Wildlife Inventory Plan
Alaska Maritime National Wildlife Refuge
Protocol #3

Version 1.4

Parameter: Productivity, phenology, and populations

Species: Black oystercatcher

PURPOSE

To estimate annual productivity, phenology and populations 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

Black oystercatchers breed along predominately rocky shorelines from Baja California to Alaska, reaching as far west as Kiska Island in the Aleutians. Birds forage on invertebrates in the rocky intertidal and use a variety of shoreline nest sites, including shallow scrapes in sand, gravel, or cobble beaches, and bare rock. Oystercatchers are territorial and defend breeding territories with loud vocalizations and displays. Females lay one to three eggs and incubation ranges from 26-32 days. Chicks often leave the nest within days of hatching and are capable of flight at about 38-40 days of age but generally remain in the territory and are provisioned by their parents for more than 50 days (Andres and Falxa 1995).

In Alaska, most egg laying occurs in May and hatching in June, although birds often relay throughout June if nests are lost early in the season. Where present, ravens, peregrine falcons, and glaucous-winged gulls prey heavily on newly-hatched chicks (e.g., Bechaver and Gehrig 2011).

PROCEDURE – PRODUCTIVITY AND PHENOLOGY

Data collection.—Oystercatcher productivity and phenology are monitored by following individually numbered nests at 3-5 day intervals through chick hatching and 5-7 days through chick fledging.

As early as possible upon arrival on the island, begin searching for nests and territorial pairs. Oystercatcher "nests" are usually just scrapes in sand or cobble or a patch of bare rock (Figure 1), so it may not be possible to identify nests before eggs are laid. Eggs are also incredibly cryptic, so even nests with eggs can be difficult to find. The presence of a vocal pair of birds along a stretch of beach is usually a sign a nest is present (or is going to be present, if it is still early). Once you suspect a nest may be present on a stretch of beach, the best way to find the site is through careful observation of the adult birds. Once incubation begins, often one bird acts as a sentinel (if not off feeding) observing the incubating bird and the area surrounding the nest. As you (or predators) approach, adults will usually try to draw you away from the nest with a feigned broken-wing display or slink away from a nest furtively. If you know a beach segment contains a territorial pair, try to scan the area from afar with binoculars to look for a sentinel bird or an incubating bird to clue you into an exact location. One of the best ways to find oystercatcher nests is to see the incubating bird pop up off the nest before it scuttles away. If birds have already noticed you and are skulking or leading you away, pay careful attention to their behavior as you walk down the beach. Some birds change their behavior as you get close to the nest; if you notice that a bird starts approaching you after originally trying to skulk or lead you away, it may be a sign that you are getting too close to eggs or chicks for their comfort! *Note: when near a nesting area, watch your step carefully – it can be extremely difficult to see a nest even when you are right on top of it and you don't want to crush any eggs!*

Upon finding a nest, mark it as in obtrusively as possible using paint pens or spraypaint on

nearby rocks, or flagging tape or flags in nearby vegetation. If a nest is found prior to clutch completion (usually 2-3 eggs), monitor the nest every 3 days until the clutch is complete and then do not check again for about 20 days, after which resume checking every 3 days until hatch. If a nest is found after clutch completion, check the nest every 5 days until close to earliest potential hatch (based on prior years' data), then every 3 days until hatch. Such frequent checks around the expected hatch date are vital because chicks can leave the nest soon after hatching, making nest fate difficult to determine if you do not find membranes or chicks. Adults will flush off the nest at every visit, so avoid checking nests when aerial predators (eagles, gulls, ravens) are close by. Around expected hatch, do not check nests during heavy rain, potentially exposing newly-hatched chicks to inclement weather.

At every visit, determine the status of each nest and record it in a field notebook using the appropriate standardized code (see pages 3-6 to 3-8 and Figure 2). Chicks can move several meters from the nest soon after hatching and can be very difficult to find. Once eggs hatch, carefully search the immediate area for chicks and membranes (freshly hatched eggshells or fresh eggshell linings). Chicks are very cryptic once out of the nest, so use caution when checking nests around expected hatch dates and WATCH WHERE YOU PUT YOUR FEET to prevent accidentally stepping on them. At each visit, you should also 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.

When recording nest statuses, it is important to record only what you saw and be sure to use the standardized codes *exactly* as instructed. 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 3). 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; Figure 4), or dead chick (Cd).

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

- It is not necessary to record the presence of adult birds at the nest. Checking nests will inevitably flush all adults from nests. Therefore, codes for adult birds (B) are not used in oystercatcher productivity monitoring.

- Because it can be difficult to find chicks once they hatch, freshly-hatched eggshells or fresh eggshell linings (called membranes; Figure 4b) left behind in or near the nest are used as evidence of successful hatch in oystercatchers. 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 oystercatchers 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.

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 chicks hatch and become mobile (usually days after hatching; Andres and Falxa 1995), they can hide incredibly well and eventually move far distances from their original nests, making following fate of chicks from individual nests post-hatch more difficult. Therefore, wait about 4 weeks after hatch to check nests again. At this point, chicks should be about ¾ or more of adult size, with black plumage and black bills or orange bills with black tips. Then check nests every 5-7 days until chicks fledge (move away from territories). You will want to be as stealthy as possible: try to observe the nest with binoculars or a scope from a distance. It can take a long time to see all chicks/fledglings, so make sure you spend enough time watching the nest area to avoid missing one. When searching for chicks/fledglings, examine the entire beach area, as they may travel large distances from the original nest site. Diet piles (e.g., limpet shells) on the beach and territorial adults are good clues that chicks are still present (if chicks are present, adults will almost certainly be in the area and very vocal; if adults are gone, it is likely the nest failed).

Once chicks fledge (begin to move away from territories), you can stop checking that nest. Generally this happens around 40-55 days of age. At the end of the season, make sure any flagging tape or flags used to mark nests are removed.

Oystercatchers whose nests fail early in incubation frequently relay (and on rare occasions will relay again if the replacement nest is also lost; Andres and Falxa 1995). Relay clutches are almost always laid in a different nest in the same territory. If you have a nest that fails at the egg stage and then a new nest that crops up in the same area, 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 relaid, 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 Dates:	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 Dates:	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 oystercatchers 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 oystercatchers, calculate a single hatch date for each nest based on the FIRST egg in a nest to hatch. Dates for chick hatching are calculated using the Julian date 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 (*in leap years, be sure to use a leap year-specific Julian date calendar!).* If the midpoint falls between two days, by convention we use the EVEN Julian date.

Occasionally, data may provide more exact information on hatching dates. If you observe an event occurring (e.g., the actual 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 pipped 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 egg and chick/membrane (e.g., no U's) less than or equal to 7 days apart for that site to be used. For oystercatchers, 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	155	160	165	170	174	180	185	Hatch date
Nest 1	E3	E3	E3	E3	C3				168
Nest 2	E3	E3	E3	E3	E2C	C3			168
Nest 3	E3	E3	E3	E2Ep	C3				166 (pipped egg)
Nest 4	E3	E3	E3	E2Cw	C3				165 (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 hatch dates.

Productivity: For oystercatchers, success is calculated as the number of known fate nest sites that fledged a chick. Because oystercatcher chicks are mobile so soon after hatching and nests are visited only every 3-5 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. 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 oystercatchers 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, chicks/membranes, and large chicks/fledglings 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 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 C3 C3 C3 C3= 3 eggs, 3 chicks, 3 fledglings
N E2 E3 E3 EM2 M3 C2 C2 C2 C2 = 3 eggs, 3 chicks, 2 fledglings
N E2 E2 Ep2 C2 N N N N N = 2 eggs, 2 chicks, 0 fledglings
N E2 E2 Ep2 N = 2 eggs, 0 chicks
N E2 E3 E3 MC2 N N N N= 3 eggs, 2 chicks (chick/mem may be from same egg), 0 fledglings
N E2 E3 E3 M3C3 C2 C2 C2 C2= 3 eggs, 3 chicks, 2 fledglings

If you cannot determine the fate of a nest for any reason (you could not refind the nest 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:

- 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)
- Nest sites with fledglings (F) – number of nest sites containing chicks/fledglings
- Total fledglings (G) – number of large chicks/fledglings seen (the sum of the highest count from every nest)

From the above values, calculate the following summary parameters:

- Mean clutch size (C/B)
- Mean brood size (E/D)
- Nesting success (D/B)
- Hatching success (E/C)
- Chick success (G/E)
- Egg success (G/C)
- Fledging success (F/D)
- Reproductive success (F/B)

PROCEDURE – POPULATIONS

***Data collection*.—**Black oystercatcher population parameters describe the total number of breeding birds on an island each year. Throughout the season, record the presence of all oystercatcher nests and territorial pairs you can find. This can be done by exploring the island on foot and by circumnavigation surveys. It may be helpful to mark nest and territory locations on a map. Late in the summer, large flocks of fledglings or migrating birds may stop by the island so daily counts of oystercatcher individuals are not used as an index of breeding population.

Data analysis.—Calculate the maximum number of breeding pairs (confirmed nest found) and territorial pairs found over the course of the season. To generate a number of breeding birds, double the nest/territorial count.

Literature Cited

Andres, B.A. and G.A. Falxa. 1995. Black oystercatcher (*Haematopus bachmani*). No. 155 *in* The Birds of North America (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

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

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.

Standardized Productivity Codes: List of Productivity Codes (OYSTERCATCHERS)

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.
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

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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 murres) 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 check, 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 black oystercatcher nests.

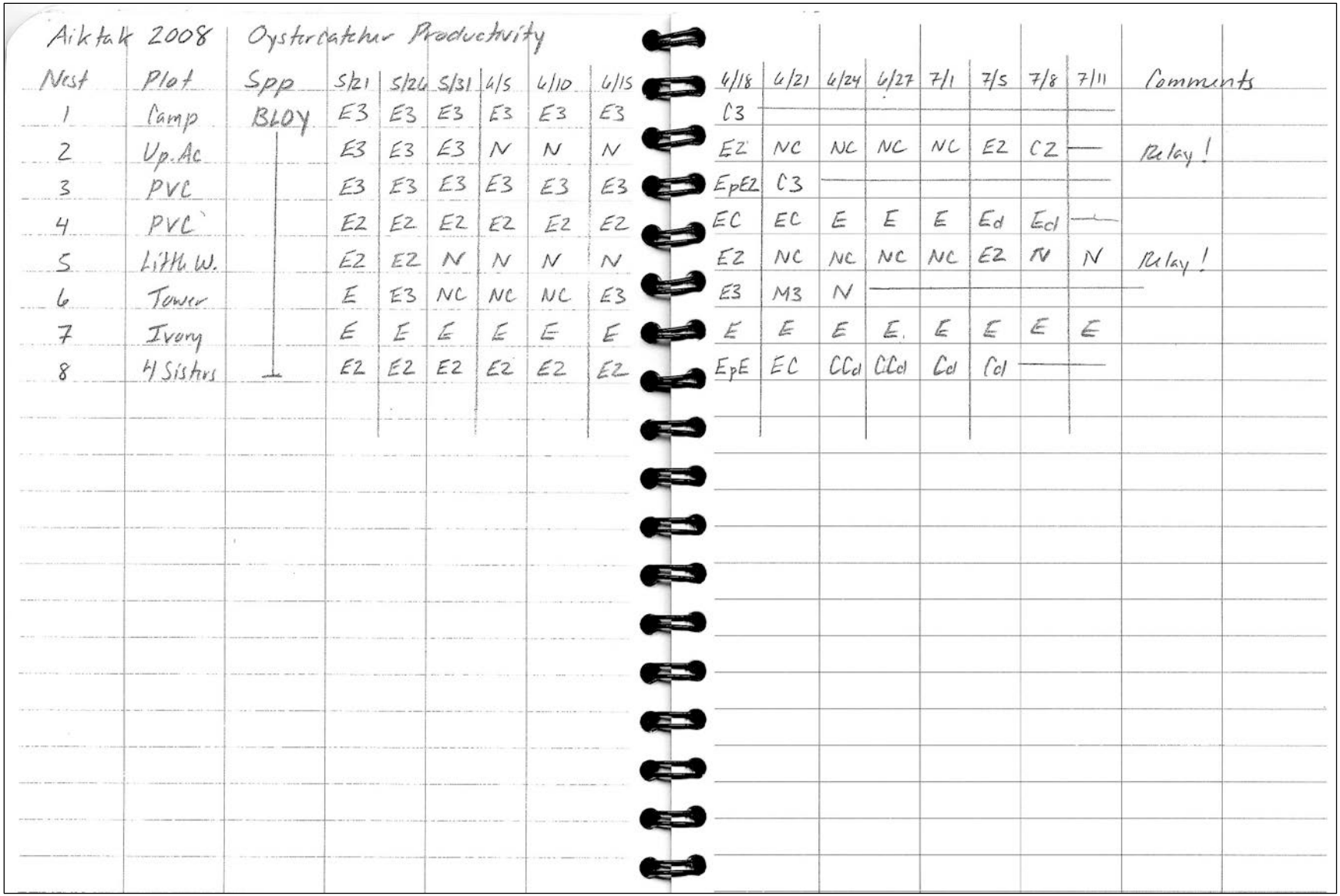

Figure 2. Example of data notebook page for recording black oystercatcher productivity data.

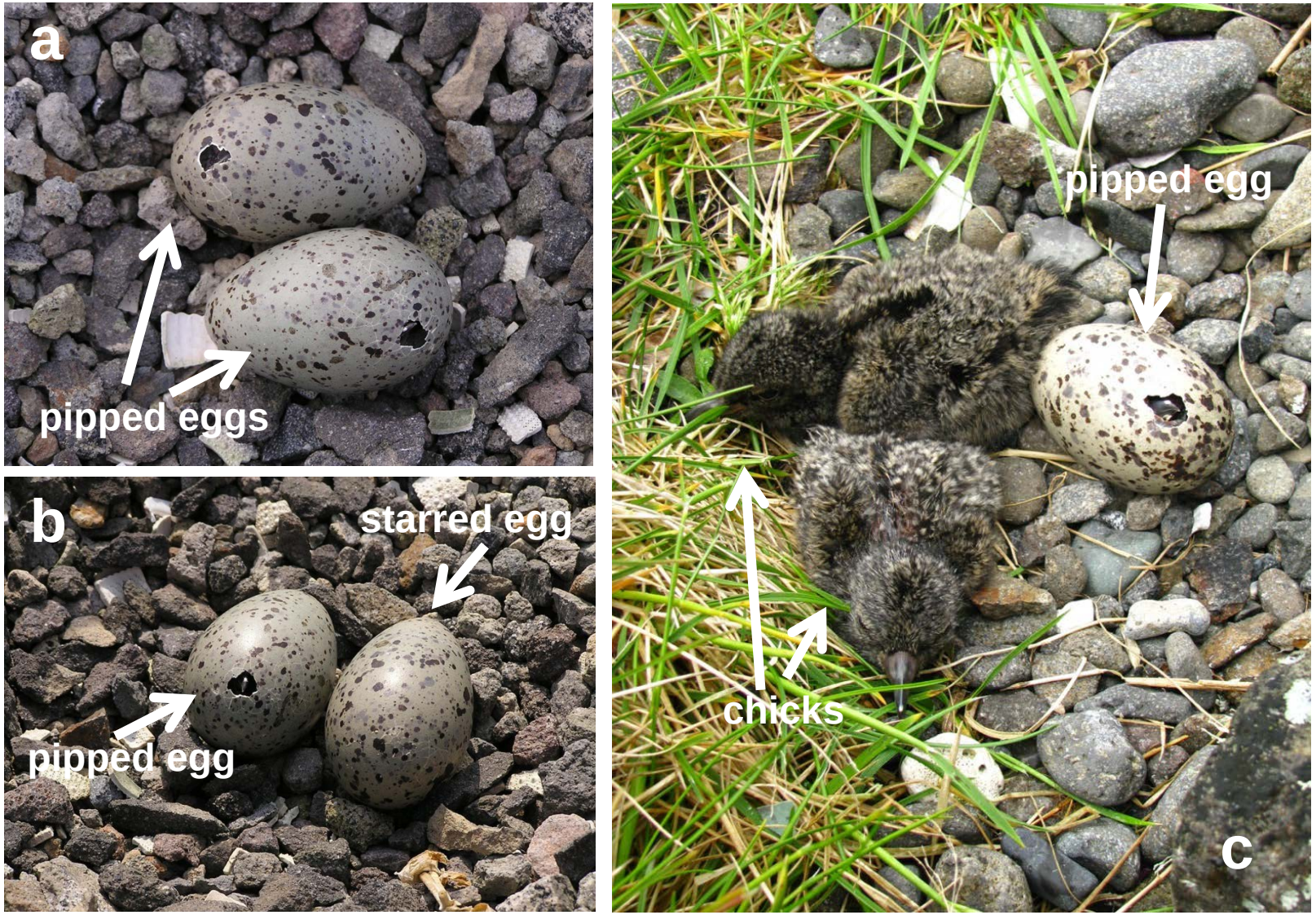

Figure 3. Photos showing pipped black oystercatcher eggs. Note that there must be a hole to classify the egg as “pipped”; right egg in photo b is only starred and not yet pipped.

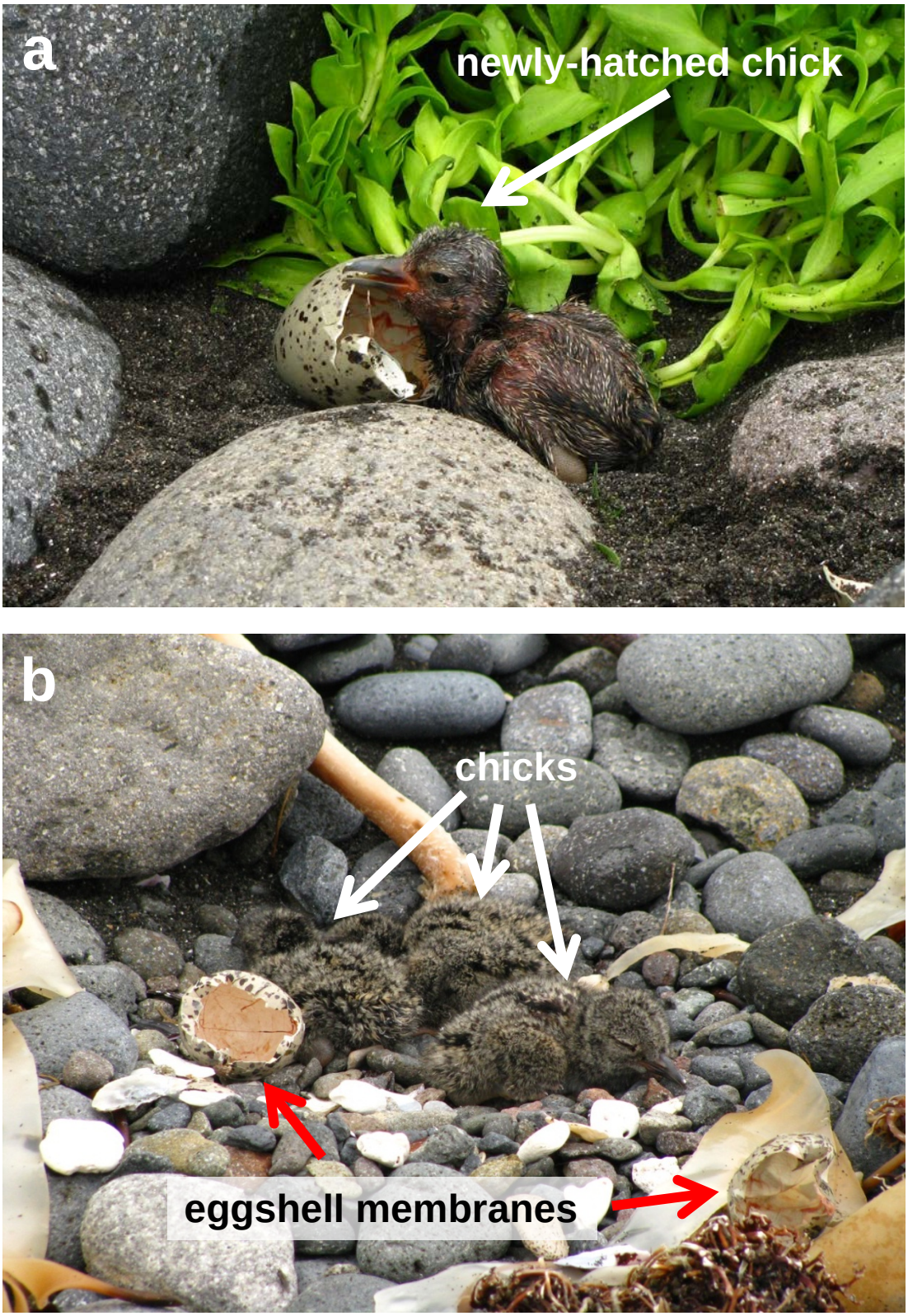

Figure 4. Photos showing black oystercatcher chicks (a) wet and newly hatched, and (b) several days old with fresh membranes at edge of nest.

Attachment A. Aiktak Island specifics (includes Figure A1)

PROCEDURE DETAILS SPECIFIC TO AIKTAK

At Aiktak Island, oystercatchers nest all around the island but are concentrated along the beaches and coves on the north side of the island.

Productivity and phenology: Areas that have contained accessible nests in past years include Petrel Valley Cove, Pleasure Cove, Little West Island, Old Camp Beach, New Camp Beach, Upland Access, Sea Lion Cove, several small ledges and coves east of Four Sisters, Ivory Cove, and Tower Cove (see Figure A1). Birds will have probably begun laying by the time you arrive on the island so begin searching for nests and territorial pairs as soon as possible. Monitor all accessible nests you find (usually 10-20). It may be helpful to map nests, although usually only one pair nests on each beach segment.

Once chicks hatch (usually from mid-June to early or mid-July at Aiktak), wait about 4 weeks after hatch before returning to the nest checks (generally late July to early August to count large chicks/fledglings. Thereafter, continue checks every 5-7 days until chicks fledge (40-55 days of age) or you leave the island (this will be about 4-5 visits, depending on timing in a given year).

At Aiktak, these checks shouldn't take long and can usually be done in conjunction with other work around the island. When checking for large chicks, try to view nests from above the beach with binoculars and scopes.

Populations: Determine the number of breeding birds on the island by trying to find all nests/territorial pairs over the course of the summer. Most of the northern coast is accessible at low tides or by dropping down into coves from the trail that skirts the northern side. The southern coast is backed by high cliffs and largely inaccessible at the shoreline, so you will have to listen and look for territorial pairs from vantage points on the cliff tops. Any opportunity to circumnavigate the island (either in a skiff or with the Tiglax) may also be helpful in locating breeding pairs on the south part of the island. In August, large flocks (sometimes more than 100) of black oystercatchers often use Aiktak as a stopover on migration; do not count these birds in population estimates.

Specific Requirements for Aiktak

Dates: Begin searching for nests in May, continue to monitor nests at 3-5 day intervals until all hatch (usually mid-June to early or mid-July).
Return in 4 weeks after hatch (usually late July to early August) to look for chicks at 5-7 day intervals.

Optimal sample size: All nests found (usually 10-20).

Time of day: Any time.

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

Equipment needed: Binoculars, Rite-in-the-Rain® notebook, map of nets (optional), paint pens/spraypaint or flagging tape/flags for marking nests, two pencils.

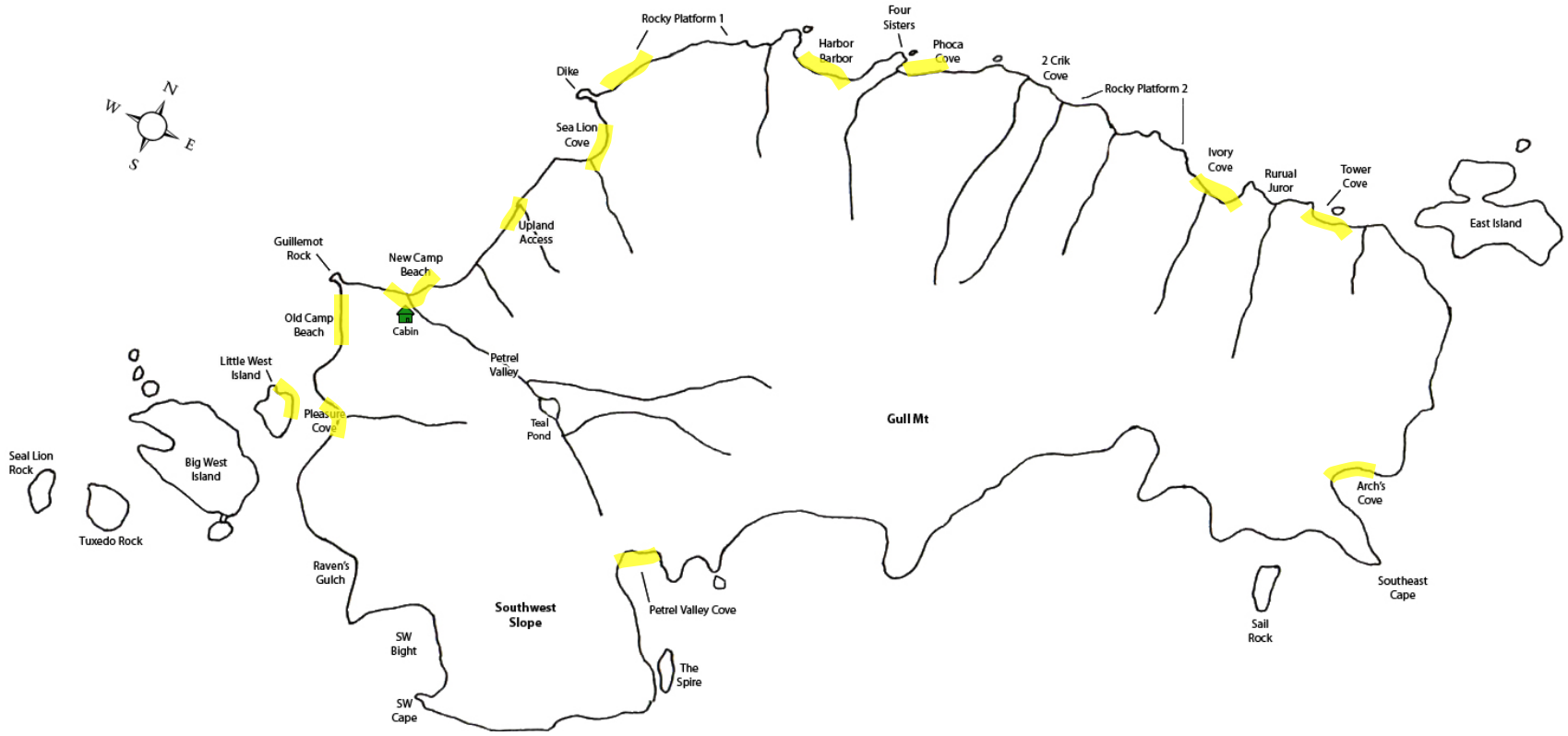

Figure A1. Locations of commonly-occupied black oystercatcher territories (highlighted in yellow) at Aiktak Island. Map should be used as a guide for where to start searching for nests, as nesting locations can change from year to year.

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	1.4
Oct 2015-Jan 2016	Added fledge age window determined from Aiktak 2015 data, clarified Ep modifier, fixed page number references in text	1.3
April 2015	Added productivity through fledging to general protocol and Aiktak appendix, 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 table and figures in island attachment, changed page number format to include protocol #, made minor grammatical edits, added fledgling count protocol, clarified pipped egg analysis in productivity.	1.1
May 2013	Protocol developed in standardized format from historic protocols, includes Aiktak attachment	1.0