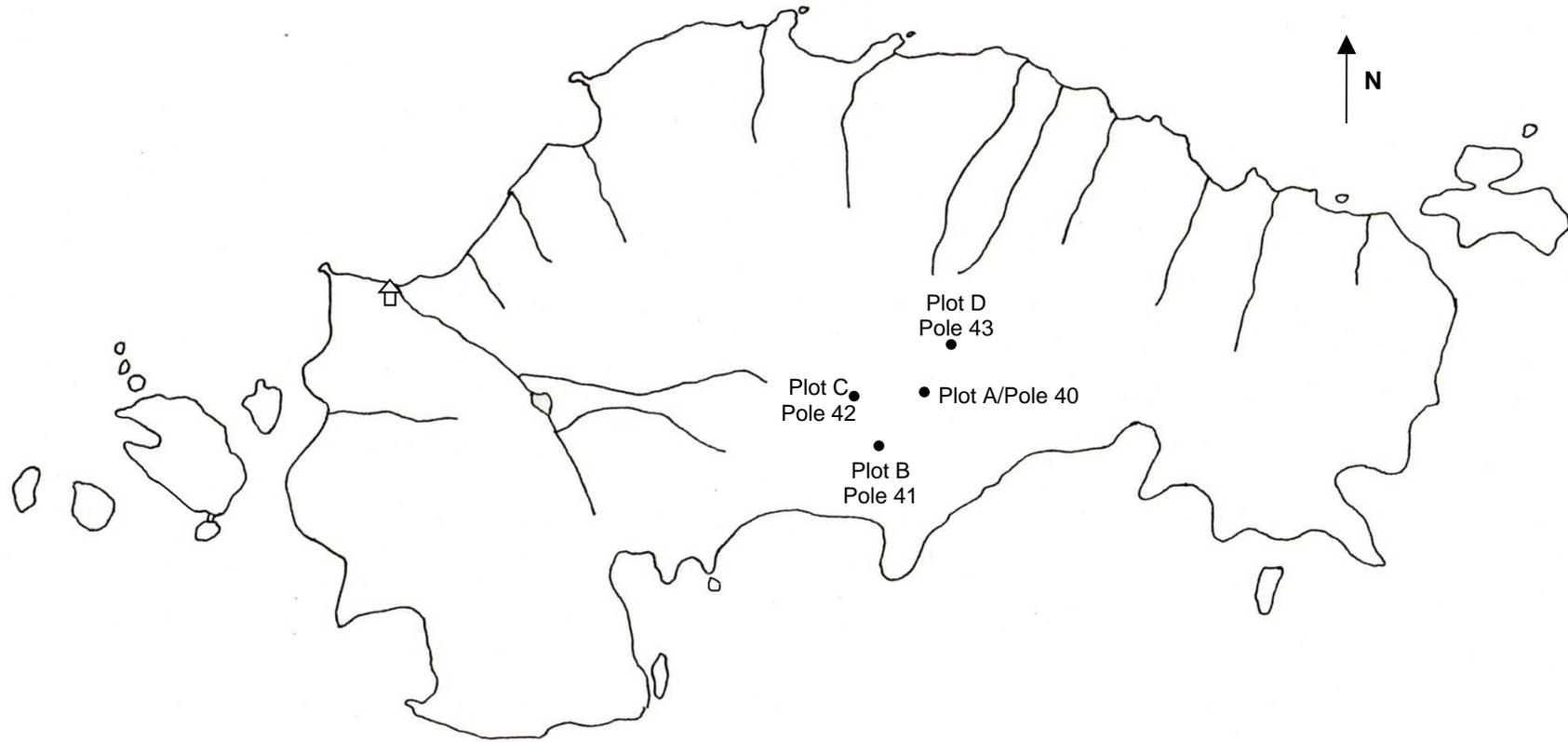


Figure A1. Location of glaucous-winged gull productivity plots (Poles 40, 41, 42, and 43 shown by black dots) at Aiktak Island.

Attachment B. Buldir Island specifics

PROCEDURE DETAILS SPECIFIC TO BULDIR

Nests can be monitored anywhere on the island. It will be more convenient to select and follow nests in areas you frequent for other work; this may or may not be possible, depending on where birds are nesting this year and your other work duties. The west beach just around the corner from Northwest Point usually has around 25 nests that are easy to find and follow. One person can check these nests while the other two are doing crevice-nester monitoring on Northwest Ridge. Another good place to monitor nests is around The Dip (convenient since you will hike to Spike Camp every 4-7 days for ledgenester, auklet and puffin monitoring). If you are hurting for sample sizes, you can also try South Marsh and Bean Goose Pond. Be extra careful in these areas since they are riddled with storm petrel burrows. Historically the north beach between Main Talus and Kittiwake Lane was a narrow, easily searched segment where large samples were monitored, but this area is not currently used because of safety concerns due to rockfalls.

Beginning in early June, mark individual nests and record nest contents every 5-7 days. Look for nests in areas where the vegetation is not too dense, as it will grow markedly over the season and obscure eggs and chicks. Depending on whether nests are on the beach or in the vegetated interior, mark nests using uniquely numbered flags, paint on rocks, or both. If using flags, it may be helpful to put the flag a little ways away from the nest, as gulls sometimes rip up flags at Buldir. Aim for a sample size of at least 30 nests. If nests are scattered, it may be helpful to mark locations with a GPS.

Specific Requirements for Buldir

Dates: Begin searching for nests in early June, continue to monitor nests until all hatch (usually mid- to late July).

Optimal sample size: 30

Time of day: Any time.

Weather: Any weather (once chicks hatch, avoid flushing birds from nests in heavy rain).

Equipment needed: Rite-in-the-Rain[®] notebook with map of plots, flags, flagging, two permanent markers, two pencils, two paint pens, GPS (optional).

Additional optional equipment: Raingear (for guano protection), helmets or flags to put in hats.

Attachment C. Chowiet Island specifics (includes Figures C1-6)

PROCEDURE DETAILS SPECIFIC TO CHOWIET

Productivity and phenology data are collected in three sub-colonies (A, B, and C) in the South Bay Colony (Figures C1-6). Beginning in late May, uniquely mark a subsample of ~25 nests in each Sub-colony (if any of the colonies have less than 25 nests, mark extra nests in other colonies). Do not select all of your nests on your first visit, as you may bias your monitoring results towards early nesters. At Chowiet, it is often possible to paint numbers on nearby rocks in addition to using flags to identify nests.

Record nest contents (numbers of eggs, egg membranes, and chicks) for each individual nest every 5-7 days until chicks hatch.

Specific Requirements for Chowiet

Dates: Begin searching for nests in late May, continue to monitor nests until all hatch (usually mid- to late July).

Optimal sample size: 75 (25 in each Sub-colony)

Time of day: Any time.

Weather: Any weather (once chicks hatch, avoid flushing birds from nests in heavy rain).

Equipment needed: Rite-in-the-Rain[®] notebook with map of plots, flags, spray paint and/or paint pens, two permanent markers, two pencils.

Additional optional equipment: Raingear (for guano protection), helmets or flags to put in hats.

**GWGU South Bay Colony
Start of Plot A
Chowiet 2004**



Figure C1. Start of South Bay Sub-colony A on Chowiet Island.

GWGU South Bay Colony
End of Plot A/Start of Plot B
Chowiet 2004

56 01.31 N 156 42.84 W



Figure C2. End of South Bay Sub-colony A and start of South Bay Sub-colony B on Chowiet Island.



Figure C3. End of South Bay Sub-colony B and start of South Bay Sub-colony C on Chowiet Island.



Figure C4. Eastern boundary of South Bay Sub-colony B on Chowiet Island.

GWGU South Bay Colony
Western side of Plot C
Chowiet 2004

56 01.28 N 156 42.58 W



Figure C5. Western side of South Bay Sub-colony C on Chowiet Island.

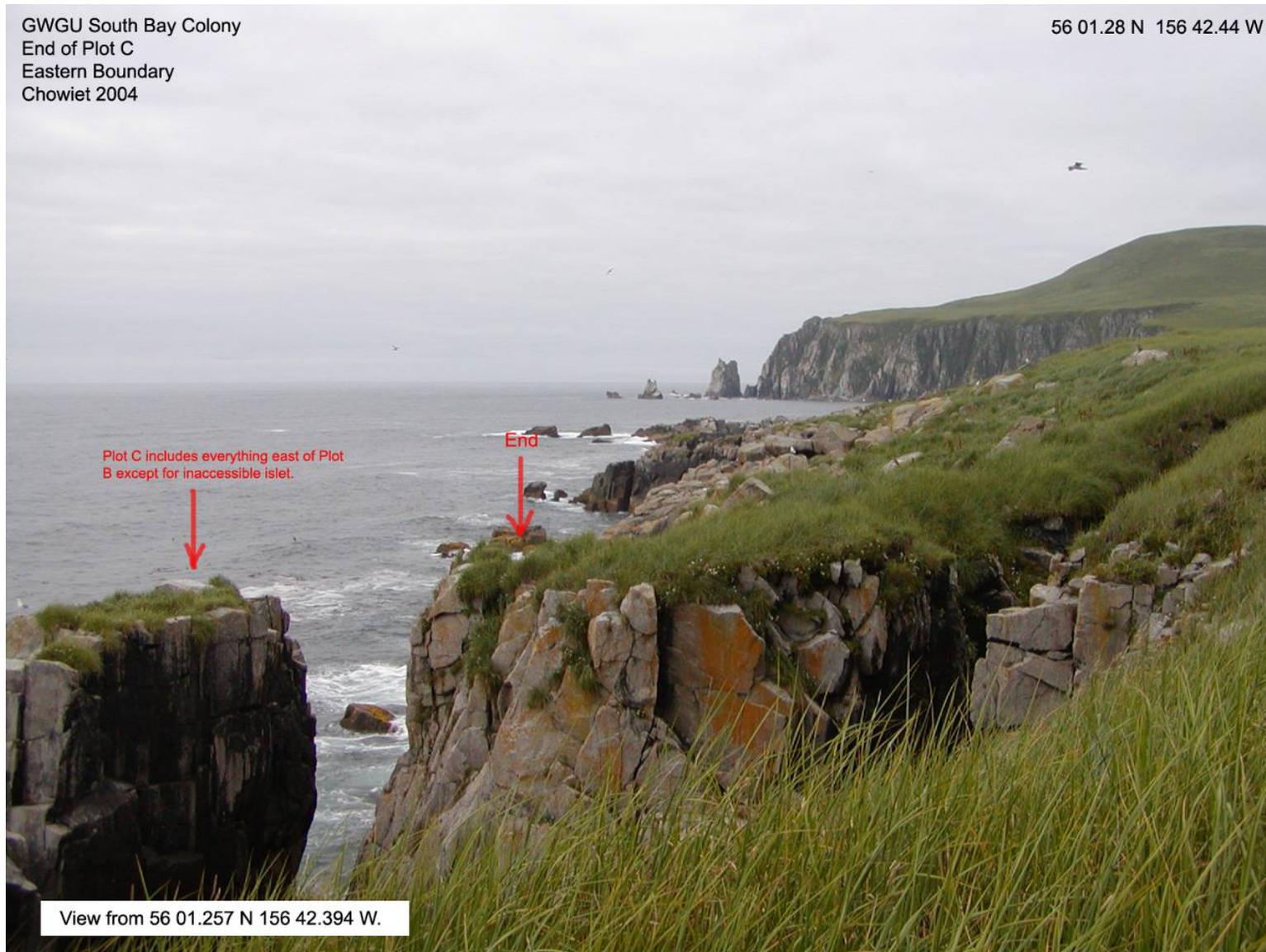


Figure C6. End of South Bay Sub-colony C on Chowiet Island.

Attachment D. St. Lazaria Island specifics (includes Figure D1-7)

BACKGROUND AT ST. LAZARIA ISLAND

At St Lazaria, nest-building usually begins in May. Chicks hatch from mid- to late June to late July; fledging occurs in August. Gulls are monitored on index plots at the center of the island (Figures D1-7).

PROCEDURE DETAILS SPECIFIC TO ST. LAZARIA

Productivity and phenology data are collected on several index plots (Figure D1):

- Big Grassy - rectangular plot (20 x 25m long) running east-west. Northwest corner permanently marked with a piece of rebar stuck in the ground & wrapped with flagging; other corners marked each year with pin flags.
- Gull Spires I, 1-1/2, & II - own entities based on discrete geophysical land forms.
- Gull Rocks
- Gauno Ridge

For safety, Gull Spires should only be accessed under dry conditions. Climbing Gull Spire II is optional as we can count nests and chicks from other vantage points. Gull Spire 1-1/2 can be viewed similarly. Any nests on Big Grassy area but outside of rectangular plot boundaries are also counted/monitored but grouped as "Out of Plot".

At St. Lazaria, **all nests within plots** are marked and monitored. Begin visiting plots, marking nests, and recording nest contents in early June; on subsequent checks, mark and begin following any new nests initiated since the previous visit. Nests should be numbered using plot name and sequential numbers (e.g., GSI-4 = Gull Spire 1, nest # 4; GR4 = Gull Rocks, nest #4). Be sure to securely place the flag near the nest (this may be difficult since there is little soil). Alternatively, aluminum tags affixed to shortened stiff wire strands (~10 cm long) may be easier to insert near nests in rock crevices or tied to tufts of grass and would be less conspicuous. Locate all nests on plot maps for a reference for future visits; you will have to draw maps for all index plots. Additionally, you will need to find the rebar on the northwest corner of Big Grassy then delineate the plot boundaries of the 20-25m long rectangular plot on Big Grassy in order to determine which nests will be included for productivity (see Figure D7). Note that all nests on Big Grassy will be used for gull population.

Specific Requirements for St. Lazaria

Dates: Begin searching for nests in early June (on or close to June 8), continue to monitor nests every 3-7 days until all eggs in a nest have hatched or failed (usually mid- to late July).

Optimal sample size: All nests in plots.

Time of day: Any time.

Weather: Any weather (once chicks hatch, avoid flushing birds from nests in heavy rain). Avoid climbing Gull Spire I and II when they are wet.

Equipment needed: Rite-in-the-Rain[®] notebook with map of plots, flags, two permanent markers, two pencils, etching implement (pen or pencil), and Ziplock bag full of aluminum tags with wire ties.

Additional optional equipment: Raingear (for guano protection), helmets or flags to put in hats.

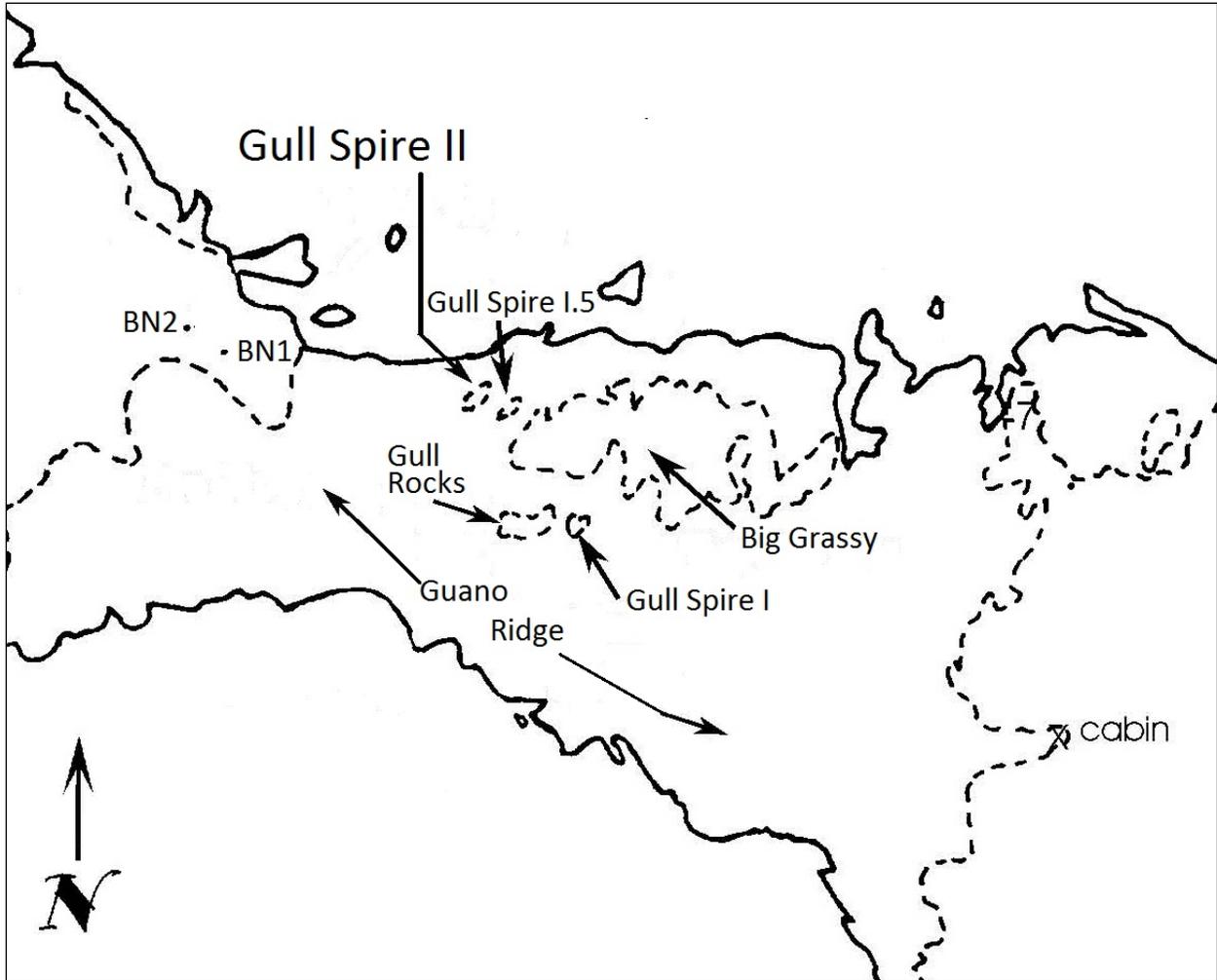


Figure D1. Map showing plot locations for glaucous-winged gull index plots at St. Lazaria Island.



Figure D2. View of gull index plots looking east. St. Lazaria Island.



Figure D3. View of gull index plots looking north at St. Lazaria Island.



Figure D4. View of a portion of guano ridge and gull rock plots looking south at St. Lazaria Island.



Figure D5. View of gull index plots looking south at St. Lazaria Island.



Figure D6. View of gull index plots looking east towards the cabin at St. Lazaria Island.

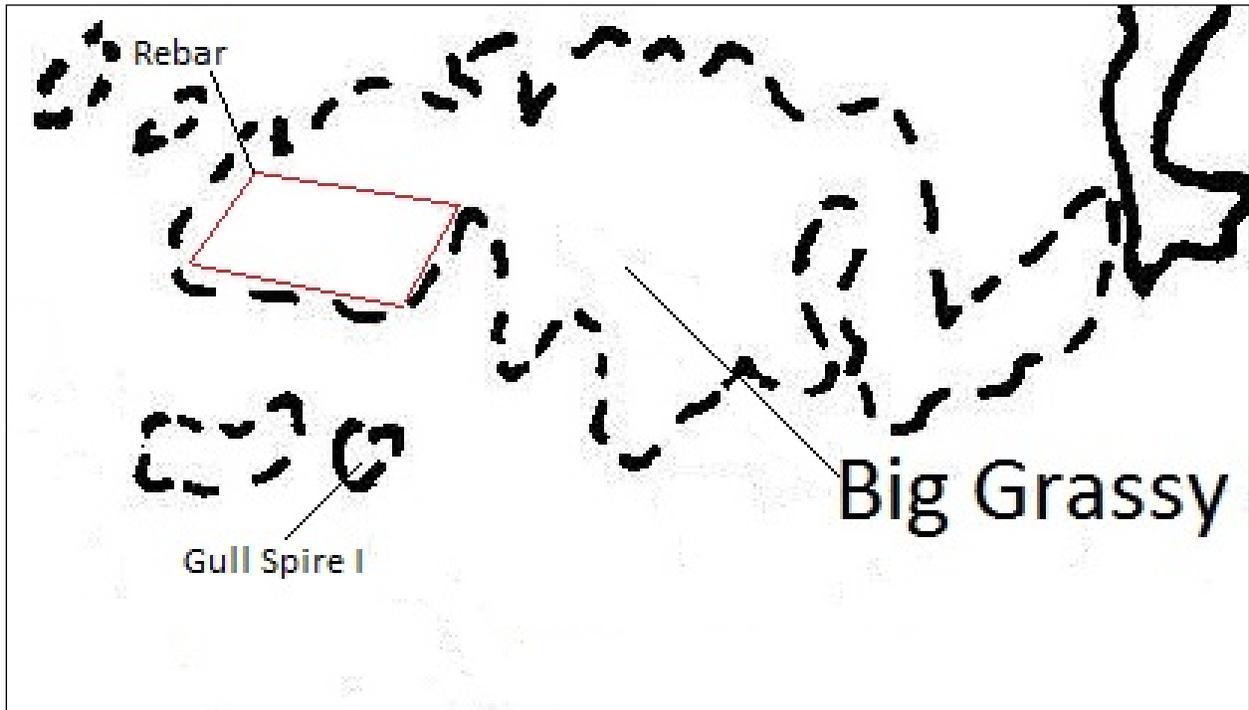


Figure D7. Map depicting approximate location of rectangular plot (20 x 25m long), marked by rebar on the northwest corner, on Big Grassy plot, St. Lázaria Island.

Protocol Revision History Log

Revision Date	Changes made	New version #
April 2017	Specified that a leap year Julian date calendar should be used in leap years, clarified that for phenology calculations we require confirmed visualization of the empty nest site, egg, or chick less than or equal to 7 days apart for that site to be used, updated Buldir attachment regarding areas to find nests and equipment needed section, clarified Aiktak attachment	1.4
Sept 2015- Jan 2016	Added to Buldir section, updated time period to begin nest searching in Chowiet section, clarified details to Aiktak section, clarified Ep modifier, fixed page number references in text	1.3
April 2015	Clarified order of membrane in standardized codes	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 #, clarified interpretation of pipped eggs with no evidence of hatch.	1.1
May 2013	Protocol developed in standardized format from historic protocols, includes Aiktak, Buldir, Chowiet and St.Lazaria attachments	1.0