

Protocol for Monitoring the Breeding Productivity of American Oystercatchers (*Haematopus palliatus palliatus*) Along the Atlantic and Gulf Coasts of the United States

March 2026 (Version 1.0)

Summary

The American Oystercatcher Working Group (AMOYWG) has developed a standardized protocol for monitoring the breeding productivity of American Oystercatchers to identify and compare changes in productivity over time and across multiple spatial scales. In this document, we define survey methods and metrics to promote consistency and accuracy in the collection, reporting, and analysis of productivity data. We also provide some basic guidance for carrying out this work in the field; however this protocol does not replace more thorough (and site-specific) training which is the responsibility of each site's leadership.

Accompanying the written protocol is an Excel template intended to guide the creation of digital collection forms (e.g., Survey123, Field Maps, NestStory, etc.) and each participant's end-of-season output will be an Excel file in the same format. Future versions of this protocol will include access to an online productivity database that will enable data sharing and regional and range-wide analyses.

Acknowledgements

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This protocol is dedicated to Shiloh Schulte (1978-2025). His vision and dedication to American Oystercatchers made this and many other Working Group projects a reality.

Citation

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Chapter 1 – Introduction

Background

The American Oystercatcher Working Group (AMOYWG) has a long history of working collaboratively on many conservation, research, and management projects designed to conserve, protect, and enhance American Oystercatcher (AMOY) populations throughout North and Central America. One of the most important collaborative efforts is the monitoring of pairs, nests, and broods to better understand how and why productivity varies across habitats over time and to explore the relative effectiveness of diverse management actions. Since the late 2000s, AMOYWG members have discussed developing a consistent and standardized method to monitor breeding productivity and constructing a centralized productivity database in which to enter and store range-wide productivity data to enhance data accuracy, sharing, and analyses across multiple spatial scales. The first version of the protocol was launched in 2022 with the support of partners from the AMOYWG.

Currently, until a database is created, the output of the protocol is an Excel file containing four spreadsheets, the contents of which are described in the chapters below. Spreadsheets can be generated by a variety of data collection processes and tools, including apps, data sheets, field journals, etc. but the final output should follow the standardized format provided.

Productivity Objective

The productivity objective of the AMOYWG is to achieve and maintain a minimum estimate of 0.55 fledglings per pair across the entire U.S. breeding range. This productivity goal was based on previous population modeling work by Ted Simons, Melissa Davis, and Shiloh Schulte.

Key Terminology

It is important to review key terms to ensure consistency in data collection and analysis for interpretation of results and effective communication among all partners. Key terms are **bolded** the first time they are used in this protocol and listed in glossary (see [Glossary](#)) for reference.

Chapter 2 – Survey Sites, Timing, and Frequency of Visits

Productivity surveys are conducted within sites, which are selected and defined by partners implementing this protocol. The site is considered the sampling frame, with repeated surveys conducted throughout the **productivity survey window** (see [Productivity Survey Window and Breeding Season Stages](#)) to monitor **pairs**, **nests**, and **broods** (see [Survey Frequency](#)).

Survey Sites

The term “site” may carry different definitions, but in this protocol, a **site** is defined as an area encompassing suitable breeding habitat in which all observable AMOY pairs, nests, and broods can be surveyed in one day under normal conditions. Site boundaries often reflect units of management or ownership. If a site cannot be consistently surveyed in a single day, it should be split into multiple sites based on access or other logistical or management considerations.

Although the method of delineating sites may vary (e.g., one partner may define an island as a single site, while another considers opposite ends of a single island two distinct sites), site boundaries should be fixed throughout the breeding season and, as much as possible, across years to ensure data comparability. If a site must be re-delineated (e.g., site boundaries

substantially change due to changes in habitat, accessibility, or land ownership), then new boundaries must be defined (see [Delineating Site Boundaries](#)).

Establishing a Site

Each site should be an area encompassing suitable breeding habitat that will be monitored during the breeding season, even if no breeding birds are observed during surveys. Sites are established prior to the start of the breeding season, and their boundaries should remain consistent throughout the breeding season. Ideally, each site would contain a single **landscape type** and general management regime; however, there may be some situations where a site could have more than one landscape or different management types. In most cases, a site should be able to be surveyed within a single eight-hour workday. A contiguous area can be partitioned into more than one site based on access, ability to conduct a survey at the site in one workday, differences in jurisdiction (e.g., a desire to report productivity for different municipalities on the same beach), or other practical considerations. For example, a large barrier island could be divided into two sites, or a cluster of small islands could make up one site, or each small island could be its own site.

Delineating Site Boundaries

Polygons illustrating site boundaries should be delineated using GPS coordinates or imagery or defined based on historical surveys of the site. Identified accuracy, projection, and coordinate system should be included with the polygon when using GIS to delineate a boundary. Ideally, site boundaries should encompass an area large enough to account for shifts in habitat suitability or growth or movements of the AMOY population. For example, if most nesting occurs on the northern end of a beach, the site boundary should still contain the entire beach length that you would survey despite the lack of current nesting elsewhere. Nesting habitat is likely to shift over time, especially in dynamic beach systems, and defining the boundary by the end of current nesting activity may not be appropriate for long-term monitoring. Therefore, including potential but not currently used nesting areas can be beneficial. Conversely, new sites can be created in future years if nesting distributions change.

Occasionally, changes in coastal geomorphology (e.g., hurricanes), land ownership, or access may require shifting site boundaries; therefore, site boundaries should be re-evaluated for accuracy before the beginning of each breeding season. When boundaries must be revised, the survey coordinator draws a new polygon to reflect the changes. Site boundaries and polygons are only revised between survey years. If a site changes within a survey year to the extent that access is affected (for example a storm creates a new inlet, preventing surveyors from accessing part of the site), the polygon is not changed but the change in **survey effort** will be captured (see [Conducting a Survey](#)).

Site-Level Field Definitions

State: The state or province in which the site is located. Sites cannot cross state lines.

Survey Organization: The organization responsible for monitoring the site, collecting, and managing the productivity data. If multiple partners are involved, list one or more lead survey coordinator(s) and their organization(s).

Site Code: A 3-8 letter code unique to the site. For convenience, codes may use a common prefix to group sites together.

Site Name: The full name of the site spelled out in complete words with no abbreviations (e.g., National Seashore instead of NS).

Site Boundary: The polygon delineating the area where all suitable breeding habitat is monitored during the breeding season even if no breeding birds are observed. Site boundaries are defined using a GPS in the field or can be digitized using imagery. Level of accuracy, projection(s), and coordinate system should be included in the metadata accompanying the polygon using a .gdb, .shp, .kml, or .kmz file.

Landscape Type: The site’s dominant landform (e.g., barrier island, dredge-material island, marsh system). Landscape type describes the site’s geography rather than the different habitats found within the site. For example, barrier islands contain various habitats including marshes, beaches, and dune systems, but their landscape type is “barrier island.” Only one dominant landscape type should be assigned to each site. Below is a description of each landscape type:

Barrier island: A sandy island located seaward of a mainland shoreline. Includes large, wide barrier islands; smaller, narrow barrier islands; and both developed and undeveloped barrier islands.

Natural non-barrier island: A distinct landform surrounded entirely by open water which is natural in origin. Note that barrier islands and natural non-barrier islands can have dredged material placed on them. Natural non-barrier islands include offshore bars, sandbars, or other ephemeral sand features.

Marsh system: A tidally influenced area dominated by wetlands-dependent vegetation and regularly entirely or partially inundated by the tide. Due to surrounding intertidal areas and/or marsh vegetation, it is not a distinct landform.

Dredged-material island: A distinct artificial landform created by the deposition of dredged sediment and surrounded entirely by open water.

Non-dredge artificial island: A distinct artificial landform composed of material other than dredged sediment (e.g., riprap, shell) and surrounded entirely by open water.

Mainland shoreline: The part of a mainland geography that abuts a body of water.

Built environment: A building, parking lot, or other developed area.

Predation Management: The management of predators for the purpose of increasing the breeding productivity of AMOY and other wildlife. This field should be populated at the end of the nesting season to reflect actual management conducted at the site. Specific methods within the broad categories below vary and can be captured in the Comments field.

Predator removal: An attempt was made (regardless of success or duration) to physically remove at least one predator from the site between the end of the previous nesting season and the conclusion of the current nesting season (e.g., at least one trap night). Removal could be lethal or non-lethal (e.g., relocation).

Predator deterrence: At least one action was implemented (regardless of success or duration) during the nesting season to prevent predators from accessing the site or entering an area where nests and/or chicks were present. Predator deterrence actions could include any combination of electric fencing, harassment, effigies, or other deterrence measures.

Both: Both predator removal and predator deterrence were deployed at the site.

Neither: Neither predator removal nor predator deterrence were used at the site.

Public Access: The overall level of public access at a site during the productivity survey window. If public access is prohibited on one half of a site but permitted on the other half, the site would be considered as having public access. In situations like this, consider splitting the area into two sites to reflect differences in management. Adding detailed comments is helpful to describe nuances. If access changes during the season, select all applicable types and state the dates that the different access levels were permitted in the Comments field.

No access: Public access, including the landing of watercraft, is not permitted anywhere on site, including within the intertidal zone.

Intertidal access only: Sites closed to the public and pets above mean high water but that allow people, pets, and watercraft to access the intertidal zone.

Access: Sites are open to the public above mean high water. This may be complete access or limited to specific areas, such as at sites with symbolic fencing.

Access Type: The type of public access pertaining to pedestrians, dogs, and ORVs. Adding detailed comments is helpful to describe nuances. If access type changes during the season, select all applicable types and state the dates that the different access levels were permitted in the Comments field.

Pedestrians permitted (no dogs): Pedestrians are permitted to access all or part of the site during the entire or part of the nesting season, but dogs are not allowed.

Pedestrians permitted (leashed dogs): Leashed dogs are permitted to access all or part of the site during all or part of the nesting season.

Pedestrians permitted (unleashed dogs): Unleashed dogs are permitted to access all or part of the site during all or part of the nesting season.

ORVs permitted: ORVs (vehicles, ATVs, UTVs, etc.) are permitted to drive on all or part of the site during all or part of the nesting season.

No access: There is no public access permitted anywhere on site, including within the intertidal zone.

Site Contact Name: First and last name of the site's primary point of contact.

Site Contact Email: Email address of the site's primary point of contact.

Site Contact Phone: Phone number of the survey coordinator.

Comments: Any general site comments (e.g., if the boundaries have had to change from previous years or other information related to any of the fields above). Including more detail is never the wrong choice.

Table 1. Description of each Site-level field (see above and “Metadata_Site” tab in Excel template), with the valid format, domain categories (see “domains” tab in Excel), and if the field is required. Data are entered in the Excel file’s “DataEntry_Site” tab.

Field	Description	Valid Format	Domains	Required?
State	State or province in which the site is located.	Free text	Select one: AL, CT, DE, DC, FL, GA, ME, MD, MA, MS, NH, NJ, NY, NC, RI, SC, TX, VA, NS, NL, NB	Yes
Survey Organization	Organization responsible for conducting surveys.	Free text	None	Yes
Site Code	A 3-8 letter code unique to the site. For convenience, codes may use a common prefix to group sites together.	Free text	None	Yes
Site Name	Full name of site.	Free text	None	Yes
Year	Year in which the survey was conducted.	Integer	None	Yes
Site Boundary	A polygon depicting the area surveyed.	.shp or .gbd	None	Yes
Landscape Type	Dominant landscape type of the site.	Free text	Select one: Barrier island, Natural non-barrier island, Marsh system, Dredged-material island, Non-dredge artificial island, Mainland shoreline, Built environment	Yes
Predator Management	Type of predation management conducted at the site between the end of the last nesting season and the end of the current nesting season.	Free text	Select one: Predator removal, Predator deterrence, Both, Neither	Yes
Public Access	Level of public access permitted during the breeding season.	Free text	Select all that apply: No access, Intertidal access only, Access	Yes
Access Type	Type of public access pertaining to pedestrians, dogs, and ORVs.	Free text	Select all that apply: Pedestrians permitted (no dogs), Pedestrians permitted (leashed dogs), Pedestrians permitted (unleashed dogs), ORVs permitted, No access	Yes
Site Contact Name	Contact’s first and last name.	Free text	None	Yes
Site Contact Email	Contact’s e-mail address.	Free text	None	Yes
Site Contact Phone	Contact’s phone number.	Numeric	None	Yes
Comments	General site comments.	Free text	None	No

Productivity Survey Window and Breeding Season Stages

This protocol requires a site to be surveyed repeatedly throughout the breeding season (see [Survey Frequency](#)). AMOY breeding phenology and migratory propensity varies across their range, with some resident individuals never leaving, some scraping for several months prior to initiating **clutches**, and other sites' pairs being migratory. Therefore, each site must establish a productivity survey window based on the behavior of AMOY in that location.

Productivity Survey Window

The productivity survey window begins 15 days prior to the site's earliest nest date based on the last 5 years of monitoring (if the earliest nest date during the last 5 years was April 16, then the survey window begins on April 1). If a site lacks previous monitoring information, consult with neighboring sites or the AMOYWG to determine a start date. The end of the productivity survey window is at least 15 days after the last chick is fledged and no other reproductive activity is observed, or 15 days after the last pair fails and no other reproductive activity is observed. The window only pertains to this protocol. However, if surveyors choose to extend the monitoring period for any reason, the additional surveys may be included, and if for any reason (such as a global pandemic) your monitoring starts late or ends early, your information is still valuable and you should continue to use the protocol and collect data.

Productivity Survey Extent

Once a chick fledges, it may leave the survey site and be seen elsewhere during other activities. Adults may also be seen elsewhere, such as while loafing or foraging off territory. These observations of off-site fledglings or adults are not part of this protocol and therefore that information cannot be entered in this protocol. However, band resightings should be reported to the AMOY Band Database.

Breeding Season Stages

The protocol defines three stages within the breeding season: **territory establishment**, **incubation**, and **brood-rearing**. For purposes of determining how often a site should be surveyed, sites enter each stage when the first pair begins territory establishment, initiates its first **clutch**, etc., but each pair will move through the stages as well.

The territory establishment stage begins when birds begin to court and defend territories. The calculated start date of the productivity survey window should fall within this stage. **Piping displays** by breeding pairs typically mark the onset of the territory establishment, although it should be noted that in areas with resident populations, mild displays may be seen year-round. Other behaviors seen during territory establishment include territorial battles between pairs and/or individuals, copulation, and **scraping**. During this time, AMOY typically become increasingly attached to their territories and may be reluctant to leave the area, even when disturbed. In addition, the timing of both territory establishment and courtship, as well as incubation, can vary within a region by habitat type. For example, in North Carolina, birds nesting in marsh systems may begin nesting several weeks before their barrier island counterparts.

The incubation stage at a site begins when the first egg is laid. The brood-rearing stage at the site starts when the first chick hatches and continues until the last chick fledges, dies, or is no longer detected by the surveyor. In this protocol, chicks are considered fledged at 35 days post-hatch.

Not all chicks ≥ 35 days of age are capable of sustained flight, however, using 35 days post-hatch provides a consistent means of assessing chick survival and avoids requiring observers to flush chicks intentionally to assess flight capability. This convention was agreed upon by the AMOYWG at the 2010 annual meeting, but some site managers may include additional metrics for their own management decision-making. Note that chicks may experience increased risk of mortality shortly before they are capable of sustained flight and in the weeks immediately following fledging, as they become bolder and venture beyond their natal territories.

The productivity survey window ends 15 days after the last active nest or brood fails, or the last brood turns 35 days old, whichever comes last. Pairs that lose their last nests or broods typically continue to exhibit some territoriality after reproductive failure, though more mildly than at the start of the breeding season. Signs that pairs are no longer reproductively active include tolerating other AMOY on their territory, no longer piping or showing other signs of agitation in the presence of humans, flocking with other AMOY, and being absent from their territories, especially during high tide.

Survey Frequency

Site survey frequency across the productivity survey window will depend on many factors such as personnel capacity, logistics and disturbance considerations. Ideally, sites should be visited at least once per week throughout the entire productivity survey window, with more frequent visits during incubation and brood-rearing to capture key milestones in each reproductive effort.

Territory Establishment Stage: 1-2 surveys per week

This frequency allows for early detection of pairs as they arrive and establish territories while reducing disturbance that may affect territory establishment. These observations will help surveyors find scrapes as clutch initiation nears.

Incubation Stage: 2-3 surveys per week

More frequent surveys increase the likelihood of accurately assessing timing of nest initiation and causes of nest failure, which inform management actions and facilitate detection of pairs moving within or out of a given site.

Brood-rearing Stage: 2-3 surveys per week

Continuing frequent surveys increases the likelihood of accurately assessing causes of brood failure and detecting chicks.

Post-fledging Stage or Post-failure of a Nest or Brood Stage: 1-2 surveys per week

Post-fledging surveys are ideally conducted around high tide when AMOY are most likely to be on territory as this aids in confirming resighting fledglings. Continue to visit both pairs with fledglings and failed pairs for at least 15 days post-failure/post-fledging.

Targeted Survey Effort: confirm hatching and fledging

The typical hatching window is between 24-28 days of incubation, and nests should be checked during this time to confirm hatching. In addition, when chick(s) approach 35 days of age, surveyors should conduct visits on or shortly after 35 days post-hatch to document the brood's fledging success or failure as accurately as possible.

Chapter 3 – Monitoring Your Site

Conducting a Survey

Conducting a survey consists of at least one surveyor checking the site at the recommended frequency (see [Survey Frequency](#)) and recording the required data in a consistent manner that maximizes detection of pairs, nests and broods.

Survey methods will vary by site, depending on type of access, terrain, and/or personnel available. Regardless of method of transit, AMOY habitat should be checked consistently and thoroughly. For example, when boating or driving a vehicle near a site, there may be areas where it is necessary to walk on the site to inspect otherwise inaccessible or not visible areas, and surveyors should always use binoculars and/or a scope to confirm presence as AMOY can also be cryptic, especially in marsh systems.

Recording Survey Effort

The surveyor should make reasonable effort to survey 100% of the site on each survey. The **proportion of site surveyed** is an estimate of survey effort per day and accounts for incomplete survey effort due to inclement weather conditions, access issues, or other impediments.

Occasionally, a surveyor may make an **opportunistic observation** of a pair, nest, or brood outside of a regular survey. For example, a surveyor may be at a site to repair symbolic fencing or respond to a stranded sea turtle and happen to observe AMOY breeding activity (e.g., a pair with chicks, a depredated nest, a new nest, etc.). If the observation is deemed reliable, the data should be recorded, even though it was not observed during a formal productivity survey.

The proportion of site surveyed should reflect the area surveyed, not just observer presence on the site. For example, at sites surveyed on land, the surveyor may be transiting along a beach and passing pairs with a failed nest or brood, or fledged chicks. If the surveyor stops to check for the presence of adult AMOY or new scrapes, that part of the site would be considered surveyed; if the surveyor does not pause to inspect the area, that part of the site would not be considered surveyed. The same principle applies to sites surveyed from a boat whereby the surveyor passes the site without stopping to look for and recording breeding activity (not surveyed) versus idling around an island and using binoculars to look for AMOY and/or signs of nesting activity (surveyed).

Table 2. Description of each Survey-level field (see above and “Metadata_Survey” tab in Excel), with the valid format, domain categories (see “domains” tab), and if the field is required. Data are entered in the “DataEntry_Survey” tab.

Field	Description	Valid Format	Domains	Required?
Site Code	A 3-8 letter code unique to the site. For convenience, codes may use a common prefix to group sites together.	Free text, 3-8 letters	None	Yes
Survey Date	Date the survey was conducted.	Date, yyyy-mm-dd	None	Yes
Proportion of Site Surveyed	Percent of the site surveyed (categorical estimate).	Free text, up to 255 characters	Select one: 100% surveyed, 99-50% surveyed, 49-1% surveyed, Opportunistic observation	Yes
Comments	Any relevant information (e.g., why the survey did not cover the entire site, mid-season changes to access, etc.).	Free text, up to 255 characters	None	No

Visiting Pairs

During a site survey, the surveyor makes visits to pairs and their territories, nests, or broods. A **visit** refers to each time a surveyor observes a specific pair, whether on a site survey or as an opportunistic observation. A visit to a pair should be as short as possible to reduce disturbance. The timing and length of each visit will vary based on weather, predator presence, and other conditions.

Visits to pairs without a known nest or brood will involve nest searching, during which the surveyor seeks to find **scrapes** (nests without eggs in them yet) by inspecting likely nesting microhabitat and looking for AMOY tracks leading to a scrape. Surveyors may also observe adults from a distance to determine if they appear to be incubating. This process may take 5-15 minutes but should generally not be longer.

Nest visits should be very brief (a minute or less unless other work such as the installation of a trail camera is performed), and in some cases concerns about disturbance or cueing predators onto the nest may dictate that the observer only records from a distance without seeing the eggs if an adult is in an incubating posture, rather than disturbing the bird off its nest.

Brood visits are often best performed at a distance because adults will use their alarm call to alert chicks to hide and because disturbing the adults away from their brood can put the chicks in danger. Time spent disturbing the adults and their brood should generally be 5 minutes or less, especially when chicks are less than two weeks old and most vulnerable to predators. Searching for chicks to band them may require more time but should generally be 15 minutes or less, especially on hot days or under other adverse conditions.

Collecting Pair/Nest Data

Upon discovery of a new pair or nest, the surveyor creates a new Pair/Nest record. During the initial visit and all subsequent visits to that pair, they enter Visit-level data and update the Pair/Nest summary data as needed ([Collecting Visit Data](#)).

When to Create a Pair/Nest Record

Ideally, the surveyor will detect most pairs at the site during the territory establishment stage before they have nests. A territorial or scraping pair without a known nest or chicks is an **unconfirmed breeding pair**. After a nest or brood has been found for the pair, it becomes a **confirmed breeding pair**. After the pair's brood fledges (including newly discovered fledged broods) or the pair is judged as failed for the year, they return to **non-breeding** status. In rare cases, AMOY nest in trios, which are also considered "pairs." A **trio** is a group of three adults that nest cooperatively, sharing incubation and brood-rearing duties at the same nest. A third adult behaving agonistically towards a pair, or merely being nearby, does not constitute a trio. Surveyors should take care to distinguish between single AMOY who are making advances or aggressing on a pair and an actual trio.

Unconfirmed breeding pairs are recorded to account for pairs that are attempting to nest but are unsuccessful at initiating a clutch or who lose their clutches before a surveyor finds the nests (e.g., rapid nest failure due to depredation, visits spaced widely so that nests or broods are missed, etc.). Therefore, in the beginning of the season, surveyors will have to decide when to create a record for each pair that they see. Some pairs' behavior may be equivocal, making it difficult to determine if they are committed to an area (especially for new surveyors), but behaviors indicative that a Pair/Nest record should be created include scraping, copulation, piping displays, **false incubating**, and being present in the same suitable nesting area across multiple visits. AMOY have high nest-site fidelity, so banded birds being present on the same territory they are known to have nested in previously is another good indicator.

Assigning Pair/Nest IDs

Each pair, regardless of confirmed or unconfirmed breeding status, gets a unique numerical **Pair ID** and will retain that pair number throughout the season's productivity survey window. For example, the first pair observed at a site is 01, the second observed pair is 02, etc. Pair numbers can be assigned non-chronologically if desired, so long as they are unique to that pair at that site.

The Pair ID number is paired with a **Nest ID** letter. When a pair is initially discovered with no nest, the "nest" letter is X. For example, the first pair discovered scraping at a site with the abbreviation CNSHK would be labeled as CNSHK01X.

Then when pair CNSHK01X is found with a nest, a new Pair/Nest record is created with the ID CNSHK01A. All alpha values assigned to nests or broods start with A, regardless of whether the surveyor *thinks* an earlier nest was missed or if the reproductive attempt was first discovered as a nest or a brood. Subsequent attempts are labeled B, C, etc.

Do not create a territory ID in cases where the pair was first discovered with a nest or a brood. These pairs will simply not have an "X" Pair/Nest record. In some cases, the nest is never found and reproductive activity isn't discovered until the brood stage. When this happens, the pair would be assigned the ID "A" for their brood.

An “X” value is *not* used between nest attempts, but only before the first nest is observed. If the nest fails, the Pair/Nest ID remains 01A unless or until the pair is discovered with a reneat (it does *not* go back to 01X). The first reneat discovered is 01B, the second reneat discovered would be 01C, and so on. In some cases when visits are frequent, egg loss may be detected during the egg-laying period. For example, the first egg is laid, then depredated, then within a few days two additional eggs are laid to complete the clutch, either in the same scrape or one nearby. As long as the laying continues within 1-4 days, this nest would keep the same ID and not be considered a reneat. If the continuing egg(s) are laid in a new scrape, the coordinates for that nest can be updated to facilitate relocating it.

If one member of a banded pair dies or disappears after the first nest attempt (the A nest) and a different bird takes its place for the B nest, that Pair ID numeric value stays the same because one of the two mates is the same, and the replacement bird’s bands (or lack thereof) is entered in the Replacement Pair Member Bands field at the Pair/Nest level. If two new birds move into a previous pair’s territory, they would receive a new Pair ID.

Assigning Coordinates

Locations of each Pair/Nest ID are recorded in the X and Y Coordinate fields. The longitude and latitude of each Pair/Nest ID must be determined using a GPS device that is accurate within 3 m, and the coordinate system used must be recorded (ideally WGS1984). Coordinates are recorded for each unique Pair/Nest ID, which includes a pair’s territory location before nesting (01X), first nest attempt (01A), and any subsequent reneating attempts (01B, 01C, etc.). Record territory coordinates by identifying the area that the pair defends most aggressively or where scrapes are concentrated. Record nest coordinates by holding the GPS device next to the nest. If the pair is discovered in the brood-rearing stage, record coordinates in the area the chicks appear to spend the most time.

Nest Site Attributes

The nest’s habitat type within a 5-meter radius of the nest and substrate type within 0.5-meter radius of the nest (what the AMOY put the scrape on) are recorded upon initial discovery.

Adult and Chick Bands

The bands, if any, on the adults and chicks associated with the Pair/Nest. Reading bands is crucial to good monitoring and therefore it is important to try to read bands every time a visit is made. As the surveyor reads and confirms the adults’ bands, and as chicks are banded, they are entered into the Pair/Nest record.

AMOY have high mate fidelity, so in most cases, only two adults will be associated with a Pair/Nest ID number. However rare they are, divorces can occur and if one member of a pair dies the remaining adult may adopt a new mate. The new mate’s bands are recorded in the Replacement Pair Member Bands field. If the pair in question is a trio, the third adult’s bands are recorded in the Adult 3 field.

Reproductive Effort Outcomes

As surveys continue throughout the productivity survey window, each nest’s Hatch Date will be determined either by direct observation of hatching (i.e., the actual date of hatching) or estimated using one of several available methods (e.g., chick ageing, pipped eggs, egg floating, median date between the last two visits, or incubation initiation date). The Estimated Fledge Date (the

date the chicks turn 35 days old) is calculated based on the hatch date. The date a nest or brood is found failed is also recorded.

Most of the Pair/Nest-level fields are entered in real time while at the site; however, four fields (Total Eggs, Total Chicks, Total Fledglings, and Outcome; see [Table 3](#)) are entered at the end of each reproductive effort (i.e., after each nest or brood has either succeeded or failed) or at the end of the productivity survey window.

To finalize values for these fields, the surveyor reviews all of the information available for each reproductive effort. This requires careful review and thought. For example, the surveyor discovers a nest with two eggs on the first visit. On the second visit, the surveyor observes only one egg, but on the third visit, the surveyor observes two eggs again. Although the number of eggs in the nest never was observed as three eggs, the surveyor knows that the female laid three eggs during that reproductive effort. In another example, at a two-egg nest the surveyor has never seen more than one chick at a time, but they banded two chicks. As a result, the total number of chicks (or fledglings if they survived to 35 days) would be two, even though they were never seen together and there are no visits with a value of two in the chicks field.

Surveyors should only enter highly certain values in the Total Eggs, Total Chicks, and Total Fledglings fields, otherwise for unknown or uncertain values, enter 99. For example, if the surveyor documented three eggs in a nest but only ever saw two chicks, the correct entry for Total Chicks is 99 because it is possible the third egg hatched and the nestling died without being seen. Similarly, if a nest is found with one egg and on the next visit three days later there are no eggs indicating complete nest failure, the number of eggs would be unknown (99) because it is unknown whether a second (or third) egg was laid before the clutch was lost. A good rule of thumb is to allow three days to pass without an additional egg laid before considering the clutch to be complete. Generally, clutch sizes \geq three eggs can be considered complete without additional information.

The Outcome field for each Pair/Nest ID is not filled out until the reproductive effort has concluded, or at the end of the productivity survey window. In some cases, monitoring will not be sufficient to know if a nest hatched and *then* the brood failed, or if the nest failed *before* hatching. In these cases, it is known that the reproductive effort failed, but not at which stage. In these situations, Outcome is “failed unknown stage” and the Total Number of Chicks is unknown (99). Similarly, a nest that has been incubating for 24-30 days is considered to be in the **hatch window**; thus if the eggs disappear during this timeframe and no chicks are ever seen, it would also be considered “failed unknown stage.” Keep in mind that incubation begins at or around the time the second egg is laid; thus, if a nest is found with the clutch already completed, the hatch window will be uncertain because it’s unknown when incubation began. In such cases, egg floating may be useful.

Pair/Nest-Level Field Definitions

Site Code: See [Site-Level Field Definitions](#). This field is required and links Site-level fields to Pair/Nest-level fields.

Pair/Nest ID: Unique identifier for each pair that incorporates a unique two-digit numeric value (e.g., 01) for the pair and a single letter representing the pair’s nest attempt to facilitate tracking multiple nest attempts by the same pair (or trio) over multiple visits.

As bands are read during visits (see [Collecting Visit Data](#)), and as chicks are banded, the adult and chick band fields will be populated.

Adult 1 Bands: The band code of one member of the pair. Use UNB if the adult is unbanded and UNK and UNK if it was not determined if the adult was banded, or enter the band code directly. If the band was seen, enter the band color and code directly in whatever shorthand is comfortable. Recording partial band reads, such as band color only or partial codes (i.e., “Dark Green C__ Triangle” or “DG”), is acceptable.

Adult 2 Bands: The band code of another member of the pair. See **Adult 1 Bands** above for data entry.

Replacement Pair Member Bands: The bands of a replacement pair member that replaces an original pair member that died or disappeared from the territory. See **Adult 1 Bands** above for data entry.

Adult 3 Bands (trio): The band code of a third banded individual in cases where the “pair” is a cooperative trio. See **Adult 1 Bands** above for data entry.

Chick 1 Bands: The band code of the first chick. Use UNB if the chick is unbanded.

Chick 2 Bands: The band code of the second chick. Use UNB if the chick is unbanded.

Chick 3 Bands: The band code of the third chick. Use UNB if the chick is unbanded.

Habitat Type: Dominant habitat type within 5-meter radius of the *nest* location. For example, if the nest is on or within an overwash fan but near marsh that fringes the back side of a barrier island, the habitat type is “overwash fan,” not marsh.

This field is populated *only* for pairs with known nests (i.e., for Pair/Nest ID 01A and all its subsequent nest attempts, if any). If a pair is found during the brood rearing stage, this value is “nest not found.” If a nest or brood is never located for a pair during the season and the pair is breeding unconfirmed, leave this field blank. Select one of the following that best fits the description of the nest’s habitat type:

Dredged sand dome: An area on a dredge material island that is elevated and typically dome- or berm-shaped.

Dune system: An area composed of sand mounds of varying size, formed by wind and often partially covered in vegetation, and interspersed with swales or low-elevation sandflats.

Jetty, groin, or revetment: An artificial hard structure usually made of rip-rap or cement that is positioned perpendicular or parallel to the shoreline.

Marsh: An area predominated by wetlands-dependent plants that is often interspersed with mudflats, wrack and/or shell deposits, sandy ridges, and other microhabitats.

Non-island dredge deposit: An area of dredged sediment deposited on a bigger landmass such as the mainland or a large barrier island.

Non-ocean beach: An inshore sandy shoreline on a bay or sound or the gently sloping shore of a dredged-material island that does not face the ocean.

Ocean beach: A sandy shoreline that faces the ocean that extends from the high tide line to the toe of an established dune system or back barrier flat or marsh.

Overwash fan: A low-elevation expanse of sediment, typically composed of sand or sand/shell mix, created when dunes on a barrier island or mainland beach are flattened by storms, tides, and waves.

Parking lot: A parking area for vehicles typically made of asphalt, cement, gravel, or crushed lime rock or shell.

Rooftop: The roof of a building.

Sand spit: An area composed of unvegetated or sparsely vegetated sand, often elongated in shape, that extends outward from the vegetated tip of an island, or out from a point of a mainland shoreline.

Sandbar: A sandy shoal, or other ephemeral formation surrounded on all sides by open water at low tide.

Shell rake: An area composed of clam and/or oyster shell deposited by storms or artificially along a marsh edge or some other land feature. Other materials such as sand and wrack may get deposited on top of the shell over time.

Other: Other habitat types not listed above. Describe habitat type in the Comments field and document with photos, if possible.

Nest not found: Only use this value when a nest was not found: a pair discovered during the brood-rearing stage or when non-viable eggs were found not in a scrape.

Substrate Type: Dominant substrate within a 0.5-meter radius from the center of the nest. The substrate field is left blank if no nest is found for a given breeding pair (e.g., Pair/Nest ID = 01X) or if it is found in the brood stage. Select one of the following that best fits the description of nest substrate:

Sand: The substrate is >90% sand.

Shell: The substrate is >90% shell.

Vegetation: The substrate is >90% vegetated. Vegetation may be living or dead, but must be rooted. If the vegetation is unrooted, see Wrack below.

Wrack: The substrate is >90% wrack. Wrack is dead unrooted vegetative material, often *Spartina* stalks, deposited by the tide.

Sand-shell mix: The substrate is <90% shell, with sand comprising the rest of the substrate type.

Sand-veg mix: The substrate is <90% vegetation, with sand comprising the rest of the substrate type.

Sand-wrack mix: The substrate is <90% wrack, with sand comprising the rest of the substrate type.

Rocks/gravel/cobble: The substrate is >90% rock (e.g., natural rock deposit or artificially placed cobble, gravel, and/or riprap).

Pavement/cement: The substrate is hard, flat, non-porous asphalt or cement.

Other: The substrate is composed of another type not listed above. Describe substrate in the Comments field and document with photos, if possible.

Nest not found: Only use this value when a nest was not found: a pair discovered during the brood-rearing stage or when non-viable eggs were found not in a scrape.

Date Found: The date that the nest or brood was discovered.

Date Found Failed: The date that the nest or brood was found failed (not the date that you assume the failure occurred). Leave blank for pairs that did not fail.

Hatch Date: Actual or estimated hatch date. Hatch date is left blank if a nest is not confirmed to have hatched. For example, an egg is pipped but subsequent visits never confirm a brood.

Hatch Date Method: Method used to determine hatch date. Consider what data are available for each nest, as each method has strengths and weaknesses. Select the one that yields the most accurate hatch date from the following list (note: the methods are listed from most to least accurate).

Actual: The surveyor observes newly hatched chicks (e.g., still wet) in the scrape. Visible chicks in the process of hatching (the eggshell in at least two separate pieces) are also considered actual.

Pipped eggs: Pipped eggs are not considered hatched. A pip is the hole the chick creates when it initially breaks through the eggshell. Hairline fractures called “starring” precede pipping but are not pipping. If the nest survives and hatches, the hatch date is one day after pipping. For example, if a nest was found pipping on May 1 and the brood was found on May 5, the hatch date would be May 2.

Chick ageing: The physical size and appearance of chicks is used to estimate their age which, in turn, is used to estimate hatch date when the surveyor was not present on the actual hatch date, or when pairs were first detected during the brooding rearing stage. If chick ageing is used to determine the hatch date, you must enter the estimated chick age and some information about the chick’s appearance in the visit’s Comments field.

Egg floating: Estimated hatch date based on angle and height above surface of one or more floated eggs. Include these values in the Comments field. When choosing to use this method, consider if it is worth the risk that comes with handling eggs.

Median date: The median (middle) date between the last visit when the nest was unhatched and the first visit when the nest was found hatched. If there is an even number of days between visits, use the earlier of the two days to minimize missing the fledging window for banding purposes. For example, you saw the nest with three eggs on May 1. You visit again on May 8 and find no eggs but an adult has food in its bill, suggesting that the nest has hatched. There are six days between May 1 and May 8, so using the median hatch date method, the hatch date is May 4.

Incubation initiation date: The date that the second egg was laid plus 26 days. Twenty-six days is the mean incubation period; incubation usually starts when the second egg is laid. Incubation period is usually 24-28 days. If the nest was monitored closely early during laying but you weren’t able to visit for a week or more after hatching, this method can be better than median date.

Estimated Fledge Date: The hatch date plus 35 days. This is the approximate date that the chicks in the brood will be 35 days old and thus fledged (e.g., a brood hatched on May 1 will be fledged on June 5). Enter a date for all nests that hatched at least one egg, even if the brood failed.

Total Eggs: The total number of eggs laid in a clutch, based on observations across all visits. Note that in some cases the known number of eggs laid may exceed the number seen on any single day. This will include viable and non-viable eggs. Leave blank for breeding unconfirmed pairs and use “99” (unknown) when the total number of eggs cannot be determined (e.g., the reproductive effort was found in the brood stage, additional eggs could have been laid between the last visit and when the nest was found failed).

Total Chicks: The total number of chicks that hatched from a nest, based on observations across all visits. Note that in some cases the known number of chicks hatched may exceed the number seen on any single day. For breeding unconfirmed pairs, leave blank. Enter 0 for pairs whose nests failed in the incubation stage. Enter “99” (unknown) when the total number of chicks cannot be determined (e.g., a reproductive effort found as a one-chick brood, a nest found with one hatched chick and two pipped eggs and more than one chick was never seen afterwards). For nests with the Outcome “failed unknown stage,” enter “99” (unknown). Enter “88” (inferred) for cases where chicks were never seen, but were inferred instead. Note that unknown indicates that either there were an unknown number of chicks or it is unknown if there were chicks at all.

Total Fledged: The total number of chicks that fledged from a nest, based on observations across all visits. Note that in some cases the known number of fledglings may exceed the number reported on any single day. Chicks are considered fledged at 35 days post-hatch date; by convention, the entire brood is considered fledged on the Estimated Fledge Date. Enter 0 for pairs with no brood and use “99” (unknown) if fledging could not be determined (i.e., no visits were made when the chicks would have been 35 days of age or older). Enter “88” (inferred) for cases where fledglings were never seen, but inferred instead. If the reproductive effort’s Outcome is “fledged,” the value for total fledged must be at least 1 or “88” (inferred).

Outcome: The overall outcome of reproductive effort for each Pair/Nest ID (e.g., pair, nest, or brood). In some cases, the surveyor may not be able to determine if the nest was lost before or after hatching. For example, one egg is pipped and one is starred and on the next visit the eggs are gone, no chicks are seen, and the adults exhibit no behaviors associated with chicks. There is no way to tell if at least one of the eggs hatched or not, so this reproductive effort would have failed in an unknown stage. Remember, an egg is not hatched until the chick is out of the shell. Thus, an egg that has pipped is not hatched yet. Select one of the following:

No nest detected: A nest or chicks were never found (i.e., an unconfirmed breeding pair throughout the productivity monitoring window).

Nest failed: The nest failed before hatching (all eggs gone/non-viable).

Brood lost: The entire brood failed before fledging (all chicks gone/dead).

Failed unknown stage: The entire reproductive effort is lost, but it is not known if it failed before or after at least one chick hatched.

Fledged: At least one of the chicks in the brood fledged.

Unknown: The reproductive outcome is unknown (the nest or brood was never deemed either failed or fledged).

Comments: Any relevant information that would help to explain the Pair/Nest-level data recorded or other observations of interest to the surveyor. Note: ensure that comments relating to specific visits are entered in the Comments field of the Visits tab.

Coordinate System: Name or EPSG code of the coordinate reference system used when recording GPS coordinates, such as WGS 1984 (preferred) or EPSG 4326, and UTM Zone 18S or EPSG 32618.

X Coordinate: Longitude or easting of each Pair/Nest ID recorded by GPS. If a nest attempt was observed, record coordinates specific to the nest. When a nest was never observed, and only a pair or brood was observed, record the coordinates based on the area in which they appear to spend the most time.

Y Coordinate: Latitude or northing of each Pair/Nest ID recorded by GPS. If a nest attempt was observed, record coordinates specific to the nest. When a nest was never observed, and only a pair or brood was observed, record the coordinates based on the area in which they appear to spend the most time.

Table 3. Description of each Pair/Nest-level field (see above and “Metadata_PairNest” tab in Excel), with the valid format, domain categories (see “domains” tab) and if the field is required for each breeding stage (Yes = all stages). Data are entered in the “DataEntry_PairNest” tab.

Field	Description	Valid Format	Domains	Required?
Site Code	A 3-8 letter code unique to the site. For convenience, codes may use a common prefix to group sites together.	Free text, 3-8 letters	None	Yes
Pair/Nest ID	Unique identifier for each pair that incorporates a two-digit unique value for the pair and a single letter representing the pair’s nest attempt to facilitate tracking multiple nest attempts by the same pair (or trio) over multiple visits.	Free text, 2-digit pair number followed by capitalized nest attempt letter (X = no nest, A = first nest, B = second nest, etc.)	None	Yes
Adult 1 Bands	The band code of one member of the pair. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, or enter band code	Yes
Adult 2 Bands	The band code of another member of the pair. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, or enter band code	Yes
Replacement Pair Member Bands	The bands of the third banded individual in cases where one member of the pair acquires a new mate. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, or enter band code	Yes
Adult 3 Bands (trio)	The band code of a third banded individual in cases where the “pair” is a cooperative trio. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, or enter band code	Yes
Chick 1 Bands	The band code of the first chick. Use UNB if the chick is unbanded.	Free text, up to 255 characters	UNB, or enter band code	Yes, Brood only

Field	Description	Valid Format	Domains	Required?
Chick 2 Bands	The band code of the second chick. Use UNB if the chick is unbanded.	Free text, up to 255 characters	UNB, or enter band code	Yes, Brood only
Chick 3 Bands	The band code of the third chick. Use UNB if the chick is unbanded.	Free text, up to 255 characters	UNB, or enter band code	Yes, Brood only
Habitat Type	Dominant habitat type within a 5-meter radius of the nest.	Free text, up to 255 characters	Select one: Dredged sand dome; Dune system; Jetty, groin, or revetment; Marsh; Non-island dredge deposit; Non-ocean beach; Ocean beach; Overwash fan; Parking lot; Rooftop; Sand spit; Sandbar, Shell rake; Other; Nest not found	Yes, Nest and Brood only
Substrate Type	Dominant substrate type within a 0.5-meter radius of the nest.	Free text, up to 255 characters	Select one: Sand; Shell; Vegetation; Wrack; Sand-shell mix; Sand-veg mix; Sand-wrack mix; Rocks/gravel/cobble; Pavement/cement; Other; Nest not found	Yes, Nest and Brood only
Date Found	The date the nest (or brood, if the nest went undetected) was found.	Date, yyyy-mm-dd	None	Yes, Nest and Brood only
Date Found Failed	The date that the nest or brood was found failed (not the date that you assume the failure actually occurred). Leave blank for pairs that did not fail.	Date, yyyy-mm-dd	None	Yes, Nest and Brood, if failed
Hatch Date	Actual or estimated hatch date.	Date, yyyy-mm-dd	None	Yes, Brood only
Hatch Date Method	The primary method used to determine hatch date. Leave blank if the nest did not hatch.	Free text, up to 255 characters	Select one: Actual, Pipped eggs, Chick ageing, Egg floating, Median date, Incubation initiation date	Yes, Brood only
Estimated Fledge Date	The hatch date plus 35 days. Enter a date for all nests that hatched at least one egg.	Date, yyyy-mm-dd	None	Yes, Brood only
Total Eggs	The total number of eggs laid in a nest, based on observations across all visits. Leave blank for breeding unconfirmed pairs.	Integer, 99 = unknown	Select one: 0, 1, 2, 3, 4, 5, 6, 99	Yes, Nest and Brood only

Field	Description	Valid Format	Domains	Required?
Total Chicks	The total number of chicks that hatched from a nest, based on observations across all visits. Leave blank for breeding unconfirmed pairs.	Integer, 99 = unknown, 88 = inferred	Select one: 0, 1, 2, 3, 4, 5, 6, 88, 99	Yes, Nest and Brood only
Total Fledged	The total number of chicks that fledged from a nest, based on observations across all visits. Leave blank for breeding unconfirmed pairs.	Integer, 99 = unknown, 88 = inferred	Select one: 0, 1, 2, 3, 4, 5, 6, 88, 99	Yes, Nest and Brood only
Outcome	The overall outcome of reproductive effort for each Pair/Nest ID.	Free text, up to 255 characters	Select one: No nest detected, Nest failed, Brood lost, Failed unknown stage, Fledged, Unknown	Yes
Comments	Any relevant information that would help to explain the Pair/Nest-level data recorded or other observations of interest to the surveyor.	Free text, up to 255 characters	None	No
Coordinate System	Name or EPSG code of the coordinate reference system used when recording X and Y coordinates (e.g., WGS 84, UTM Zone 18S, EPSG 4326, EPSG 32618).	Free text, up to 255 characters	None	Yes
X Coordinate	Longitude or easting of each Pair/Nest ID recorded by GPS.	Number, up to 6 digits	None	Yes
Y Coordinate	Latitude or northing of each Pair/Nest ID recorded by GPS.	Number, up to 6 digits	None	Yes

Collecting Visit Data

The status of each reproductive effort is recorded during repeated visits to the pair, nest, or brood during the productivity survey window. As with the Pair/Nest-level fields, which fields require data is based on the breeding stage of each pair. Breeding unconfirmed pairs (pairs without nests or chicks whose Pair/Nest ID ends in an X) are checked and their presence (or absence) is recorded until the end of the breeding season. For breeding confirmed pairs (pairs with nests or chicks whose Pair/Nest ID ends in A, B, etc.), their presence and nest or and brood information is collected. For nests, this includes whether the nest is within a closed area and the number of eggs. For broods, this includes the number of chicks observed or if adult behavior leads the surveyor to infer chicks. For both nests and broods, information about failure is recorded, if/when it happens.

Recording Pair Presence

Pair presence should be recorded throughout the productivity survey window. Pairs whose chicks have fledged should be visited and recorded for at least 15 days after the fledge date. Afterwards, monitoring can cease, though additional visits sometimes yield surprising discoveries—in 2022, a pair in Texas became the first AMOY known to have raised a second brood when after fledging a banded chick they fledged another chick from a second nest. Pairs that have failed should be monitored until they cease to show signs consistent with breeding unconfirmed status. At some sites, pairs may remain on territory into the fall, while at others they may disperse relatively quickly. Some pairs will hold a territory all season with no nest found, but these, too, will cease to show breeding behaviors over time.

There is no field for recording presence or number of scrapes on a pair's territory, but surveyors can use the Visit tab's Comments field to record the presence or absence of scrapes. Scrapes precede each nesting attempt and can indicate that a pair has lost a nest or brood and is preparing to renest. Noting "hot scrapes" (well-tended, well-formed scrapes that look ready for an egg) can also assist in nest searching during future visits.

Recording Nest/Brood Contents

For each visit to a pair with a nest or brood, the surveyor records the number of eggs and chicks *actually observed* on that visit. Numbers should not be estimated or assumed. During the chick-rearing stage, unknown should only be used when the surveyor did not see any chicks and could not infer chicks from adult behavior, but was not confident that the brood had been lost.

Inferring Chick Presence

AMOY are especially adept at hiding their chicks from observers, especially in habitats that provide a lot of cover like marshes. They are also able to learn to recognize surveyors and some individuals will learn to respond at a greater and greater distance when approached, using vocalizations to cue the chicks to hide, which makes productivity monitoring difficult. To address this, the protocol allows surveyors to infer the presence of chicks from reliable adult behavioral cues if chicks are not seen directly.

To avoid disturbing AMOY for long periods of time while searching for chicks, surveyors should become familiar with each pair's behavior—some are more reactive than others—and observe them closely for behavioral cues from which the presence of chicks can be inferred. Behaviors are an adult observed with food, a three-note chick call, open shellfish on the territory, or other

adult behaviors described below. When selecting the general “adult behavior” option, surveyors must describe the behavior in that visit’s Comments field because the behavioral cues may be specific to that pair, and these notes may be helpful to other observers.

When cueing their chicks to hide, AMOY will use a rapid, [three-note alarm call](#) which they rarely use except when alerting a chick (also referred to as chick calls). Unless the surveyor knows the pair is still in the nest stage or has other knowledge specific to the pair or individual, this vocalization can be used to infer the presence of a chick. AMOY feed their unfledged chicks on their territories, either by opening shellfish in the area or bringing the fleshy part of previously opened shellfish to the territory. Therefore, finding freshly opened shells (e.g., mussels, clams) on the territory or seeing an adult returning with food in its bill is also a reliable indicator that chicks are present. When using opened shells, it is important to determine if there are new shells from the previous visit. Adults can display a range of other behaviors when attempting to distract a perceived threat (the surveyor) away from their broods. These usually involve some form of circular or back-and-forth distraction motion, including running or walking back and forth, running down the beach to “lead” the threat away, pacing back and forth on the territory, **false brooding**, and flying in rapid circles. These activities can be accompanied by piping calls or three-note alarm calls and a general frantic or highly agitated behavior, but pairs and individuals may also be silent and choose instead to skulk at a distance without such displays. Finally, if a pair can be observed from a distance, they will often appear alert or vigilant, such as a pair standing upright in a patch of grass and looking around when previously their normal preferred loafing area had been at the shoreline. If potential avian predators such as gulls are nearby, the adults may be seen flying at or otherwise attacking them as they defend unseen chicks. Be aware that some pairs are less reactive and more nonchalant than others, and some may not respond unless the surveyor is near to their brood. Therefore, one visit with no response may mean that the surveyor was not close enough to elicit a response. Conversely, if a pair has lost its brood, they will often be seen “sulking” by sitting or standing together on the shore and being generally less responsive to intruders.

While the three-note chick call, open shellfish, and adults with food items in their bills are fairly straightforward to see and interpret, other behaviors are less so. Therefore, pay attention to pairs’ “personalities” (especially level of reactivity) and patterns of response throughout the season. Sometimes, an adult or a pair is just responding to the surveyor’s presence and not alerting a chick, and conversely some adults or pairs respond more subtly, or their chicks are not close enough to elicit an obvious response. If in doubt, keep in mind that Unknown is an option, and include clear notes in the Comments field to aid interpretation of behaviors on future visits. Discussions with other people who have monitored AMOY, including on the Working Group list-serv, may also be helpful.

Finally, both chicks and fledglings can be inferred—there is no age cut-off beyond which it’s not possible to infer—but once chicks are able to fly, they tend to hide less and become more visible and adults are usually less agitated.

Determining Nest/Brood Status

For pairs that are breeding unconfirmed, a nest/brood status is not entered. Pairs that have eggs only are **incubating**; pairs that have one or more chicks are **hatched**; pairs that have one or more fledglings (chicks ≥ 35 days old) are **fledged**. Note that literal incubation (the adults regularly sitting on the eggs) often does not begin until the clutch has at least two eggs; however, even if

the pair has a single egg they are not incubating, its status is still incubating to indicate that a clutch has been initiated. When a nest or brood is discovered to have failed, the status on that date is **failed**. Visits to the pair will continue, but after the visit on which the failure was discovered and before the next reproductive attempt is found, the nest/brood status is left blank.

On some visits, the surveyor will not be able to determine if the brood is still active and the status will be **unknown**. There may also be cases where the nest's condition could not be ascertained (e.g., uncertainty if an egg is viable), and the status would be unknown in that case as well. Entering "unknown" encourages further investigation on the next visit, and it's a good idea to use the Comments field to describe what you saw or why you are uncertain. On the visit that chick(s) are seen at 35 days of age or older, the pair's status is **fledged**. Continue to enter fledged if the chicks are seen or inferred on subsequent visits, and unknown or failed if the presence of fledged chicks is uncertain during a visit or they are found dead. Although a pair's reproductive effort will still be considered fledged because they survived to 35 days, it is useful to capture as much information as possible with visits beyond the 35-day period.

Cause of Nest or Brood Failure

When all eggs or all chicks have been lost from a reproductive effort, the nest or brood is considered to have **failed**. When a nest or brood fails, the cause of the failure, whether observed directly or suspected, is recorded in the Cause of Nest/Brood Failure fields. In some cases, one egg or one chick will be lost at a time (e.g., a nest that previously had a three-egg nest is visited and found to only have two eggs in it). Details of these partial loss events should be noted in the Comments field for each relevant visit, but the Cause of Nest/Brood Failure field should only be entered if/when the entire reproductive effort fails.

Failure events are not often observed directly (e.g., seen by the surveyor's own eyes, by a trail camera, or with evidence that can only indicate one cause). This often leaves surveyors to infer the cause of failure from supporting evidence. Therefore, it is important to differentiate when surveyors have high or low confidence in the cause of failure. Frequent surveys or trail cameras often result in increased confidence of the cause of failure.

To accurately record the causes of failure, surveyors first decide whether the cause of failure was directly observed or not. A **directly observed cause of failure** is one that the surveyor saw in person while on a visit or using photos or video from a trail camera or has direct and certain evidence with no other explanation (e.g., the pair's chick found dead in a tire track, or the clutch found washed out of the nest and nonviable after a storm). Reporting a directly observed cause of failure indicates very high confidence in accuracy. In contrast, if a cause of failure is not observed directly, a surveyor may indicate a suspected cause of failure, as long as there is some supporting evidence. A not directly observed cause of failure is one for which the surveyor has reasonable supporting evidence that points to a specific cause of failure. For example, a surveyor may reasonably suspect depredation by crows if crows were observed harassing the pair the day before the nest failed (this example also requires frequent visits). Crows generally being present at the site is not sufficient as supporting evidence for a suspected cause of failure. Another example of a suspected cause of failure is the wrack line found higher than the nest, because it's possible the eggs were depredated before the overwash event. In this example, if an egg was also found washed out in the marsh behind the nest, then flooding/overwash would be a directly observed cause of failure. When there is no evidence or insufficient evidence to record a directly

observed or suspected cause of failure, the cause of failure is **unknown** (and cause of failure is not directly observed).

The cause of failure is the reason that the *last* egg or chick was lost. For example, a pair may be incubating a two-egg nest when a crow grabs one egg from them. They continue to incubate the remaining egg until it is washed out by a high tide. The cause of failure will be flooding/overwash and the crow predation will be noted in the comments.

Examples of causes of failure, either observed directly or suspected, are provided below to help surveyors make more accurate assessments. Surveyors should record any evidence used to make a determination in the Nest/Brood Failure Comments field and, when applicable, provide detail on the species of predator suspected or known to have caused the failure. Even in cases where the cause is unknown, comments can provide site managers and other decision makers with valuable context.

Depredation:

Directly observed: Yes; Cause: Depredation The surveyor observes a predator (e.g., mammalian, avian, reptilian, or crustacean) take an egg or chick, or pecked, broken eggshell(s) being found in or near the nest with a yolk in the nest, or yolk in the nest.

Directly observed: No; Cause: Depredation The surveyor observes predator tracks leading up to or in the vicinity of the nest or adults or chicks seen being harassed by a predator the day before the nest/brood fails.

Directly observed: No; Cause Unknown A chick carcass found in a ghost crab hole, harassment by a predator days or weeks before failure, or a flock of immature gulls loafing at a site should be considered an unknown cause of failure and should be recorded in the Comments field.

Flooding/overwash:

Directly observed: Yes; Cause: Flooding/overwash The surveyor finds the clutch non-viable in the wrack line behind a scrape that shows signs of recent inundation, or submerged by water or sand near the nest location.

Directly observed: No; Cause: Flooding/overwash The surveyor observes that a nest above the mean high-water line has disappeared (the scrape has been obliterated) and a fresh wrack line is landward of the nest's previous location (note that although it's clear that the scrape has overwashed, the eggs could have been depredated prior to the flooding).

Directly observed: No; Cause Unknown If the high tide line or storm tide line does not extend above the nest's location, then the cause of failure is unknown.

Human Activity: For a nest to fail due to human activity, the activity itself must harm the eggs or chicks. If human activity results in abandonment, the cause of failure will be "Abandonment – human activity," as described below.

Directly observed: Yes; Cause: Human activity The surveyor or trail camera observes a trespasser removing eggs from a nest, a chick is found dead in a tire track, or the surveyor observes beachgoers flush an adult off its nest and a crow immediately fly in and peck the eggs.

Directly observed: No; Cause: Human activity Beachgoers are seen trespassing into a posted area in proximity to the nest and displacing the adults for hours. On the next visit the eggs are gone.

Directly observed: No; Cause Unknown The surveyor observes crowds of people visiting the beach on a holiday weekend and a nest or brood disappears over that same weekend.

Abandonment: Abandonment is when eggs are left unattended in their nest so long that they are no longer viable. Common signs are the absence of adults over a period of days (often adults will not begin incubating until their clutch is complete, so be cautious in identifying abandonment when a nest is newly found), eggs being stone cold to the touch (the risks vs. benefits of touching eggs should be considered), or eggs being dewy. Abandonment is the exception to the rule, as it will always be a directly observed cause of failure (the eggs are intact in the nest, but the adults are absent). There are various causes of abandonment, such as human disturbance or harassment by predators, and it is important to differentiate these for management, so there are three types of abandonment.

Directly observed: Yes; Cause: **Abandonment – human activity** The abandonment follows observation of human or pet presence at or near the nest (e.g., a dog running in a posted area, campers near the nest, a capture/banding session).

Directly observed: Yes; Cause: **Abandonment – other** A non-anthropogenic event preceded the abandonment, such as an owl roosting nearby, a heat wave, etc. When this option is selected, describe what the “other” event is in the Nest/Brood Loss Comments field.

Directly observed: Yes; Cause: **Abandonment – unknown** There is no known precipitating event. Sometimes adults will continue to incubate long after the expected hatch date; in these cases, the eggs were or became non-viable at some point during incubation, so this is not considered abandonment because a pair can’t abandon non-viable eggs.

Failure to Hatch: There are cases where nests are incubated long after the expected hatch date (>35 days of incubation). Usually the adults eventually stop incubating the eggs, and it becomes apparent to the surveyor that the eggs are non-viable, either because they are cracked, too heavy, or too light. These eggs could have never been viable to start, or they could have become non-viable at some point for unobserved reasons. Failure to hatch is always directly observed, because the eggs remain but have not hatched.

Other: A cause of failure not included in the above options.

Directly observed: Yes; Cause: **Other** The surveyor observes the hatching chicks covered in ants, resulting in mortality, or finding eggs trampled by recognizable deer or horse tracks.

Directly observed: No; Cause: **Other** A tern colony surrounds the pair, engulfing its nest and during subsequent visits the nest has disappeared. A nest is located at the edge of a scarp that collapses, coinciding with the loss of the nest. A sea turtle or alligator crawl traverses the exact location where a nest had been located, and no egg remains are found.

Additional Situations Involving Failures

In some cases, when surveys are infrequent, a surveyor may discover that a pair has a new nest without finding the first nest has failed. For example, an “A” nest is recorded in early May. The surveyor does not return for two weeks and finds the pair with a “B” nest in a new location. In this case, enter both a visit for the “A” nest, in order to capture data related to its failure, and a visit for the new “B” nest on that same date. Conversely, if surveys are frequent, depredation may be detected during the egg-laying period. For example, the first egg is found, then depredated. The female could continue that same laying bout in the same scrape or a nearby

scrape. As long as the laying resumes within 1-4 days, the nest ID would remain the same. Depending on their data collection tool, sites may choose to capture (or not capture) the two sets of coordinates in different ways. It is important that the ID is consistent and the surveyor can continue to navigate to the active nest.

Finally, a nest may be discovered in a failed state. For example, a nest is located for the first time with yolky sand and/or broken egg shells in the scrape and no viable eggs. Clearly, there was one or more eggs present, but they are no longer viable. Create a record for the nest in the Pair/Nest tab and create a visit for the discovery of both the nest's existence and failure. Total number of eggs in its Pair/Nest record would be unknown.

Recording Bands

During visits, surveyors should make regular efforts to read and re-read bands, as band reading during visits is what is used to assign bands to each pair in the Pair/Nest tab. Frequently re-checking bands helps to ensure that bands of both adults and chicks are read correctly, that “divorces” or “adoptions” are detected, and that chicks are not double-counted or missed. At a minimum, surveyors should confirm adults' bands during each re-nesting attempt and chicks' bands should be confirmed whenever possible. If a pair's bands can't be read during a nesting attempt, that Pair/Nest ID should reflect the uncertainty, meaning one or both of the members' bands may be UNK, even though the bands were read during a previous or subsequent reproductive effort. In areas where pairs are nesting in close proximity to each other, bands should be read more often to confirm which birds are paired and which pairs belong to which nest or brood.

Surveyors should enter band codes in a consistent format, which will make submitting sightings to the AMOY Band Database easier; for example, using consistent abbreviations for band colors (e.g., BK = Black, DG = Dark Green). If a bird is unbanded, enter UNB. If the surveyor cannot determine if the bird is banded, enter UNK. It is also acceptable to enter partial band information, such as DG for a situation where the band color was seen, but the code couldn't be read.

Either during or at the end of the season, surveyors should review their Visit-level band sightings and ensure that they are consistent with the bands assigned to each nest attempt in the Pair/Nest tab. Errors in reading or assigning band codes can be corrected at that time but these errors and uncertainties can be captured in the Visit-level Comments field.

Unusual Situations

Surveyors may encounter unusual situations not covered by this protocol. In general, make detailed and specific comments and, if needed, consult with co-workers and/or others in the AMOY Working Group for advice. Here are a few examples that have been encountered during the development of this protocol.

Pairs seen incubating only: In some cases, you may be able to see that an adult is incubating but be unable to check the contents of a nest. You will enter “incubating” for that visit's Nest/Brood Status and enter “unknown” for the number of eggs. It is recommended to make a note in the Comments field as well.

Continued clutches: **Continued clutches** occur when eggs are lost during laying. The pair may continue laying in the same scrape or a new one nearby. As long as the clutch is continued within 1-4 days, regardless of it being in the same scrape or a new one, it would be considered the same nest and keep the same nest ID.

Adoption: **Adoption** occurs when a pair begins caring for a chick that is not their biological chick. This can only be detected if the chick and at least some of the adults involved are banded and there are robust observations establishing what pair the chick(s) belonged to in the first place. When assigning chicks to a pair, assign them to their biological parents, but include detailed notes in the visit's Comments field to explain the situation and which adults are actually caring for the chick(s).

Visit-Level Field Definitions

Site Code, and Pair/Nest ID: See [Pair/Nest-Level Field Definitions](#). These fields are required to link Pair/Nest-level fields to Visit-level fields.

Date: The date of visit.

Observer: The first and last name of the surveyor conducting the visit, or enter “trail camera.”

Pair Presence: Number of unconfirmed or confirmed breeding adults observed at each Pair/Nest ID during the visit. Select one of the following:

One: A single adult is observed at the Pair/Nest ID location during the visit.

Pair: Two adults are observed at the Pair/Nest ID location during the visit.

Trio: Three cooperative adults are observed at the Pair/Nest ID location during the visit.

None: No adults are observed at the Pair/Nest ID location during the visit.

Unknown: The surveyor did not attempt to locate or identify the adults at the Pair/Nest ID location during the visit or could not determine if the pair was present (e.g., multiple adults are present and the members of the pair can't be identified).

Closed Area: The nest location in relation to any closed areas posted with symbolic fencing or other signage to deter public access. Closed areas may change over multiple visits throughout the breeding season. Select one: yes or no.

Nest/Brood Status: The status of the nest or brood during the visit (not entered for breeding unconfirmed pairs because they do not yet have a nest or a brood). Select one of the following:

Incubating: At least one viable egg is in the nest, or an adult is observed incubating the nest from a distance (nest contents do not need to be observed directly, especially in cases when disturbance and/or creation of scent trails to the nest are being minimized). If the adults are not yet actually incubating because the clutch is not yet complete, status is still incubating.

Hatched: At least one egg in the nest is hatched. Chicks in the process of hatching beyond pipping (the eggshell is in at least two separate pieces) are considered hatched. A pipped egg is not considered hatched.

Fledged: At least one chick in the brood reached a minimum 35 days post-hatch date.

Failed: The nest or brood failed completely (no eggs or chicks).

Unknown: Nest or brood status is unknown.

Directly Observed Nest/Brood Failure: When a nest or brood is found failed, the cause of failure is either observed directly by the surveyor or trail camera or not. Select one of the following:

Yes: There is direct evidence of nest or brood failure seen by the surveyor or trail camera.

No: The surveyor or trail camera did not directly observe the cause of nest or brood failure.

Cause of Nest/Brood Failure: When a nest or brood is found failed, the cause of failure is identified, regardless of if the surveyor directly observed it or not. Select one of the following and record supporting evidence in the Nest/Brood Failure Comments field:

Depredation: Nest or brood was lost due to a predator (note the species or more general taxon in the Nest/Brood Failure Comments field).

Flooding/overwash: Nest or brood was washed away or submerged by water or sand.

Human activity: Nest or brood was destroyed by human activity. Being disturbed by human activity without resulting mortality does not apply.

Abandonment – human activity: Due to human activity, the nest was left untended for so long that the eggs became non-viable.

Abandonment – other: Due to some other known cause, the nest was left untended for so long that the eggs became non-viable. Note the cause in the Nest/Brood Failure Comments field.

Abandonment – unknown: The nest was left untended for so long that the eggs became non-viable with no cause identifiable.

Failure to Hatch: The eggs did not hatch after >35 days of incubation while the adults continued to care for them.

Other: Nest or brood was lost to other causes (e.g., trampling by deer or horse, being overrun by a tern colony, etc.). Describe in Nest/Brood Failure Comments field.

Unknown: No observable evidence to suggest a cause of nest or brood failure.

Nest/Brood Failure Comments: Any observations related to nest or brood failure during the visit, such as descriptions of evidence to support your conclusion or the known or suspected predator species responsible for the failure.

Number of Viable Eggs: Number of apparently viable eggs observed during the visit. Non-viable eggs are recorded separately. If the nest was not approached, and the adult was just observed in an incubating posture, enter unknown and enter “Incubating” in the Nest/Brood Status field.

Number of Non-viable Eggs: Number of *obviously* non-viable eggs observed during the visit. If the surveyor is unsure if the egg is viable or not, they should consider it viable. Non-viable eggs are cracked or otherwise opened unnaturally (pecked, bitten, crushed); eggs that contain an obviously dead chick or embryo; eggs that have been abandoned; and eggs that have failed to

hatch. Signs of being non-viable without the shell being compromised include eggs being extremely lightweight, smelling rotten, or being cold and dewy. If you find a nest with eggshell fragments only, or any amount of shell estimated to be less than 50% of an unhatched egg, the number of eggs is 0. Also, do not count successfully hatched eggshells that remain in the area as non-viable. Note specific attributes of the non-viable eggs in the Comments field (e.g., “one egg with hole pecked in it,” “one egg out of scrape, cold, and with sand caked on it”).

Number of Young: Number of live young (chicks or fledglings) observed during the visit, or if there is evidence to infer one or more chicks or fledglings is present. Also note if you saw one or more of the young fly in the Comments field, as the age when they become truly flight capable is of interest to site managers. If presence is inferred, enter “88” (inferred), and if no determination can be made regarding chick presence or loss, enter “99” (unknown). Note that this field encompasses both chicks (under 35 days), and fledglings, (35 days or older). Some sites may want to collect counts of chicks and fledglings separately, which can be done by adding fields to their specific data collection, but this field is a total of all the pair’s known offspring, both chicks and fledglings.

Evidence for Young: The type(s) of parental behavior or other signs from which you inferred a chick or fledgling was present. Entered only when the Number of Young field is inferred (as opposed to chicks being observed directly). If multiple types of evidence are observed, pick the type that comes first on the list below and mention the other type(s) in the Comments field.

Adult observed with food: Parent seen on territory with food item in its bill.

Three-note chick call: Distinctive rapid, three-note alarm call uttered by adults and rarely used for any purpose other than to alert chicks to danger (listen here: <https://macaulaylibrary.org/asset/167935111>).

Open shellfish on territory: Freshly opened bivalve shells found on the pair’s territory, with observed new shells between visits to distinguish recent feeding activity from older shells.

Adult behavior: A variety of other behaviors can indicate the presence of a chick or fledgling. These include *distraction responses* (such as piping, flying in circles, false brooding, running or walking back and forth) that range in how frantic the adults appear to be; *vigilance* (adults are alert and directing their attention in a focused manner); and *attacking predators* (flying at, pecking, etc., especially other birds). When “adult behavior” is selected as Evidence for Young, describe the behavior in the visit’s Comments field.

Number of Dead Young: Number of dead young (chicks or fledglings) observed during the visit. If no dead young are observed, enter 0, not unknown. It is helpful to add notes in the Comments field and/or take photos to help determine the cause of death.

Adult 1 Bands: The band code of one member of the pair. Use UNB if the adult is unbanded and UNK if it was not seen if the bird is banded. If the band was seen, enter the band color and code directly in whatever shorthand is comfortable. Recording partial band reads, such as band color only or partial codes (i.e., “Dark Green C__ Triangle” or “DG”), is acceptable.

Adult 2 Bands: The band code of another member of the pair. See **Adult 1 Bands** above for data entry.

Replacement Pair Member Bands: The bands of a third banded individual when one member of the pair acquires an additional mate. See **Adult 1 Bands** above for data entry.

Adult 3 Bands (trio): The band code of a third banded individual in cases where the “pair” is a cooperative **trio**. See **Adult 1 Bands** above for data entry.

Chick 1 Bands: The band code of the first chick. Use UNB if the chick is unbanded and UNK if it is unknown if the chick is banded. If the band was seen, enter the band color and code directly (partial band reads, such as color only, are allowed).

Chick 2 Bands: The band code of the second chick. See **Chick 1 Bands** above for data entry.

Chick 3 Bands: The band code of the third chick. See **Chick 1 Bands** above for data entry.

Comments: Any relevant information that would help to explain the Visit-level data recorded or other observations of interest.

Table 4. Description of each Visit-level field (see above and “Metadata_Visits” tab), with the valid format, domain categories (see “domains” tab) and if the field is required. Data are entered into the “DataEntry_Visits” tab.

Field	Description	Valid Format	Domains	Required?
Site Code	A 3-8 letter code unique to the site. For convenience, codes may use a common prefix to group sites together.	Free text, 3-8 letters	None	Yes
Pair/Nest ID	Unique identifier for each pair that incorporates a two-digit unique value for the pair and a single letter representing that nest attempt.	Free text, 2-digit pair number followed by capitalized nest attempt letter (X = no nest, A = first nest, B = second nest, etc.)	None	Yes
Date	The date of the visit.	Date, yyyy-mm-dd	None	Yes
Observer	The surveyor’s first and last name, or enter “trail camera.”	Free text, up to 255 characters	None	Yes
Pair Presence	Number of unconfirmed or confirmed breeding adults observed at each Pair/Nest ID during the visit.	Free text, up to 255 characters	Select one: One, Pair, Trio, None, Unknown	Yes
Closed Area	The nest location in relation to any closed areas posted with symbolic fencing or other signage to deter public access.	Free text, up to 255 characters	Select one: Yes, No	Yes, Nest only
Nest/Brood Status	The status of the nest or brood during the visit.	Free text, up to 255 characters	Select one: Incubating, Hatched, Fledged, Failed, Unknown	Yes, Nest and Brood only
Directly Observed Cause of Nest/Brood Failure	When a nest or brood is found failed, the cause of failure is either observed directly by the surveyor or trail camera or not.	Free text, up to 255 characters	Select one: Yes, No	Yes, Nest and Brood only, on date found failed
Cause of Nest/Brood Failure	When a nest or brood is found failed, the cause of failure is identified, regardless of if the surveyor directly observed it or not.	Free text, up to 255 characters	Select one: Depredation, Flooding/overwash, Human activity, Abandonment - human activity, Abandonment - other, Abandonment - unknown, Failure to hatch, Other, Unknown	Yes, Nest and Brood only, on date found failed

Field	Description	Valid Format	Domains	Required?
Nest/Brood Failure Comments	Any observations related to the failure of nest or brood during the visit, such as direct or supporting evidence.	Free text, up to 255 characters	None	No
Number of Viable Eggs	Number of apparently viable eggs observed during the visit.	Integer, 99 = unknown	Select one: 0, 1, 2, 3, 4, 5, 6, 99	Yes, Nest only
Number of Non-viable Eggs	Number of <i>obviously</i> non-viable eggs observed during the visit.	Integer, 99 = unknown	Select one: 0, 1, 2, 3, 4, 5, 6, 99	Yes, Nest only
Number of Young	Number of live offspring (chicks and fledglings) observed during the visit.	Integer, 99 = unknown if young are present, 88 = young are inferred to be present	Select one: 0, 1, 2, 3, 4, 5, 6, 88, 99	Yes, Brood only
Evidence for Young	The type of parental behavior or other signs from which you inferred a chick or fledgling was present during the visit. Entered only when the Number of Young field = 88.	Free text, up to 255 characters	Select one: Adult observed with food, Three-note chick call, Open shellfish on territory, Adult behavior	Yes, when Number of Young = 88
Number of Dead Young	Number of dead young (chicks or fledglings) observed during the visit.	Integer	Select one: 0, 1, 2, 3, 4, 5, 6	Yes, Brood only
Adult 1 Bands	The band code of one member of the pair. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No
Adult 2 Bands	The band code of another member of the pair. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No
Adult 3 Bands	The band code of a third banded individual in cases where the “pair” is a cooperative trio. Use UNB if the adult is unbanded and UNK if it was not determined if the adult was banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No
Chick 1 Bands	The band code of the first chick. Use UNB if the chick is unbanded and UNK if it was not seen if the chick is banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No

Field	Description	Valid Format	Domains	Required?
Chick 2 Bands	The band code of the second chick. Use UNB if the chick is unbanded and UNK if it was not seen if the chick is banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No
Chick 3 Bands	The band code of the third chick. Use UNB if the chick is unbanded and UNK if it was not seen if the chick is banded. Partial band reads, such as color only, are allowed.	Free text, up to 255 characters	UNB, UNK, enter band code	No
Comments	Any relevant information that would help to explain the Visit-level data recorded or other observations of interest.	Free text, up to 255 characters	None	No

Chapter 4 – Data Management

As of March 2026, a database has not yet been developed. The AMOYWG envisions a productivity database that is user friendly, easily queried, and straightforward to access and upload data. Until a database exists, data will be gathered by participants using their preferred method, which requires surveyors to conduct their own quality assurance (minimizing data errors during data collection) and quality control (fixing data errors after collecting and entering data) and to format their final output to match the Excel import template.

Data Collection

There are multiple methods for recording data in the field following this protocol. Surveyors can use paper datasheets or field notebooks that are entered into an Excel spreadsheet once back in the office; a digital data collection app such as Survey123, Field Maps, or NestStory; or a combination of methods. To minimize data entry errors, a digital data collection app is recommended but not required. Whatever the data collection method, thorough and detailed training is needed for technicians and anyone else using this protocol.

This protocol does not limit or restrict the collection of additional data that is important to the site's management. Additional fields can be incorporated into any app or data sheet.

Excel Import Template and Other Resources

The import template is an Excel file consisting of metadata and a data entry tab that corresponds to Tables 1-4 in this protocol. The Excel template and this protocol, along with any training resources, field “cheat sheets,” or data quality checklists that are developed will be available on the [AMOYWG website](#).

Data Sharing

As part of database development, a data sharing agreement will be drafted with input from all interested AMOYWG partners. Sites using this protocol are encouraged to share their finalized Excel import template with the productivity points of contact after each breeding season, to maintain records for the future database.

Glossary

Breeding season: Encompasses the three reproductive stages, beginning with territory establishment, followed by the incubation stage and ending when the brood-rearing stage is complete.

Brood: A set of chicks hatched from the same nest and belonging to one pair.

Brood-rearing stage: Begins when chicks hatch and continues until young have fledged.

Clutch: The group of eggs in one nest attempt. A clutch is complete when the female has finished laying eggs. Typical AMOY clutches are 2-3 eggs.

Confirmed breeding pair: A confirmed breeding pair is a pair for which eggs or chicks are found.

False incubating/False brooding: A type of distraction display in which an adult pretends to brood or incubate by crouching down in a location where there are no eggs or chicks.

Fledged: Chicks are considered fledged at 35 days post-hatch. They may become physically capable of flight sooner or later (usually not before 30 days and sometimes after 40 days).

Habitat type: Dominant habitat type within a 5-meter radius of the nest. Habitat types are: Dredged sand dome; Dune system; Jetty, groin, or revetment; Marsh; Non-island dredge deposit; Non-ocean beach; Ocean beach; Overwash fan; Parking lot; Rooftop; Sand spit; Sandbar; Shell rake; Other; Nest not found.

Hatch window: The period of time 24–30 days after incubation begins when a nest is expected to hatch. Nests that are lost during the hatch window without evidence for or against hatching will have the Outcome “Failed unknown stage.”

Hatched: Chicks in the process of hatching beyond pipping (the eggshell is in at least two separate pieces) are considered hatched. Pipped eggs are not considered hatched. A chick that has separated its eggshell into halves but is still lying between the pieces, is hatched.

Incubation stage: Begins with the commencement of egg-laying.

Landscape type: The dominant type of large-scale landform the site consists of which can be a Barrier island; Natural non-barrier island; Marsh system; Dredged-material island; Non-dredge artificial island; Mainland shoreline; Built environment.

Nest: A scrape that has eggs laid in it.

Non-breeding: A bird that does not have eggs or chicks and does not exhibit breeding behaviors.

Opportunistic observation: An observation of a pair, nest, or brood outside of a regularly scheduled survey that does not include surveying the entire site. This is considered a visit to the pair, nest or brood (survey effort is opportunistic observation). For example, someone is called out to fix a posting and when there, they see that a nest has hatched.

Pair: Two adults that associate with each other for the purpose of reproducing. May be breeding confirmed (documented with eggs, chicks, or fledglings) or breeding unconfirmed (exhibit behaviors consistent with breeding, but no eggs, chicks, or fledglings documented).

Piping Display: Two or more birds displaying while running parallel with heads bobbing up and down and giving piping calls. The piping display is used in intra-specific interactions with neighboring pairs (common early in the breeding season), in courtship, and greeting.

Pipped: An egg is pipped when the chick has created a small hole as it initially breaks through the eggshell. Hairline fractures called “starring” precede pipping but are not pipping.

Post-fledging stage: The stage during which the fledge(s) continue to associate with the parents.

Productivity survey window: The period of time during which data is collected for this protocol. The start of the productivity survey window begins 15 days before the typical first nest date based on a 5-year average of the first nest detected at a site. If a site has not had previous monitoring to determine it’s the first nest date, consult with neighboring survey coordinators or the AMOYWG. This window is defined only for this protocol (e.g., not for conducting management or other reconnaissance activities). The conclusion of the productivity survey window is at least 15 days after the last chick has fledged (if the final reproductive effort was a successfully fledged brood) or 15 days after the last nest has failed (if the final reproductive effort was a failed nest). Some sites may choose to monitor before or after these 15 days in the beginning or end of the breeding season.

Scrape: A shallow depression created by the adults through a process known as scraping. A scrape becomes a nest when eggs are laid in it.

Site: A geographically logical area that encompasses all suitable breeding habitat that will be monitored during the breeding season, even if no nesting birds ultimately occur there. Sites are established prior to the start of the breeding season, have generally consistent boundaries within and across years, usually contain a single landscape type, are usually surveyed within a single workday visit.

Starred: An egg is starred when hairline fractures are visible on the outer surface in a spiderweb shape. Starring occurs as the chick begins to break through the eggshell and precedes pipping but is not pipping.

Substrate type: The type of material found on the ground within a 0.5-meter radius of the nest location. Substrate types are: Sand; Shell; Vegetation; Wrack; Sand-shell mix; Sand-veg mix; Sand-wrack mix; Rocks/gravel/cobble; Pavement/cement; Other; Nest not found.

Survey effort: The percent of suitable habitat at a site surveyed during a survey.

Territory establishment: Typically indicated by the onset of piping displays, although in areas with resident populations mild displays may be seen year-round.

Trio: A group of three adults that nest cooperatively (i.e., all three are associated with a single nest), sharing incubation and brood-rearing duties. A third adult behaving antagonistically towards a pair, or merely being nearby, does not constitute a trio.

Unconfirmed breeding pair: A pair that exhibits behavior consistent with breeding but for which eggs or chicks could not be found. Examples of behaviors include scraping, mating, and territorial displays or battles, as well as acting defensive of or sticky to an area when approached by other AMOY or people (including the surveyor).

Visit: Each time a surveyor observes a specific pair whether on a site survey or as an opportunistic observation.

References

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