Black-Legged Kittiwake Monitoring Handbook

First Edition

Elizabeth Ross Hooge
Rusty Yerxa
Philip N. Hooge

Prepared For Glacier Bay National Park & Preserve

Alaska

USGS-Biological Resources Division
Glacier Bay Field Station
P.O. Box 140
Gustavus, AK 99826

June 1998

Black-Legged Kittiwake Monitoring Handbook

First Edition

Glacier Bay National Park & Preserve
Alaska

Elizabeth Ross Hooge[1]
Rusty Yerxa[2]
Philip N. Hooge[1]

[1]USGS - Biological Resources Division
Alaska Biological Science Center
Glacier Bay Field Station
P.O. Box 140
Gustavus, AK 99826-0140

[2]National Park Service
Glacier Bay National Park & Preserve
P.O. Box 140
Gustavus, AK 99826-0140

USGS-Biological Resources Division
Glacier Bay Field Station

P.O. Box 140
Gustavus, AK 99826

June 1998

Table of Contents

Preface

This is the first edition of the Glacier Bay Black-legged Kittiwake Monitoring Handbook. This work resulted from six years of experience (1992-1997) conducting or participating in the kittiwake monitoring program at Glacier Bay.

The purpose of this handbook is to outline a methodology for monitoring Glacier Bay National Park's Black-legged Kittiwake population. We developed and here describe a technique that substantially reduces the cost of annual censusing while retaining equal accuracy and retaining or increasing precision over previous methods.

Acknowledgments

Data were collected by L. Climo, T. Duncan and H. Lentfer in 1991 and 1992. We thank M.L. Kralovec, A. Maselko, L. Sharman, M. Schroeder, C.R. Soiseth, and S.R. Whitney for their help in the field, and C.A. Dick for assistance counting slides and assembling this protocol. This work was funded by an NSF pre-doctoral fellowship (to ERH), by the USGS-Biological Resources Division, and by the National Park Service.

Introduction

Monitoring Seabirds

Seabirds are often the most easily studied top-level predators in marine ecosystems because they spend most of their time above the water's surface and generally breed in dense localized aggregations (Harris & Wanless 1990, Furness & Camphuysen 1997). As a result, scientists and managers frequently use them as indicators of both biological and physical parameters of the marine environment (Harris & Wanless 1990; for review see Furness & Camphuysen 1997). Monitoring population change is an integral part of seabird research, as fluctuations in numbers may be correlated with other population parameters including reproductive success, mortality, and foraging strategy, which in turn may interact with external phenomena such as oceanographic conditions, changes in fishery stocks, and pollution or disturbance levels (Springer et al. 1984, Hatch 1987, Harris & Wanless 1990, Hatch & Hatch 1990, Furness & Camphuysen 1997).

Censuses of seabirds have traditionally been accomplished by direct visual observation (Coulson & White 1956, Nettleship 1976a, Barrett & Schei 1977, Stowe 1982, Wanless et al. 1982, Barrett 1985, Richardson 1985, Bibby et al. 1992). More recently, photography has been used with apparent success to monitor several species of seabird (Nettleship 1975, Nettleship 1976b, Nettleship 1976a, Nettleship 1978, Harris 1987; but see Bibby et al. 1992), though counting from photographs has been recommended by some authors only for colonies or portions of colonies that are difficult or impossible to census via direct visual observation (Nettleship 1976a, Barrett & Schei 1977, Barrett 1985). Photographic techniques are attractive because they offer labor and cost savings over visual observations in the field (Harris 1987).

<u>*Black-legged Kittiwakes*</u>

Black-legged Kittiwakes (*Rissa tridactyla*) are small long-lived gulls that nest colonially in dense aggregations on cliff faces and feed by shallow plunge-diving, dipping, or surface-seizing (Hatch et al. 1993). In Glacier Bay they are thought to feed on capelin (*Mallotus villosus*), Pacific sandlance (*Ammodytes hexapterus*), herring (*Clupea harengus*), amphipods, and euphausiids. They are dependent on the surface availability of food items, in contrast to other seabirds such as murrelets that dive more deeply to feed on the same prey species. Black-legged Kittiwakes have experienced increasingly frequent breeding failures throughout the Gulf of Alaska over the past 20 years (Hatch et al. 1993, but see Murphy et al. 1991). Studies indicate that food limitations may be responsible for these reproductive fluctuations (Hatch and Hatch 1990; Hatch et al. 1993).

Reproductive failures such as those described elsewhere have also been observed at Glacier Bay National Park. There are numerous colonies within the Park, some of which are on the outer Gulf of Alaska coast and Cross Sound area, and eight of which are within the Bay proper (Fig. 1). Many but not all of the outer coast colonies have experienced either declines in numbers or complete abandonment in the past ten to fifteen years. Within the Bay, population trends are variable; some colonies are declining, while several new sites have recently been recently colonized. A

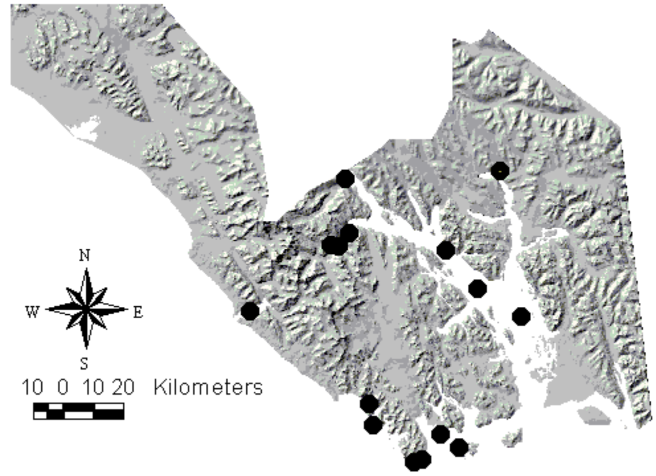


Fig. 1. Black-legged Kittiwake colony locations, shown by black dots, in the Glacier Bay area.

systematic effort to census this species accurately within the Park began in the summer of 1991, and has continued annually to the present (Climo and Duncan 1991, Lentfer 1992, Yerxa 1993, Yerxa and Hooge 1994, Yerxa et al. 1995).

Monitoring Protocol

The recommended protocol for monitoring kittiwakes is to take a series of five sets of 35 mm color slide photographs of each colony during the incubation stage. After the film is developed, birds and nests should be counted from the projected slides. Reproductive success should be evaluated by counting all visible chicks at the colony one to three separate times during the peak of fledging. A subsequent colony visit may also be desired to establish that the youngest nestlings survived to fledging age.

POPULATION ASSESSMENT BY PHOTOGRAPHY

We have demonstrated that a carefully taken, appropriately timed series of 35mm color slide sets can produce a precise and accurate census of small to moderately large (3,000 pairs) Black-legged Kittiwake colonies (see Appendix E).

Other researchers have successfully used color videography for estimating waterfowl populations (e.g. Anthony et al. 1995), and high quality enlarged black and white photos to count Black-legged Kittiwakes and other cliff- or ground-nesting seabird species (Nettleship 1975, Nettleship 1976a, Nettleship 1976b, Barrett & Schei 1977, Nettleship 1978, Barrett 1985, Harris 1987). Monochrome print enlargements cost substantially more than developing color slides, and we have found that projecting slides onto a screen provides all the enlargement necessary for detailed viewing and counting.

Although photographs require some subjective interpretation due to their two-dimensional nature, much observer error is eliminated by the photographic technique. Among the excluded sources of observer bias are physical fatigue, environmental conditions such as wind, precipitation, waves, and currents (Stowe 1982), and temporal constraints (inability to observe the colony repeatedly or for a protracted time period). Probably most errors in the slide-based censusing are due to poor image quality. Slide viewing generates a single count that can be verified at any time.

Taking photographs and counting birds and nests from the resultant color slides requires much less field time than direct visual censusing, since the photography itself takes less than two hours on average for a relatively large colony. Because of the cost and complex logistics required for field sessions, photography is much easier and less expensive to accomplish, yet retains the accuracy and improves the precision of the traditional direct censusing method. Additional advantages to this technique include the ability to take multiple sets of colony photographs within brief periods of good weather, the flexibility to perform the slide-counting during less busy times of the year, the reduced observer error, and the permanence of the photographic record.

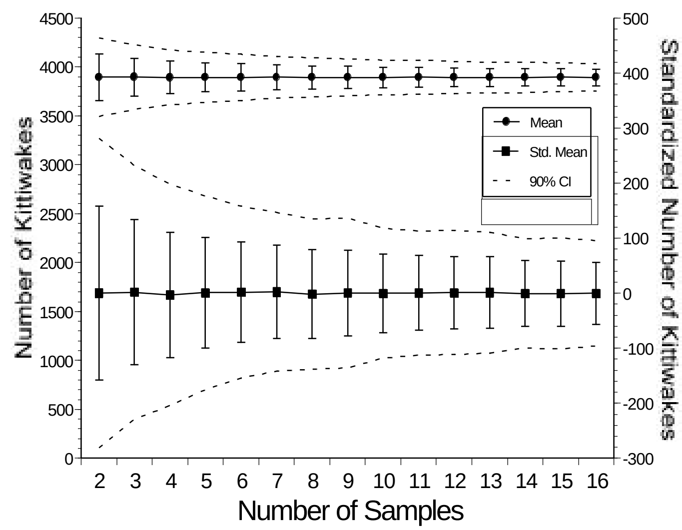


Fig. 2. Bootstrap examination of the effect on population counts of numbers of censuses conducted at the Margerie Glacier colony. The upper lines (and left-hand axis) show the population counts with 90% confidence intervals at each sample size. The lower lines (and right-hand axis) show the standardized population counts with 90% confidence intervals. The standardized axis refers to counts above or below the mean. Means ± SD are also depicted. The samples were taken with replacement from our 33 photographic and direct bird censuses from 1991 through 1995, running 5,000 replicates for each interval. Standardized bird counts were examined in order to control for annual variation in bird numbers; standardizing was accomplished by subtracting the annual mean number of kittiwakes for each year from the

Number of Replicates

Other workers have recommended three to ten annual replicates for censusing Black-legged Kittiwake colonies in order to adequately compensate for daily and seasonal variation in colony attendance (Nettleship 1976a, Stowe 1982, Wanless et al. 1982, Barrett 1985, Hatch & Hatch 1988, Bibby et al. 1992).

To determine the optimum number of replicated photographic counts per year, we conducted a bootstrap analysis (Efron 1982) of both bird counts and standardized bird counts using Resampling Stats (Bruce 1991). This analysis (Fig. 2) showed that five annual photographic samples were sufficient to capture the majority of variation and produce a precise and accurate census, since the asymptote for the 90% confidence intervals of both measures occurred between 5 and 10 counts. The standard deviations were small compared to the colony's population size, and taking more than five annual samples did little to further decrease the variance.

We also conducted a power analysis to confirm that five annual censuses were sufficient. The program MONITOR (Gibbs 1995, available at http://www.im.nbs.gov/powcase/powcase.html on the Internet) was used to estimate the ability of visual and photographic censuses to detect population changes through time (Fig. 3).

We found that five annual photographic censuses have a probability of greater than 90% to detect an annual change in population size of two percent or more at the 0.05 significance level. Increasing the number of annual counts from five to eight or ten produced only small gains in the ability to detect changes in population size of less than two percent.

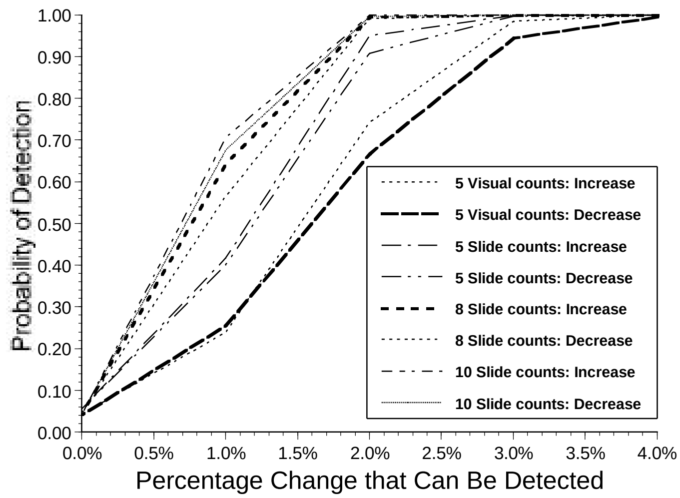


Fig. 3. Power analysis of different numbers of slide-based censuses as well as visual vs. slide counts. The probability of detecting a significant change (either increase or decrease) in population size at the 0.05 level, two-tailed, is shown. For the purposes of this MONITOR simulation, the Margerie Glacier colony was considered to be a single plot, counted five times per year for seven consecutive years, corresponding to our five counts each year from 1991-1997. The initial values entered into the simulation were the 1992-1994 visual census mean and SD for birds. In addition, we ran the

Our conclusion is that five sets of photographs of each colony should be taken and counted each year. More than five sets will provide little increase in the precision, accuracy, or power of the monitoring program. If at all possible, no fewer than five counts should be made of any colony, although obviously one or two counts will provide better information than none.

Timing of Photography: Date

The photographic series should be shot during mid- to late June, the middle to end of the egg-incubation period, because colony attendance has been shown to be most stable during this time (Hatch and Hatch 1988, see also Barrett 1985, Coulson and White 1956, Nettleship 1976a, Richardson 1985, Wanless et al. 1982). Since incubation at Glacier Bay's colonies probably begins in late May to early June (Climo and Duncan 1991), photographs may be taken earlier in June, but should not be taken later than the 1st of July. After this date partial and entire colony abandonment has been observed in some cases, and attendance may decline or become more variable if reproductive failure has occurred. Counts made after this date will still provide some information but should be treated with caution.

Timing of Photography: Time of Day

Take the photographs between approximately 0900 and 1600 hours daily, Alaska Daylight Time, again because attendance has been shown to be least variable at these times (Hatch & Hatch 1988, see also Barrett 1985, Coulson and White 1956, Nettleship 1976a, Richardson 1985, Wanless et al. 1982). The lack of light in the evening also causes photographs to be too dark or the shutter speed to be too slow, resulting in poor image quality.

Timing of Photography: Other Considerations

Weather

Do not photograph Black-legged Kittiwake colonies in steady rain or strong winds (above Beaufort Force 4), since such conditions affect colony attendance (Coulson & White 1956, Stowe 1982, Wanless et al. 1982). In addition, in steady rain it is nearly impossible to keep high-quality optical equipment (binoculars and camera) dry while taking multiple carefully-framed photographs.

Presence of Predators

Photographs should also not be taken when predators, including Bald Eagles (*Haliaeetus leucocephalus*), Golden Eagles (*Aquila chrysaetos*), Peregrine Falcons (*Falco peregrinus*), Common Ravens (*Corvus corax*), and brown bears (*Ursus horriblis*) are present on or near the area being photographed. These predators cause varying degrees of disruption and even temporary abandonment of nests. Thus, do not take photos of disturbed plots during or immediately after such events.

If a predator is present on a plot, the photography of that plot and any affected adjacent plots should be suspended or delayed until a later time, when the effects of the disturbance are judged to have subsided based on the subjective judgment of the observers. The amount of time to wait following predator disturbances ranges from approximately five minutes for Common Ravens (which cause very localized effects with little duration) to a half-hour or more for Peregrine Falcons.

Camera and Lens

We used a 35 mm camera with a 75-210 mm zoom lens. A zoom lens is required for properly framing the multiple photographs of each plot. A lens larger than 210 mm would be useful for documenting the extremely high nesting areas that have recently been colonized at the Margerie Glacier colony. In addition, because exposure and focus are crucial to image quality (see *Photographic Technique: Exposure*, below), an automatic camera, including auto-focus, is recommended.

Film

Kodachrome color slide film was chosen because its developed slides have a longer shelf life than do other film types. Do not use E-6 or other film processes that have a shorter archival life. Since the permanence of the record is a principle benefit of the photographic census method (see Nettleship 1975, Nettleship 1976a, Nettleship 1976b, Nettleship 1978), the monitoring program should capitalize on this advantage.

A film speed of 200 ASA has been used with success from 1993 through 1997. A flexible speed with relatively high resolution is selected so that photographs can be taken under both sunny and overcast lighting conditions without losing much detail. Experimenting with 400 ASA Kodachrome film may result in slightly better images under certain lighting conditions.

Subdividing the Colony: Plots

The Margerie Glacier, Kashoto Glacier, and Lone Island colonies have been subdivided into plots along their lengths to facilitate counting by decreasing the size of the census units. These plot boundaries follow natural topographic features of the cliff face, such as cracks, mineral intrusions, and waterfalls (Nettleship 1976a, Stowe 1982, Bibby et al. 1992), and have been documented photographically to assure continuity between years and by different workers.

Black and white photo prints, of the entire cliff face and of the boundary areas in detail, were marked with permanent pen to delineate the plots. Two sets of these photos are maintained, one for yearly field use and one for archived records. A written description of the features dividing each plot accompanies each set of marked photos (see Appendices B and C). These photo sets must be updated or augmented regularly when new colonies are founded or the physical extents of existing colonies change.

Plot boundaries were originally selected based both on physical size of the plot as well as on number of nests per plot. From trial-and-error an upper limit of approximately 250 to 300 nests seemed to be the most an observer could accurately and efficiently count at one time.

Photographic Technique

The photography should be performed by two people, both of whom should have 8x30 to 10x40 high-quality binoculars for viewing the colony and its constituent plots, particularly the high ones. At least one team member must be familiar with the monitoring protocol and Glacier Bay's kittiwake colonies, but ideally both workers would have some knowledge or experience.

Photographing the entire Margerie Glacier colony (~3,000 pairs) once requires two to three rolls of 36-exposure film, and takes approximately two hours on average (range: 1.2 - 3.2 hr from 1993-1995). Smaller colonies such as Riggs

Glacier, Gloomy Knob, and South Marble Island take much less time, usually 15-30 minutes each.

Because image quality is vital to accurate and efficient slide-based counting, the photographer must pay close attention to viewing angle, focus, shutter speed, lighting, and contrast. In addition, it is extremely helpful to visualize the extent of each plot, and to plan the number and order of frames, prior to photographing.

Photographic Technique: Positioning

Photography should be performed from a skiff or open boat located 30-150 m in front of the colony's cliff face. None of Glacier Bay's kittiwake colonies can be observed from land.

One person should operate the boat and write notes while the other visualizes and takes photographs. This procedure is facilitated if both workers are aware of each plot's extent and topography; in this way the boat operator can judge independently whether the positioning is correct for a particular plot photograph.

A crucial consideration in framing the photos is to shoot a section of the colony from a position as nearly perpendicular to the center of the plot's face as possible. Counting birds becomes increasingly difficult as the cliff angles away from the viewer, and nests may be entirely invisible from the slides if rock ledges or surface irregularities obstruct the photographer's line of sight. Thus, as the cliff face varies from alcoves to promontories the boat operator may have to reposition the skiff once or more to photograph a single plot from different vantage points.

Occasionally when currents in front of a colony are particularly strong and cannot be avoided, the boat operator may have to run the skiff's outboard motor continuously. Ideally, though, the boat operator should identify where to maneuver the boat, then bring it to a halt in the correct location for the photographer to shoot the photos with the motor disengaged.

Photographic Technique: Exposure

The film exposure is also important to the quality of the slides. Slight underexposure of the film proves far better than any overexposure when counting adult kittiwakes from the slides, due to the white-and-pale-gray color of the birds against the prevalently pale gray cliffs in Glacier Bay. In addition, full sunlight shining on the cliff is extremely challenging for the counter. The white and gray adult birds become difficult to distinguish from the background rock in full sun, and such conditions are prone to overexposure. If photographs must be taken of a colony in full sun, the photographer may wish purposely to underexpose those frames slightly.

It is also nearly impossible to obtain good film exposure if a single frame encompasses both some parts of the cliff in full sun and some in shade. In this situation either the sunny birds are overexposed or the shady birds are greatly underexposed. If a plot has both sunny and shaded portions, divide the plot so that the two areas are photographed in separate frames.

Overcast days or times when the sun is not directly shining on the colony therefore produce the best photographs, although rain is obviously contraindicated when using high-quality camera equipment.

Needless to say, properly focussing each and every frame is another essential aspect of the photography. Poorly focussed slides are extremely difficult to count.

Photographic Technique: Framing the Photos

Every roll of film <u>must</u> begin with a ‘roll ID shot’ to uniquely identify each set of photographs (all of which look very similar if they are not marked!). Write the full date, project identifier, and roll number on a sheet of paper that is photographed before any data slides are shot (e.g. “ 20 June, 1998 KW-98-1 ” represents the first roll of kittiwake monitoring photos in 1998, shot on June 20, 1998). Ideally, each roll should also conclude with this same ‘roll id shot,’ in case the first slide is lost or does not develop properly.

During the photography, the plot number and a detailed description of each frame are recorded on waterproof data sheets, in permanent black ink if possible, to aid the later sorting and viewing of slides (see Appendix A). Any notes and additional photo descriptions written on the data sheets as the frames are shot greatly assist the later counting of birds from the slides.

In general, except as prevented by predator disturbances or sea conditions, the plots should be photographed in consecutive linear order along the length of the colony to facilitate the later viewing and counting from the projected slides. This practice simplifies the verification of plot boundaries and of birds along the boundaries during the slide counts, since a boundary is usually photographed from two slightly different perspectives for the two adjacent plots.

In addition, most plots should be photographed in a standard sequence. We recommend a general sequence of “left before right, and lower before upper,” which results in a standard set of frames in the progression “lower left, upper left, lower right, upper right.” Because plots are of different size and shape, the number and arrangement of recommended frames may be modified for some plots, but this general standardized sequence greatly facilitates later sorting and viewing of slides.

Although not always possible, aligning the frames horizontally and vertically when taking multiple photographs of one plot is useful, too; this practice helps in visualizing the spatial relationship between slides. Also, photo frames that depict approximately equal-sized portions of the cliff face work best for the counting, since individual birds from different slides are then of similar projected size on the screen.

With all of the above recommendations in mind, sufficient overlap among adjacent photo frames remains vital to ensure complete coverage and accurate counting of each colony plot. Any lack of overlap, for instance due to widely spaced or discrete groups of nests, must be carefully noted on the accompanying data sheets to prevent confusion during slide viewing. Splitting one plot’s photo frames between two different rolls of film should also be avoided, even at the cost of a few wasted frames, because it makes later sorting and viewing of the slides much more difficult and confusing.

The ideal number, arrangement, and shooting angle of the photo frames for each plot at the relatively large Margerie Glacier colony have only been determined after experience at shooting the photos and viewing the resultant slides. Once efficient frame schemes for all of the plots were determined, they were recorded to aid future censuses; this list of recommended photo frames is expected to aid new workers not familiar with the Margerie Glacier colony (see Appendix D). This list must be actively revised on a continuing basis if, as in Glacier Bay, colony sites and their physical extents are dynamic from year to year.

Counting from Slides

All of the data slides must be developed (either mail or deliver them to a photo shop). Ensure that every roll's instructions include that particular roll's number, in case the 'roll ID shots' do not develop properly. Also be certain that the development process will include sequential numbering of the slides (some film developing does not include numbering). When the developed slides are received, each slide must be individually labeled (by hand) with the project name, year, and roll number (e.g. "KW-98-1" represents roll #1 of the kittiwake monitoring photos in 1998). Use a black permanent pen for this labeling.

Counting Unit: Birds or Nests?

There is disagreement in the literature regarding the unit to be counted when monitoring Black-legged Kittiwake colonies. The apparently occupied nest (AON) is the counting unit most widely recommended (Coulson & White 1956, Nettleship 1976a, Barrett & Schei 1977, Stowe 1982, Barrett 1985, Coulson & Thomas 1985, Richardson 1985, Bibby et al. 1992), yet there is substantial variation in the way this term is defined and applied. Some workers count only nests with at least one member of the breeding pair in attendance (Coulson & White 1956, Stowe 1982, Wanless et al. 1982, Bibby et al. 1992), whereas others may include some unoccupied nest sites (Nettleship 1976a, Barrett & Schei 1977, Barrett 1985, Hatch & Hatch 1988, see also Methods).

Furthermore, counting nests, occupied or not, relies on varying and often ambiguous criteria, such as "obviously... built or maintained during the year in question" (Barrett 1985) and "must have some built-up edge to qualify" (Nettleship 1976a, see also Methods). Some nonbreeding birds not only occupy sites on the cliff, but also bring nest materials to them. Although these structures are "generally less well built and less obvious than active nests" (Nettleship 1976a, Hodges 1977, Wanless et al. 1982, Bibby et al. 1992), discerning them from active nests clearly requires an element of observer subjectivity (Wanless et al. 1982, Hatch & Hatch 1988). Moreover, whitewashed roosting sites marked solely by guano (Nettleship 1976a, Bibby et al. 1992) should also be omitted from AON's, keeping in mind that 'active' nests, too, usually have “a covering of white faeces” (Bibby et al. 1992).

However, some researchers have counted individual kittiwakes instead of, or in addition to, AON’s (Barrett & Schei 1977, Hodges 1977, Wanless et al. 1982, Richardson 1985, Hatch & Hatch 1988, Murphy et al. 1991). Bird counts at a colony are reported to experience greater diurnal, daily, and seasonal fluctuations than do nest counts (Coulson & White 1956, Nettleship 1976a, Hodges 1977, Wanless et al. 1982, Barrett 1985, Hatch & Hatch 1988). Also, counts of birds do not accurately represent the breeding population, since nonbreeders of various types attend the colony as well (Coulson & White 1956, Coulson 1959, Nettleship 1976a, Hodges 1977, Bibby et al. 1992). In contrast, nest counts are reasonably stable within the season and they “convey more information about the size of the breeding population” (Hatch & Hatch 1988); most authors cite these two reasons for selecting AON’s as the counting unit.

Nonetheless, there are compelling arguments against counting nests and in favor of counting individuals. “Most people with practical experience of seabird counting have serious reservations about the usefulness of this category [nests] as it necessitates a human deciding where it is possible for a bird to lay or incubate an egg” (Wanless et al. 1982). Identifying birds is a much less ambiguous task, and is therefore less subject to observer bias and inter-observer variance (Wanless et al. 1982, Hatch & Hatch 1988). Such counts index the size of the entire population (both breeders and nonbreeders), an equally valid measure though with different emphasis. Most importantly, Hatch & Hatch (1988) demonstrated that counts of birds were superior to nest counts for detecting *annual* changes in the numbers of Black-legged Kittiwakes. Mean attendance had a much lower coefficient of variation *among years* and thus more closely followed real population change through time than did nest numbers (Hatch & Hatch 1988).

Our results from counts at the Margerie Glacier colony concur with Hatch & Hatch (1988) regarding the interannual stability of colony attendance; kittiwake counts varied more than did nest counts both within and between years (Table 1). Our within-year coefficient of variation for nests, which averaged slightly higher than that for bird counts, was greater than expected, since other workers have all reported that yearly nest numbers are more stable than bird numbers (see above). One possible explanation for this relatively large variance is the high level of predation experienced

Counting Unit		All Years	1991	1992	1993	1994	1995	Across Years
Individuals	$\bar{x}$ ±SD	3884±317	4059±279	3660±409	3686±188	4193±75	3970±193	3913±234
	CV	0.082	0.069	0.112	0.051	0.018	0.049	0.060
	N	33	6	6	10	6	5	5
Nests	$\bar{x}$ ±SD	2729±236	2939±47	2675±175	2635±63	3193±12	2454±75	2779±289
	CV	0.087	0.016	0.065	0.024	0.004	0.030	0.104
	N	24	3	5	10	3	3	5

Table 1. Shown in the table are the means and standard deviations, the coefficients of variation (CV), and sample sizes (N) for all counts from 1991-1995, by year and counting unit. The category "All Years" combines all counts from all years. The category "Across Years" is the comparison of the five annual means (1991-1995).

by kittiwakes at the Margerie Glacier colony. Numerous predation events by multiple individuals of several different species have been observed at this colony each year (pers. obs.); changes in numbers of attended nests may reflect nest losses, abandonment, or relocations due to predation pressure.

In light of others' recommendations and our experience, we recommend that both birds and nests continue to be counted from slides for Glacier Bay's Black-legged Kittiwake colonies. Although censusing individual kittiwakes seems to furnish a better basis for interannual comparisons of population size, nest numbers provide more information about annual reproductive effort, and are an important baseline for chick counts later in the summer. Both measures are successfully documented by our 35 mm color slide methodology (see Appendix E).

Counting Technique: Slide Projection

Once the film is developed, counting birds or nests only from one set of slides of the entire Margerie Glacier colony (~3,000 pairs) requires approximately six hours when done by two observers and nine hours when performed by a single observer. Counting both birds and nests simultaneously from a set of slides takes from ten hours with two observers to sixteen hours for one person working alone. Poor photo quality (focus, shutter speed, lighting, or contrast) and lack of familiarity with the colonies increase the amount of time required to perform the counts. All slide-based plot counts should be recorded in permanent black ink on data sheets for subsequent entry into a computerized database (see Appendix A).

First-year birds, identified by plumage (Coulson 1959), should not be counted, nor groups of more than ten "loafing" birds not associated with nests; such groups often form near the water or along the sides or top of nesting areas. When counting from nests, include only those with recently added nest material and at least one bird in attendance.

One or two observers count birds and nests for the five photo sets of each colony by viewing the slides in a darkened room. Project the slides onto either a traditional slide-viewing screen, or onto a white dry-erase board. Counting from the board is easier because the images of birds and nests can be marked with dry-erase pens. A clear sheet of plexiglass or polycarbonate plastic (available from a hardware or plastics store) mounted on a white wall may be substituted for the dry-erase board.

We have employed two different projection techniques, using either one or two slide projectors with 102-152mm zoom lenses. Viewing two adjacent slides at once, using two projectors side-by-side, enables the overlap between frames to be discerned easily and prevents double counting or omission of individuals. Although that is our recommended viewing method, we have also successfully used a single projector by advancing and reversing the frames to ensure full coverage and prevent duplicate counting. If using two projectors, it is helpful to use identical slide projectors so that the slides' on-screen brightness, color, and magnification were the same. In addition, a remote control both for advancing the frames and for focussing is important; auto-focus was not desirable since repeated fine-tuning of the focus was crucial to counting from the slides.

Slides should be sorted into the left and right slide carousels according to the frames' depiction of left or right sides of each plot, when applicable. This 'spatially accurate' projection of plots onto the screen greatly assists visualizing the plots in the office. Another aid to keeping slides in order is placing the slides, numbered during film development, into the same-numbered slots in their respective slide carousels. If only using a single projector, inserting all of the slides into their respectively numbered slots of the one carousel is still extremely useful, so that the observer can easily verify which frame is being viewed at any time, without removing the slide from the carousel. We recommend viewing only a single roll of slides at one time for similar reasons of reducing confusion during the viewing process.

Once the slides are appropriately distributed between the two carousels, or into a single carousel, the birds and nests can be counted plot by plot. Here again we have experimented with several techniques. Initially we had two observers count the projected images together, so only a single number was obtained for each plot from each of the five sets of photos. Counting consisted of both observers' standing close to a traditional slide screen; one of the observers led by pointing to the projected birds and counting aloud, while the other closely followed the counting to ensure complete coverage and to prevent duplication. In subsequent years of this continuing monitoring project, a single observer working alone with one or two slide projectors has successfully accomplished the counting task, but has required more time to do so.

A later improvement consists of projecting the slides either onto a commercially available white dry-erase board or onto a white wall covered with a thin sheet of transparent plastic. Although the projector's bulb does create a reflection on both the clear plastic sheet and the dry-erase board, the observer can easily avoid its glare by viewing slides from an angle to either side. Non-permanent marking pens such as dry-erase markers, which wipe away easily, should be used on the clear plastic or dry-erase board to divide each projected slide into smaller counting units and to record numbers. The board can be wiped clean as needed, usually after each set of two slides, or after one plot is completed.

Alternatively, one observer can count by simultaneously circling each bird on-screen and clicking a hand-held 'tally-whacker.' The circles can be counted afterwards to check the tally-whacker's total. Another successful single-observer technique is to mark each adult on the screen with a small vertical hatch mark, and to circle those birds that are on nests. Having multiple different colors of dry-erase pen is useful for all work on the board. After the lights are turned on, birds and nests (hatches and circles) can be separately counted and re-counted. A second observer can aid either of the latter methods by helping visualize the plots on-screen and by verifying the number of marks made on the board. For these reasons a second observer does substantially reduce the amount of time required.

EVALUATION OF REPRODUCTIVE SUCCESS VIA CHICK COUNTS

Instantaneous counts of the number of chicks at a colony are not the most accurate measure of reproductive success, since not all nestlings counted will actually fledge. However, in the absence of longitudinal studies of individual nests through the season they do provide an easily obtained index to the colony's annual reproductive output. We thus recommend making two to three visits timed about a week apart in late July to early August to each Black-legged Kittiwake colony. At this time all visible nestlings should be counted. A follow-up visit can establish whether the youngest nestlings survive to fledging age.

Timing of Chick Counts

Chick counts should be performed from the last week of July to the first two weeks of August. Breeding phenology varies geographically, by colony, and in different years, but the peak of fledging for Glacier Bay usually seems to occur between the first of August and approximately August 15 (Climo and Duncan 1991, Yerxa 1993). Since the timing varies, reports by other observers or Park employees (particularly Interpretation Rangers) may be used to identify the appropriate time for chick counting.

Because some nestlings counted will be younger and not yet ready to fledge, the total count includes some chicks that may not survive to fledging age. A visit to the colony two to three weeks after the final chick count can ascertain whether any of the younger nestlings still survive (J.F. Piatt pers. comm. to M.L. Kralovec).

Counts should not be conducted in heavy rain because binocular optics became severely fogged in the open skiff. Also, brooding adults often obscure the view of their nestlings when it is wet. However, unlike during the photography, predator disturbances can be used to advantage for the chick counts because the nestlings become much more visible once the adults abandon the cliff face.

Chick Counting Technique

Two observers should carefully count all of the visible chicks at a colony by visually scanning each nest with 8x10 to 10x40 high-quality binoculars. Ideally the observers should use binoculars with the same power and field of view so their vision is equivalent. Counting, like the photography, should be conducted from a skiff or open boat located 30-150 m in front of the colony. Because the nestlings can be quite small, the observers may want to position themselves closer to the cliff for chick counts than for photography. Being perpendicular to the plot under scrutiny is once again crucial (see *Photographic Technique: Positioning*, above).

Even in years with high reproductive output, it is possible for both observers to agree on a single number of chicks. For each plot, one person 'leads' by announcing out loud which nest or group of nests should be examined by both observers, stating how many chicks are seen there, and describing where next to look. The second observer follows the verbal instructions, examining the indicated nests, and should concur or disagree out loud. Visualizing the extent of each plot before counting the chicks in it is very helpful.

A mechanical counting device should be used to keep track of the chicks counted during this procedure for each plot. Since nests with single chicks should be tallied separately than those with two or three chicks, a multiple-field counter or two to three single 'tally-whackers' can be used. Chick numbers by plot, along with any notes about the age or condition of the chicks, should be recorded on waterproof data sheets, in black permanent pen if possible, for later database entry (see Appendix A).

DATA MANAGEMENT

Calculating the Numbers

To calculate each of the five annual censuses for birds and nests, sum all of the plot totals from each colony for each slide-count set. Do the same summation for the chick counts at each colony.

Computer Network: Data Entry and Retrieval

All plot and colony counts for birds, nests, and chicks should be entered into DBF database files on the Glacier Bay National Park computer network (see Appendix I for database fields and definitions). Currently these files are located in the **Data** folder of the '**Kittiwak**' project within GLBA Science Projects. Listed below are the relevant databases and their current paths (see Appendix I for file structure):

Enter slide-based bird and nest counts into:

Science\eco_data\data\glba\kittiwak\data**slides.dbf**

Enter chick counts into:

Science\eco_data\data\glba\kittiwak\data**chicks.dbf**

(Older data from visually-observed bird and nest counts are entered in:

Science\eco_data\data\glba\kittiwak\data**adults.dbf** and **nests.dbf**)

Data sheet templates (see Appendix A), created in the spreadsheet program Microsoft Excel, are also available within the **Monitor** folder inside the '**Kittiwak**' project:

Science\eco_data\data\glba\kittiwak\monitor\datasheet\templates**Chick_DS.xls**, **ChickDS2.xls**, **Ph_DS.xls**, **Ph_DS2.xls**, **SlideBirdDS.xls**, **SlideNestDS.xls**

This handbook, produced using MS Word 97, is also available on the GLBA network inside the same **Monitor** folder (within the '**Kittiwak**' project):

Science\eco_data\data\glba\kittiwak\monitor**Monitoring_Handbook.doc**

Archiving the Data

All original data sheets from the kittiwake monitoring program, and both sets of kittiwake colony and boundary photographs (one archived, one for field use) are stored in Glacier Bay Field Station's Field Notes Cabinet in labeled notebooks. Future data should immediately be archived in the same manner. All color data slides are also currently stored in Glacier Bay Field Station, but should be properly stored in an organized container in a designated location.

Reference List

Abacus Concepts. 1996. StatView. v. 4.5 Abacus Concepts, Inc. Berkeley, CA.

Anthony, R.M., Anderson, W.H., Sedinger, J.S. & L., M.L. 1995. Estimating populations of nesting brant using aerial videography. *Wildl. Soc. Bull.* 23:80-87.

Barrett, R.T. 1985. Further changes in the breeding distribution and numbers of cliff-breeding seabirds in Sor-Varanger, North Norway, 1975-1983. *Fauna norv. Ser. C, Cinclus* 8:35-39.

Barrett, R.T. & Schei, P.J. 1977. Changes in the breeding distribution and numbers of cliff breeding sea birds in Sor-Varanger north Norway. *Astarte* 10:29-36.

Bibby, C., Burgess, N.D. & Hill, D.A. 1992. *Bird census techniques*. Academic Press, New York.

Bruce, P.C. 1991. Resampling Stats. v. 3.16 Resampling Stats, Inc. Linthicum, MD.

Climo, L. & Duncan, T. 1991. The status of black-legged kittiwakes at Glacier Bay National Park and Preserve, Alaska in 1991. U.S. National Park Service, Glacier Bay National Park and Preserve,.

Coulson, J.C. 1959. The plumage and leg colour of the kittiwake and comments on the non-breeding population. *British Birds* 52:189-196.

Coulson, J.C. & Thomas, C.S. 1985. Changes in the biology of the Kittiwake (*Rissa tridactyla*): a 31-year study of a breeding colony. *J. Anim. Ecol.* 54:9-26.

Coulson, J.C. & White, E. 1956. A study of colonies of the kittiwake *Rissa tridactyla* (L.). *Ibis* 98:63-79.

Efron, B. 1982. *The jackknife, the bootstrap, and other resampling plans*. Society for Industrial and Applied Mathematics, Philadelphia.

Furness, R.W. & Camphuysen, C.J. 1997. Seabirds as monitors of the marine environment. *ICES Journal of Marine Science* 54:726-737.

Gibbs, J.P. 1995. MONITOR. v. 6.3

Harris, M.P. 1987. A low-input method of monitoring kittiwake *(Rissa tridactyla)* breeding success. *Bio. Cons.* 41:1-10.

Harris, M.P. & Wanless, S. 1990. Breeding success of British kittiwakes *(Rissa tridactyla)* in 1986-1988: evidence for changing conditions in the northern North Sea. *Journal of Applied Ecology* 27:172-187.

Hatch, S.A. 1987. Did the 1982-1983 El Nino-Southern Oscillation affect seabirds in Alaska? *Wil. Bull.* 99:468-474.

Hatch, S.A., Byrd, G.V., Irons, D.B. & Hunt Jr., G.L. 1993. Status and ecology of kittiwakes (*Rissa tridactyla* and *R. brevirostris*) in the North Pacific. In: Vermeer, K., Briggs, K.T., Morgan, K.H. & Siegel-Causey, D. (eds). *The status, ecology, and conservation of marine birds of the North Pacific*. Canadian Wildlife Service Special Publication, Ottawa, Canada, pp. 140-153.

Hatch, S.A. & Hatch, M.A. 1988. Colony attendance and population monitoring of black-legged kittiwakes on the Semidi Islands, Alaska. *The Condor* 90:613-620.

Hatch, S.A. & Hatch, M.A. 1990. Components of breeding productivity in a marine bird community: key factors and concordance. *Can. J. Zool.* 68:1680-1690.

Hodges, A.F. 1977. Counts at kittiwake colonies. *Bird Study* 24:119-125.

Lentfer, H. 1992. Census of breeding population and productivity of selected black-legged kittiwake colonies in Glacier Bay National Park & Preserve, Alaska. U.S. National Park Service, Glacier Bay National Park and Preserve.

Murphy, E.C., Springer, A.M. & Roseneau, D.G. 1991. High annual variability in reproductive success of Kittiwakes (*Rissa tridactyla* L.) at a colony in western Alaska. *J. Anim. Ecol.* 60:515-534.

Nettleship, D.N. 1975. A recent decline of Gannets, *Morus bassanus*, on Bonaventure Island, Quebec. *Can. Field-Nat.* 89:125-133.

Nettleship, D.N. 1976a. Census techniques for seabirds of arctic and eastern Canada. Canadian Wildlife Service.

Nettleship, D.N. 1976b. Gannets in North America: present numbers and recent population changes. *Wil. Bull.* 88:300-313.

Nettleship, D.N. 1978. Population analysis of colonial nesting seabirds from photography. *Ibis* 120:119.

Richardson, M.G. 1985. Status and distribution of the kittiwake in Scotland in 1981. *Bird Study* 32:11-18.

Springer, A.M., Roseneau, D.G., Murphy, E.C. & Springer, M.I. 1984. Environmental controls of marine food webs: food habits of seabirds in the eastern Chuckchi Sea. *Canadian Journal of Fisheries and Aquatic Science* 41:1202-1215.

Stowe, T.J. 1982. Recent population trends in cliff-breeding seabirds in Britain and Ireland. *Ibis* 124:502-510.

Wanless, S., French, D.D., Harris, M.P. & Langslow, D.R. 1982. Detection of annual changes in the numbers of cliff-nesting seabirds in Orkney 1976-80. *J. Anim. Ecol.* 51:785-795.

Yerxa, R. 1993. Black-legged kittiwake colonies: summary of 1993 field work. U.S. National Park Service, Glacier Bay National Park and Preserve.

Yerxa, R. & Hooge, E.R. 1994. Status of selected black-legged kittiwake colonies in Glacier Bay, Alaska: census and productivity report. U.S. National Park Service, Glacier Bay National Park and Preserve.

Yerxa, R., Kralovec, M.L. & Hooge, E.R. 1995. Status of black-legged kittiwake colonies in Glacier Bay National Park and Preserve, Alaska: census and productivity report. U.S. National Park Service, Glacier Bay National Park and Preserve.

Appendix A: Data Entry Forms

PHOTO FRAME ID DATA SHEET - FRONT SIDE (WATERPROOF PAPER)

I99

Name:	Page:

Rissa tridactyla

Colony Photography Data Sheet

Glacier Bay National Park, Gustavus, Alaska, USA

Colony:			Count set #:	
Film Roll #:	Film type:	ASA:	Time photog. began:	Time photog. ended:

Photographers:

Day, Mo.

Frame #	Plot / Subject	Notes

☐ Entered into Database

PHOTOS

PHOTO FRAME ID DATA SHEET - BACK SIDE (WATERPROOF PAPER)

I99

Colony:

Day, Mo.

Frame #	Plot / Subject	Notes

☐ Entered into Database

PHOTOS

KITTIWAKE COUNT DATA SHEET

I99

Name:	Page:

Rissa tridactyla

Slide Count Data Sheet: Birds

Glacier Bay National Park, Gustavus, Alaska, USA

Colony:		Count set #:	
Film Roll #:	Date of photog.:	Time photog. began:	Time photog. ended:

Day, Mo.

Photographers:

Counters:

Plot #	Frames used	# Birds	Notes

☐ Entered into Database

SLIDES: Birds

NEST COUNT DATA SHEET

I99

Name:	Page:

Rissa tridactyla

Slide Count Data Sheet: Nests

Glacier Bay National Park, Gustavus, Alaska, USA

Colony:		Count set #:	
Film Roll #:	Date of photog.:	Time photog. began:	Time photog. ended:

Day, Mo.

Photographers:

Counters:

Plot #	Frames used	# Nests	Notes

☐ Entered into Database

SLIDES: Nests

CHICK COUNT DATA SHEET - FRONT SIDE (WATERPROOF PAPER)

I99

Name:	Page:

Rissa tridactyla

Chick Count Data Sheet

Glacier Bay National Park, Gustavus, Alaska, USA

Day, Mo.

Colony:

Observers:

Plot #	Count set #	Time Begin	Time End	# chicks, single broods	# chicks, 2-chick broods	# chicks, 3-chick broods
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			

Notes:

☐ Entered into Database

CHICKS

CHICK COUNT DATA SHEET - BACK SIDE (WATERPROOF PAPER)

I99

Colony:

Day, Mo.

Plot #	Count set #	Time Begin	Time End	# chicks, single broods	# chicks, 2-chick broods	# chicks, 3-chick broods
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			
		:	:			

Notes:

☐ Entered into Database

CHICKS

Appendix B: Description of Plot Boundaries, by Colony

MARGERIE GLACIER KITTIWAKE COLONY PLOT BOUNDARIES
(from left to right)

Plot 1. Big waterfall at south end of colony to first landslide north.

Plot 2. Landslide to waterfall in deep 45° crack.

Plot 3. 45° crack to 80° crack.

Plot 4. 80° crack to middle of slide.

Plot 5. Slide to vertical crack north of patch of vegetation.

Plot 6. Vertical crack to 135° crack.

Plot 7. Triangle from 135° crack to next crack (≅ 60°).

Plot 8. Sheer face to 60° crack (starts as 45° angle and then angles up).

Plot 9. 60° crack to deep vertical crack (not counting nests inside crack).

Plot 10. Deep crack (including birds inside) to slide.

Plot 11. Slide to wide vertical crack, not counting birds in crack, just those on the south side.

Plot 12. Crack to diagonal black intrusion line, counting birds in crack but not those within the intrusion line.

Plot 13. Black intrusion line (inclusive) to beginning of rock slide, including triangular apron (see photos).

[For 1991 data only: Black intrusion line (inclusive) to end of cliff/Margerie Glacier face, because there were no birds in what later became Plot 14.]

Plot 14. Edge of rock slide to end of cliff/Margerie Glacier face.

BOUNDARIES BETWEEN SUBDIVIDED PLOTS, MARGERIE GLACIER
(from left to right)

Plot 2a to 2b. Birds in the crack are in 2b.

Plot 3a to 3b. Birds in the crack are in 3a.

Plot 8a to 8b. Birds in black sill are in 8a.

Plot 9a to 9b. Birds in crack are in 9b.

Plot 12a to 12b. Birds in the crack are in 12a.

Plot 13a to 13b. Birds on the boundary are in 13a.

LONE ISLAND KITTIWAKE COLONY PLOT BOUNDARIES
(from right to left)

Plots 1, 2, and 3

(Still need to write descriptions of plot boundaries for Lone Island)

Plot 2 to 3. Birds in crack are in plot 3.

KASHOTO GLACIER KITTIWAKE COLONY PLOT BOUNDARIES
(from left to right)

Plots 1, 2, and 3

(Still need to write descriptions of plot boundaries for Kashoto Glacier)

Appendix C: Colony Photographs

OVERALL VIEWS

& PLOT BOUNDARY CLOSE-UPS

Appendix D: Suggested Photo Frames for the Margerie Glacier Colony

Plot 1: 1. Very far left (hasn't had any kittiwakes for several years)

2. Far left (very few kittiwakes: this is the edge of the main nesting area)

3. Lower left

4. Upper left

5. Lower right

6. Upper right

7. Extreme upper right (the separate rock outcrop with birds, at upper right)

Plot 2A: Multiple pictures of two upper left areas, which have expanded since 1995, *plus*:

1. Far left lower

2. Far left upper

3. Lower left

4. Upper left

5. Lower right

6. Upper right

7. Even higher right

Plot 2B: 1. Main section: left

2. Main section: right

3. Above main section (vertical?)

4. Lower right (taken from far right to get birds around corner)

5. Upper right (taken from far right)

Plot 3A: 1. Lower left

2. Upper left

3. Lower right

4. Upper right

Plot 3B: 1. Lower far left

2. Upper far left (*plus*:? one for new birds above this frame?)

3. Middle – left

4. Middle – right

5. Lower far right

6. Upper far right

plus: about six photos of the sheer cliff immediately above the right half of the plot

plus: about four or five photos of the new super-high birds, as zoomed as possible

Plot 4: 1. Lower left

2. Upper left

3. Top right, around the corner (has not had kittiwakes since 1995)

4. Right remaining (has never had kittiwakes)

Plot 5: 1. All (has never had kittiwakes)

Plot 6: 1. Left (make sure you get farthest left birds)

2. Middle

3. Right

4. Upper left-? (new birds in 1996, not photographed in 1997...)

Plot 7: 1. Left

2. Right (taken from slightly to the right)

Plot 8A: 1. Left all (vertical shot) (taken from far left)

2. Lower right

3. Upper right

Plot 8B: 1. Lower left

2. Lower right (taken from around corner to right, IF any birds there at bottom)

3. Upper all

Plot 9A: 1. Lower left

2. Middle left

3. Upper left

4. Lower right

5. Upper right

Plot 9B: 1. Left (lower) (All)

2. Lower right

3. Upper right

Plot 10: 1. Lower left

2. Upper left

3. Lower right

4. Upper right

plus: two to four frames of new super-high birds, as zoomed as possible

Plot 11: 1. Lower left
2. Upper left
3. Lower middle
4. Upper middle
5. High right – but taken from the left
6. Right all (vertical shot) (may require two vertical shots from sea level to height)
plus: one or two frames of new super-high birds, as zoomed as possible

Plot 12A: 1. Lower
2. Middle
3. Top left
4. Top right (taken from further right, to get birds around the corners to the right)

Plot 12B: 1. Lower left
2. Upper left
3. Lower right
4. Upper right

Plot 13A: 1. Left (taken from the left)
2. Right (taken from the right)

Plot 13B: 1. Lower left (down to the water around plot 13A)
2. Upper left (area above 13A) (make sure you get all the way to the boundary)
3. Lower right
4. Middle right
5. Upper right

Plot 14: 1. All (keep boat in gear the whole time for rapid escape from falling ice)

TOTAL = ~100 frames (maximum)

Appendix E: Paper Submitted to Journal of Field Ornithology

PHOTOGRAPHIC VS. VISUAL CENSUSES IN MONITORING SEABIRD COLONIES: A PICTURE IS WORTH A THOUSAND COUNTS

Elizabeth Ross Hooge1 and Rusty Yerxa2

[1] USGS-Biological Resources Division
Alaska Biological Science Center
Glacier Bay Field Station
P.O. Box 140
Gustavus, AK 99826-0140

[2] US National Park Service
Glacier Bay National Park and Preserve
P.O. Box 140
Gustavus, AK 99826

Running Head: Hooge & Yerxa – Photographic vs. visual counts of seabird colonies

Submitted to: *Journal of Field Ornithology*

Send correspondence and proofs to: Elizabeth Ross Hooge
USGS-BRD
Glacier Bay Field Station
P.O. Box 140
Gustavus, AK 99826

(907) 697-2230
(907) 697-2654 FAX

E-mail: elizabeth_ross_hooge@usgs.gov

ABSTRACT

We evaluated the precision and accuracy of two methods and two counting units for censusing Black-legged Kittiwake colonies to determine the most cost effective and accurate technique for long-term monitoring of seabird colonies. Viewing 35 mm color slides produced counts with as much accuracy as and more precision than traditional direct observation. Counts of individuals were more suitable than nest counts for interannual comparisons. Visual censusing was affected by observer experience but not by daily fatigue. Five annual counts were sufficient to detect annual changes in population size with relatively high power. The use of color slide photography is recommended for monitoring cliff-nesting seabirds because it reduces field time, produces a permanent record, and is at least as accurate as direct counts.

Seabirds are often the most easily studied top-level predators in marine ecosystems because they spend most of their time above the water's surface and generally breed in dense localized aggregations (Furness and Camphuysen 1997, Harris and Wanless 1990). As a result, scientists and managers frequently use them as indicators of both biological and physical parameters of the marine environment. Monitoring population change is an integral part of seabird research, as fluctuations in numbers may be correlated with other population parameters including reproductive success, mortality, and foraging strategy, which in turn may interact with external phenomena such as oceanographic conditions, changes in fishery stocks, and pollution or disturbance levels (Furness and Camphuysen 1997, Harris and Wanless 1990, Hatch 1987, Hatch and Hatch 1990, Springer et al. 1984).

Censuses of seabirds have traditionally been accomplished by direct visual observation (Barrett 1985, Barrett and Schei 1977, Bibby et al. 1992, Coulson and White 1956, Nettleship 1976a, Richardson 1985, Stowe 1982, Wanless et al. 1982). More recently, photography has been used with apparent success to monitor several species of seabird (but see Bibby et al. 1992, Harris 1987, Nettleship 1975, Nettleship 1976a, Nettleship 1976b, Nettleship 1978), though counting from photographs has been recommended by some authors only for colonies or portions of colonies that are difficult or impossible to census via direct visual observation (Barrett 1985, Barrett and Schei 1977, Nettleship 1976a).

Photographic techniques are attractive because they offer labor and cost savings over visual observations in the field (Harris 1987). Since we could find no comparisons between direct visual counts of seabird colonies and simultaneously taken photographs, we decided to test the validity of photographic monitoring. We selected the Black-legged Kittiwake (Rissa *tridactyla)* for this experiment because Glacier Bay National Park & Preserve had initiated annual monitoring of this species two years previously, using labor-intensive replicated visual counts. Specifically, our questions were: 1) Do counts from photographs provide levels of accuracy and precision equal to those of more traditional techniques? 2) How many annual counts are sufficient to characterize the population? 3) For direct counts, how large is observer error? and 4) Does observer fatigue or inexperience increase observer error?

STUDY SITE AND METHODS

This study was conducted in Glacier Bay National Park & Preserve, located at the northern end of Southeast Alaska. The bay itself is a 'Y'-shaped fjord estuarine system with numerous glaciers, many of which terminate in the sea. Black-legged Kittiwakes, small long-lived gulls that nest colonially in dense aggregations on cliff faces and feed from the ocean's surface, have experienced increasingly frequent breeding failures throughout the Gulf of Alaska over the past 20 years (Hatch et al. 1993, but see Murphy et al. 1991). A systematic effort to census this species accurately within the Park began in the summer of 1991, and has continued annually to the present.

This paper will focus solely on counts made of the Park's largest colony, next to the Margerie Glacier at the northern end of Tarr Inlet (59°01.50'N, 137°03.00'W). This colony comprises approximately 3,000 pairs of kittiwakes breeding on a 1.5-km section of sheer sea-bounded cliff immediately adjacent to a tidewater glacier (Climo and Duncan 1991, Lentfer 1992, Yerxa 1993, Yerxa and Hooge 1994, Yerxa et al. 1995). The Margerie Glacier colony has been divided into 20 contiguous plots along its length to facilitate counting by decreasing the size of the census units. Plot boundaries follow natural topographic features of the cliff face, and have been documented photographically to assure continuity between years (Bibby et al. 1992, Nettleship 1976a, Stowe 1982).

The census method used from 1991 through 1993 consisted of two observers' counting birds and nests visually with 8-10 power binoculars during mid- to late June, the middle to end of the egg-incubation period. Colony attendance by Alaskan Black-legged Kittiwakes has been shown to be most stable during this time period and from 0900 to 1600 hours daily, Alaska Daylight Time (Barrett 1985, Coulson and White 1956, Hatch and Hatch 1988, Nettleship 1976a, Richardson 1985, Wanless et al. 1982). From 1993 to the present, photographs of the colony were taken during the same time period and times of day. Observers counted or photographed from a skiff 14 to 21 feet long, positioned 30-150 m in front of the colony's cliff face. None of Glacier Bay's kittiwake colonies can be observed from land.

From 1991 through 1993, the entire colony was censused visually at least five times each year for both birds and nests (except 1991: only three nest counts). Each observer independently counted all of the kittiwakes or nests within one plot, and then the two observers compared their results. If the two counts were not within 5% of one another, the plot was recounted using the same method until this criterion was met. All counts, whether 'accepted' by the 5% rule or not, were recorded on data sheets for later entry into a computerized database.

First-year birds, identified by plumage (Coulson 1959), were not counted, nor were groups of more than ten birds not associated with nests; such groups often formed near the water or along the sides or top of nesting areas. We counted only nests with recently added nest material and also, from 1992 onward, at least one bird in attendance (Climo and Duncan 1991; see Discussion). Counts were not conducted in steady rain or strong winds (Coulson and White 1956, Stowe 1982, Wanless et al. 1982), nor in the presence of predators such as Bald Eagles (Haliaeetus *leucocephalus)*, Peregrine Falcons (Falco *peregrinus)*, and Common Ravens (Corvus *corax)*.

In 1993, five complete photographic sets of the entire Margerie Glacier colony were also taken during the same time period (16-26 June) as the visual counts; we ensured enough overlap between adjacent photo frames to enable accurate counting of each plot. The photos were taken with a 35mm camera and 75-210mm zoom lens, using 200 ASA Kodachrome color slide film. A flexible film speed with relatively high resolution was chosen so that photographs could be taken under both sunny and overcast lighting conditions without losing much detail. The plot number and a detailed description of each frame were recorded on data sheets. In 1994 a single visual count of both birds and nests plus four additional nest counts were made during the field photography session (19-25 June); in 1995 one visual nest count was made during the photography (15-16 and 26-29 June), and another two from 9-11 July.

Once the film was developed, one or two observers counted birds and nests for the five photo sets by viewing the slides in a darkened room. We projected the slides onto either a traditional slide-viewing screen, or onto a white dry-erase board. Counting from the board was easier because the images of birds and nests could be marked with dry-erase pens. All slide-based plot counts were recorded on data sheets for subsequent entry into a computerized database.

To calculate each of the five annual visual censuses for birds and nests, both observers' accepted counts for all 20 plots of the colony were summed and averaged. Averaging was not required for the photographic censuses; when two observers worked together on the slides, they generated a single collaborative count for each plot. Additionally, a sample of multiple plots counted by a single observer revealed no significant difference between the original counts and later verification counts (Wilcoxon matched-pairs signed-ranks test, $z = -1.604$, $n = 16$, $P < 0.11$).

For analyses of inter-observer error, fatigue, and observer experience, data from all visual plot counts of birds at the Margerie Glacier colony from 1992 through 1994 were used (from six whole-colony censuses in 1992, five in 1993, and one in 1994). Counts for which the two observers' results did not agree within 5% were categorized as 'not accepted,' whereas those counts that did agree within 5% (and were used in the census results) were labeled 'accepted.'

Count quality was taken to be the proportion of counts that were 'accepted.' The first time the two observers counted a plot during each whole-colony census was considered a 'first' count, whether or not it was 'accepted.' 'Experienced' observers were defined as having spent at least 15 hours visually counting kittiwakes during their lifetime; a plot count could therefore be conducted by 0, 1, or 2 experienced observers. The number of hours censusing elapsed in a day was calculated cumulatively beginning with each day's first plot count and ending with that day's final count; yearly and lifetime experience (number of hours) were similarly summed from the beginning of the year or the observer's first count. Cumulative time per census was calculated in the same way from the start of each whole-colony count. Inter-observer error is the relative difference between the two observers' counts of a single plot, as a percentage of the plot mean.

We conducted a bootstrap analysis (Efron 1982) of both bird counts and standardized bird counts using Resampling Stats (Bruce 1991). We sampled with replacement from our 33 photographic and direct bird censuses from 1991 through 1995, running 5,000 replicates for each interval from 2 to 15 counts. Standardized bird counts were also examined in order to control for annual variation in bird numbers; standardizing was accomplished by subtracting the annual mean number of kittiwakes for each year from the individual counts.

Power analysis was performed using the program MONITOR (Gibbs 1995, available on the Internet at http://www.im.nbs.gov/powcase/powcase.html) to determine the ability of visual and photographic censuses to detect population changes through time. For the purposes of the MONITOR simulation, the Margerie Glacier colony was considered to be a single plot, counted five times per year for seven consecutive years, corresponding to our five counts each year from 1991-1997. The initial values entered into the simulation were the 1992-1994 visual census mean and SD for birds (3715.1 $\pm$ 339.2, n = 12) and the 1993-1995 values for the slide counts of birds (3949.4 $\pm$ 262.7, n = 15). In addition, we ran the simulation for both eight and ten counts per year using the slide-based mean and SD. The results report the probabilities of detecting significant change at the 0.05 level, two-tailed.

Remaining analyses were performed with StatView (Abacus Concepts 1996), using nonparametric statistical tests (Siegel 1956). Two-tailed tests were employed except when the direction of the expected difference was predicted *a priori*. Variances are provided as standard errors for statistical tests, and as standard deviations for descriptive statistics.

RESULTS

Each visual census of the whole colony, for both individuals and nests, required 6.3 to 15.8 hr of elapsed work time to complete, or one to two work days ($\bar{x} \pm SD = 10.0 \pm 3.2$, $n = 12$). Five nest-only counts were performed in 1994 and 1995, requiring 3.6 to 8.8 hr each to complete ($\bar{x} = 5.8 \pm 2.1$). Photographing the entire colony once required two to three rolls of 36-exposure film, and took approximately two hours ($\bar{x} = 1.9 \pm 0.6$, range: 1.2 - 3.2 hr, $n = 15$). Counting birds or nests only from one set of slides required approximately six hours when done by two observers and nine hours when performed by a single observer. Counting both birds and nests simultaneously from a set of slides took from ten hours with two observers to sixteen hours for one person working alone. Poor photo quality (focus, shutter speed, lighting, or contrast) increased the amount of time required to perform the counts.

Photographic censuses varied little from direct censuses (Fig. 2.1). There was no significant difference between the number of kittiwakes or nests counted by the two techniques (Wilcoxon matched-pairs signed-ranks test, $z = -0.135$, $n = 5$, $P \leq 0.89$ for individuals; $z = -0.944$, $n = 5$, $P \leq 0.35$ for nests). In 1994 the single visual bird census recorded 4222 birds, while the five slide counts yielded a mean ± 1 SD of 4188 ± 82.

Nest counts varied more than kittiwake counts both within and between years (Table 2.1). Bootstrapping showed that the asymptote for the 90% confidence intervals of both the mean bird counts and the mean standardized bird counts occurred between 5 and 10 counts (Fig. 2.2). We then examined the power curves for our census techniques (Fig. 2.3), and found that under the current photographic monitoring protocol our statistical power is greater than 0.9 to detect an annual change in population size of two percent or more at the 0.05 significance level. Surprisingly, visual censusing provided slightly less power. Increasing the number of annual replicated counts from five to eight or ten provided a slight increase in power.

The number of hours elapsed since the beginning of each day's work (i.e. daily fatigue) had no effect on the quality of the visual counts (Mann-Whitney *U* test, $z = -0.827$, $n1 = 163$, $n2 = 220$, $P \leq 0.20$). Both the cumulative number of hours worked each year and the observers' lifetime experience did affect the quality of the visual counts, with 'accepted' counts occurring significantly later (Mann-Whitney *U* test, $z = -2.398$, $n1 = 163$, $n2 = 220$, $P \leq 0.01$ for yearly experience; $z = -2.065$, $n1 = 163$, $n2 = 222$, $P \leq 0.02$ for lifetime experience); yearly and lifetime experience were highly correlated (Spearman rank correlation, $rs = 0.449$, $n = 383$, $P \leq 0.0001$). However, the number of 'experienced' observers did not influence visual count quality (? 22 = 2.07, $n = 386$, $P \leq 0.36$). Lastly, the amount of time required to make one complete visual count of the colony (both birds and nests) was not correlated with either the observers' yearly or lifetime experience (Spearman rank correlation, rs = -0.133 and 0.315 respectively, both n = 12, $P \leq 0.66$ and 0.30).

Inter-observer error was higher when a plot was counted the first time in each colony count; 'first' counts of kittiwakes averaged 6.7% error, whereas the 'accepted' plot counts averaged 2.3%. The five 1993 slide counts of birds, which varied little from the 'accepted' visual counts, more closely approached significance when compared to the 'first' visual counts (Wilcoxon matched-pairs signed-ranks test, z = -1.483, n = 5, $P \leq 0.14$).

DISCUSSION

There is disagreement in the literature regarding the unit to be counted when monitoring Black-legged Kittiwake colonies. The apparently occupied nest (AON) is the counting unit most widely recommended (Barrett 1985, Barrett and Schei 1977, Bibby et al. 1992, Coulson and Thomas 1985, Coulson and White 1956, Nettleship 1976a, Richardson 1985, Stowe 1982), yet there is substantial variation in the way this term is defined and applied. Some workers count only nests with at least one member of the breeding pair in attendance (Bibby et al. 1992, Coulson and White 1956, Stowe 1982, Wanless et al. 1982), whereas others may include some unoccupied nest sites (Barrett 1985, Barrett and Schei 1977, Hatch and Hatch 1988, Nettleship 1976a see also Methods).

Furthermore, counting nests, occupied or not, relies on varying and often ambiguous criteria, such as "obviously... built or maintained during the year in question" (Barrett 1985) and "must have some built-up edge to qualify" (Nettleship 1976a see also Methods). Some nonbreeding birds not only occupy sites on the cliff, but also bring nest materials to them. Although these structures are "generally less well built and less obvious than active nests" (Bibby et al. 1992, Hodges 1977, Nettleship 1976a, Wanless et al. 1982), discerning them from active nests clearly requires an element of observer subjectivity (Hatch and Hatch 1988, Wanless et al. 1982). Moreover, whitewashed roosting sites marked solely by guano (Bibby et al. 1992, Nettleship 1976a) should also be omitted from AON's, keeping in mind that 'active' nests, too, usually have "a covering of white faeces" (Bibby et al. 1992).

However, some researchers have counted individual kittiwakes instead of, or in addition to, AON's (Barrett and Schei 1977, Hatch and Hatch 1988, Hodges 1977, Murphy et al. 1991, Richardson 1985, Wanless et al. 1982). Bird counts at a colony are reported to experience greater diurnal, daily, and seasonal fluctuations than do nest counts (Barrett 1985, Coulson and White

1956, Hatch and Hatch 1988, Hodges 1977, Nettleship 1976a, Wanless et al. 1982). Also, counts of birds do not accurately represent the breeding population, since nonbreeders of various types attend the colony as well (Bibby et al. 1992, Coulson 1959, Coulson and White 1956, Hodges 1977, Nettleship 1976a). In contrast, nest counts are reasonably stable within the season and they "convey more information about the size of the breeding population" (Hatch and Hatch 1988); most authors cite these two reasons for selecting AON's as the counting unit.

Nonetheless, there are compelling arguments against counting nests and in favor of counting individuals. "Most people with practical experience of seabird counting have serious reservations about the usefulness of this category [nests] as it necessitates a human deciding where it is possible for a bird to lay or incubate an egg" (Wanless et al. 1982). Identifying birds is a much less ambiguous task, and is therefore less subject to observer bias and inter-observer variance (Hatch and Hatch 1988, Wanless et al. 1982). Such counts index the size of the entire population (both breeders and nonbreeders), an equally valid measure though with different emphasis. Most importantly, Hatch & Hatch (1988) demonstrated that counts of birds were superior to nest counts for detecting *annual* changes in the numbers of Black-legged Kittiwakes. Mean attendance had a much lower coefficient of variation *among years* and thus more closely followed real population change through time than did nest numbers (Hatch and Hatch 1988, Irons et al. 1987).

Our results concur with Hatch & Hatch (1988) regarding the interannual stability of colony attendance; both within-year and between-year variances of kittiwake counts at the Margerie Glacier colony were smaller than those for nest counts (Table 2.1). Our within-year coefficient of variation for nests, which averaged slightly higher than that for bird counts, was greater than expected, since other workers have all reported that yearly nest numbers were more stable than bird numbers (see above). One possible explanation for this relatively large variance is the high level of predation experienced by kittiwakes at the Margerie Glacier colony. Numerous predation events by multiple individuals of several different species have been observed at this colony each year (Chapter IV); changes in numbers of attended nests may reflect nest losses, abandonment, or relocations due to predation pressure.

Regardless of the counting unit selected, we have demonstrated that a carefully taken, appropriately timed series of 35mm color slide sets can produce a precise and accurate census of a moderately large Black-legged Kittiwake colony. Numbers of both birds and nests observed directly in the field did not differ significantly from those determined by viewing projected slides (Fig. 2.1). Moreover, our bootstrapping of bird counts (Fig. 2.2) showed that five annual photographic samples were sufficient to capture the majority of variation and produce a precise and accurate census. The standard deviations were small compared to the Margerie Glacier colony's population size, and more samples did little to further decrease the variance.

Our power analysis (Fig. 2.3) confirmed that increasing the number of counts to eight or ten produced only small gains, since five yearly photographic counts were already capable of detecting significant annual changes as small as two percent with a probability of at least 90% (Fig. 2.3). Other workers have also recommended three to ten annual replicates for censusing Black-legged Kittiwake colonies in order to adequately compensate for daily and seasonal variation in colony attendance (Barrett 1985, Bibby et al. 1992, Hatch and Hatch 1988, Nettleship 1976a, Stowe 1982, Wanless et al. 1982).

The use of color slides for monitoring seabird colonies has not previously been described, although color videography has been used successfully for estimating waterfowl populations (e.g.Anthony et al. 1995). High quality black and white photos, enlarged to 20 x 25 cm or larger, have been used to count Black-legged Kittiwakes and other seabird species, but the accuracy of the technique has not been compared with direct censusing (Barrett 1985, Barrett and Schei 1977, Harris 1987, Nettleship 1975, Nettleship 1976a, Nettleship 1976b, Nettleship 1978). Projecting our slides onto a screen provided all the enlargement necessary for detailed viewing and counting, and allowed us to vary the degree of image enlargement. Monochrome print enlargements cost substantially more than developing color slides; this expense may be of concern when multiple annual photo count sets are desired, as in this study.

To enable long-term storage of the photographic record, film with a short archival life (e.g. E-6 process) should be avoided. With photo counts, the images can be reviewed years later to confirm results and analyze other parameters such as spatial changes or habitat use, an important consideration for long-term data sets (Nettleship 1975, Nettleship 1976a, Nettleship 1976b, Nettleship 1978).

Contrary to our expectations, we found no evidence that daily fatigue affected the accuracy of direct observations. Nonetheless, visual censusing in the field is more prone to observer error than slide-based counts due to physical fatigue, environmental conditions such as wind, precipitation, waves, and currents (Stowe 1982), and temporal constraints (inability to observe a colony plot repeatedly or for a protracted time period). These factors plus other inherent variation were among the causes of our average inter-observer differences for 'first' and 'accepted' direct bird counts of 6.7% and 2.3% respectively. Although recounting a plot if the two observers' numbers were not within 5% of one another did compromise the independence of the two counts, we continued this practice because of the resultant substantial decrease in inter-observer error (Barrett and Schei 1977). Using 'first' counts would have introduced further variance and might have compromised our accuracy, as demonstrated by the larger difference between the slide and 'first' counts in 1993 than between the slide and 'accepted' counts.

Although photographs do require some subjective interpretation due to their two-dimensional nature, much observer error is eliminated by the photographic technique since viewing slides generates a single count that can be verified at any time. Probably most errors in the slide-based censusing were due to poor image quality. The photographer should avoid overexposure, variable lighting, shutter speeds of less than 1/500th of a second, and careless focussing, all of which can make accurate counting difficult and greatly slow the procedure. The film selected should be relatively fast yet have high resolution in order to retain image detail while maintaining flexibility under different lighting conditions.

While experience did influence the visual counts of the kittiwake colony, the effect was less extensive than we had predicted. The number of 'experienced' observers did not significantly affect the quality of our visual censusing, but greater within-year and lifetime experience, which are highly correlated, increased the proportion of 'accepted' counts. Neither yearly nor lifetime hours of counting kittiwakes was correlated with the amount of time required to directly census the entire colony. Though our experience indicates that completely naïve observers have difficulty making accurate counts (pers. obs.), it appears that less than 15 hours are sufficient to train new workers.

Direct visual counts of the entire Margerie Glacier colony, both birds and nests, averaged 10 hours, while taking one set of photos and counting from the slides required about 12 hours (both using two workers). Counts of nests only took about six and eight hours respectively. Although the total time expended is similar, the latter method required much less field time since the photography itself took less than two hours on average. Because of the cost and complex logistics required for field sessions, photography is much easier and less expensive to accomplish, yet retains the accuracy and improves the precision of the traditional direct censusing method. Additional advantages to this technique include the ability to take multiple sets of colony photographs within brief periods of good weather, the flexibility to perform the slide-counting during less busy times of the year, the reduced observer error, and the permanence of the photographic record.

To be viable in an era of decreasing budgets, the cost and difficulty of long-term monitoring programs must be minimized while maintaining precision and accuracy. Although censusing individual kittiwakes seems to furnish a better basis for interannual comparisons of population size, nest numbers provide more information about annual reproductive effort. Both measures were successfully documented by our 35 mm color slide methodology. These results should substantially reduce the expense required to sustain annual monitoring of Black-legged Kittiwakes and serve to validate the use of photographic techniques in seabird censuses.

ACKNOWLEDGMENTS

Data were collected by L. Climo, T. Duncan and H. Lentfer in 1991 and 1992. We thank M.L. Kralovec, A. Maselko, C. Soiseth, and S.R. Whitney for their help in the field. P.N. Hooge furnished statistical and editorial advice. This work was funded by an NSF pre-doctoral fellowship (to ERH), by the USGS-Biological Resources Division, and by the National Park Service. This work was conducted in Glacier Bay National Park and Preserve with the permission of the National Park Service. This research represents partial fulfillment of the requirements for the Ph.D. (for ERH) from the University of California, Berkeley.

LITERATURE CITED

Abacus Concepts. 1996. StatView. Abacus Concepts, Inc. Berkeley, CA.

Anthony, R.M., W.H. Anderson, J.S. Sedinger and L.L. McDonald. 1995. Estimating populations of nesting brant using aerial videography. Wildl. Soc. Bull. 23:80-87.

Barrett, R.T. 1985. Further changes in the breeding distribution and numbers of cliff-breeding seabirds in Sor-Varanger, North Norway, 1975-1983. Fauna norv. Ser. C, Cinclus. 8:35-39.

Barrett, R.T. and P.J. Schei. 1977. Changes in the breeding distribution and numbers of cliff breeding sea birds in Sor-Varanger north Norway. Astarte. 10:29-36.

Bibby, C., N.D. Burgess and D.A. Hill. 1992. Bird census techniques. Academic Press, New York.

Bruce, P.C. 1991. Resampling Stats. Resampling Stats, Inc. Linthicum, MD.

Climo, L. and T. Duncan. 1991. The status of black-legged kittiwakes at Glacier Bay National Park and Preserve, Alaska in 1991. U.S. National Park Service, Glacier Bay National Park and Preserve,.

Coulson, J.C. 1959. The plumage and leg colour of the kittiwake and comments on the non-breeding population. British Birds. 52:189-196.

Coulson, J.C. and C.S. Thomas. 1985. Changes in the biology of the Kittiwake (Rissa *tridactyla):* a 31-year study of a breeding colony. J. Anim. Ecol. 54:9-26.

Coulson, J.C. and E. White. 1956. A study of colonies of the kittiwake *Rissa tridactyla* (L.). Ibis. 98:63-79.

Efron, B. 1982. The jackknife, the bootstrap, and other resampling plans. Society for Industrial and Applied Mathematics, Philadelphia.

Furness, R.W. and C.J. Camphuysen. 1997. Seabirds as monitors of the marine environment. ICES Journal of Marine Science. 54:726-737.

Gibbs, J.P. 1995. MONITOR.

Harris, M.P. 1987. A low-input method of monitoring kittiwake *(Rissa tridactyla)* breeding success. Bio. Cons. 41:1-10.

Harris, M.P. and S. Wanless. 1990. Breeding success of British kittiwakes *(Rissa tridactyla)* in 1986-1988: evidence for changing conditions in the northern North Sea. Journal of Applied Ecology. 27:172-187.

Hatch, S.A. 1987. Did the 1982-1983 El Nino-Southern Oscillation affect seabirds in Alaska? Wil. Bull. 99:468-474.

Hatch, S.A., G.V. Byrd, D.B. Irons and G.L. Hunt Jr. 1993. Status and ecology of kittiwakes (Rissa *tridactyla* and *R. brevirostris)* in the North Pacific. In: Vermeer, K., K.T. Briggs, K.H. Morgan & D. Siegel-Causey (eds). The status, ecology, and conservation of marine birds of the North Pacific. Canadian Wildlife Service Special Publication, Ottawa, Canada, pp. 140-153.

Hatch, S.A. and M.A. Hatch. 1988. Colony attendance and population monitoring of black-legged kittiwakes on the Semidi Islands, Alaska. The Condor. 90:613-620.

Hatch, S.A. and M.A. Hatch. 1990. Components of breeding productivity in a marine bird community: key factors and concordance. Can. J. Zool. 68:1680-1690.

Hodges, A.F. 1977. Counts at kittiwake colonies. Bird Study. 24:119-125.

Irons, D.B., D.R. Nysewander and J.L. Trapp. 1987. Changes in colony size, and reproductive success of black-legged kittiwakes in Prince William Sound, Alaska, 1972-1986. U.S. Fish and Wildlife Service.

Lentfer, H. 1992. Census of breeding population and productivity of selected black-legged kittiwake colonies in Glacier Bay National Park & Preserve, Alaska. U.S. National Park Service, Glacier Bay National Park and Preserve.

Murphy, E.C., A.M. Springer and D.G. Roseneau. 1991. High annual variability in reproductive success of Kittiwakes (Rissa *tridactyla* L.) at a colony in western Alaska. J. Anim. Ecol. 60:515-534.

Nettleship, D.N. 1975. A recent decline of Gannets, *Morus bassanus*, on Bonaventure Island, Quebec. Can. Field-Nat. 89:125-133.

Nettleship, D.N. 1976a. Census techniques for seabirds of arctic and eastern Canada. Canadian Wildlife Service.

Nettleship, D.N. 1976b. Gannets in North America: present numbers and recent population changes. Wil. Bull. 88:300-313.

Nettleship, D.N. 1978. Population analysis of colonial nesting seabirds from photography. Ibis. 120:119.

Richardson, M.G. 1985. Status and distribution of the kittiwake in Scotland in 1981. Bird Study. 32:11-18.

Siegel, S. 1956. Nonparametric statistics for the behavioral sciences. McGraw-Hill, New York.

Springer, A.M., D.G. Roseneau, E.C. Murphy and M.I. Springer. 1984. Environmental controls of marine food webs: food habits of seabirds in the eastern Chuckchi Sea. Canadian Journal of Fisheries and Aquatic Science. 41:1202-1215.

Stowe, T.J. 1982. Recent population trends in cliff-breeding seabirds in Britain and Ireland. Ibis. 124:502-510.

Wanless, S., D.D. French, M.P. Harris and D.R. Langslow. 1982. Detection of annual changes in the numbers of cliff-nesting seabirds in Orkney 1976-80. J. Anim. Ecol. 51:785-795.

Yerxa, R. 1993. Black-legged kittiwake colonies: summary of 1993 field work. U.S. National Park Service, Glacier Bay National Park and Preserve.

Yerxa, R. and E.R. Hooge. 1994. Status of selected black-legged kittiwake colonies in Glacier Bay, Alaska: census and productivity report. U.S. National Park Service, Glacier Bay National Park and Preserve.

Yerxa, R., M.L. Kralovec and E.R. Hooge. 1995. Status of black-legged kittiwake colonies in Glacier Bay National Park and Preserve, Alaska: census and productivity report. U.S. National Park Service, Glacier Bay National Park and Preserve.

TABLES

Table 2.1. Shown in the table are the means and standard deviations, the coefficients of variation (CV), and sample sizes (N) for all counts from 1991-1995, by year and counting unit. The category "All Years" combines all counts from all years. The category "Across Years" is the comparison of the five annual means (1991-1995).

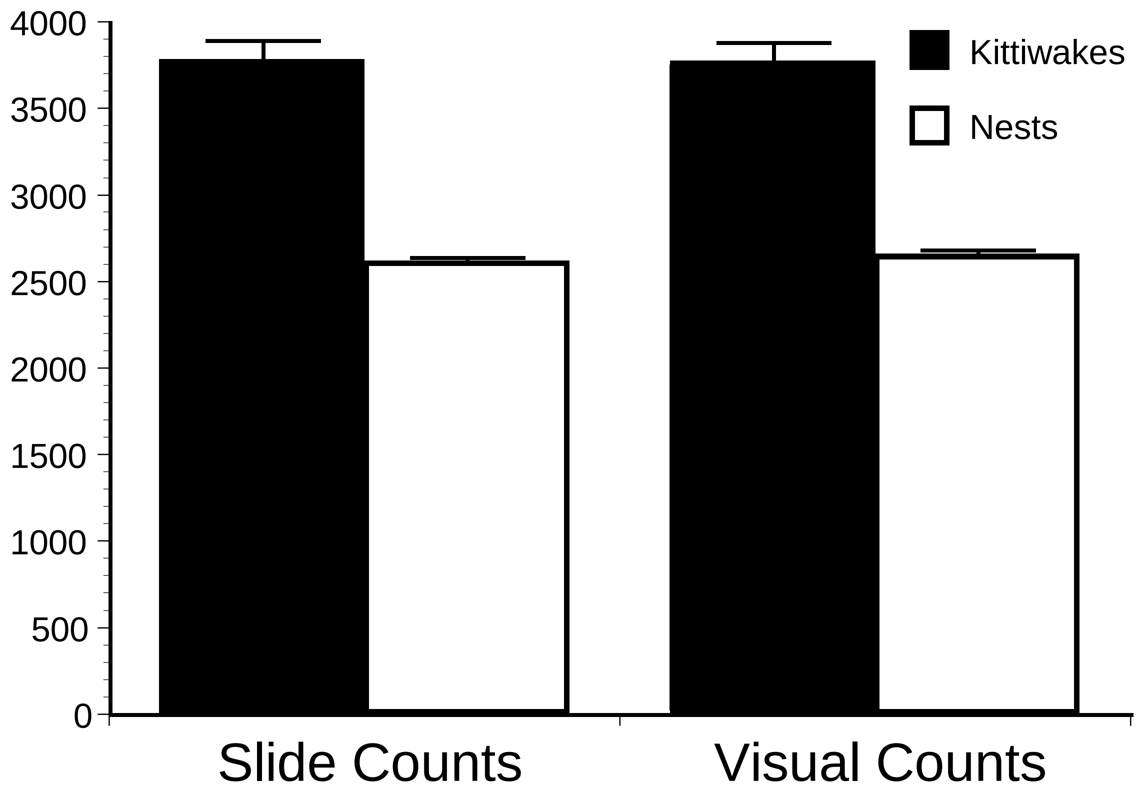
Counting Unit		All Years	1991	1992	1993	1994	1995	Across Years
Individuals	$\bar{x}$±sd	3884±317	4059±279	3660±409	3686±188	4193±75	3970±193	3913±234
	CV	0.082	0.069	0.112	0.051	0.018	0.049	0.060
	N	33	6	6	10	6	5	5
Nests	$\bar{x}$±sd	2729±236	2939±47	2675±175	2635±63	3193±12	2454±75	2779±289
	CV	0.087	0.016	0.065	0.024	0.004	0.030	0.104
	N	24	3	5	10	3	3	5

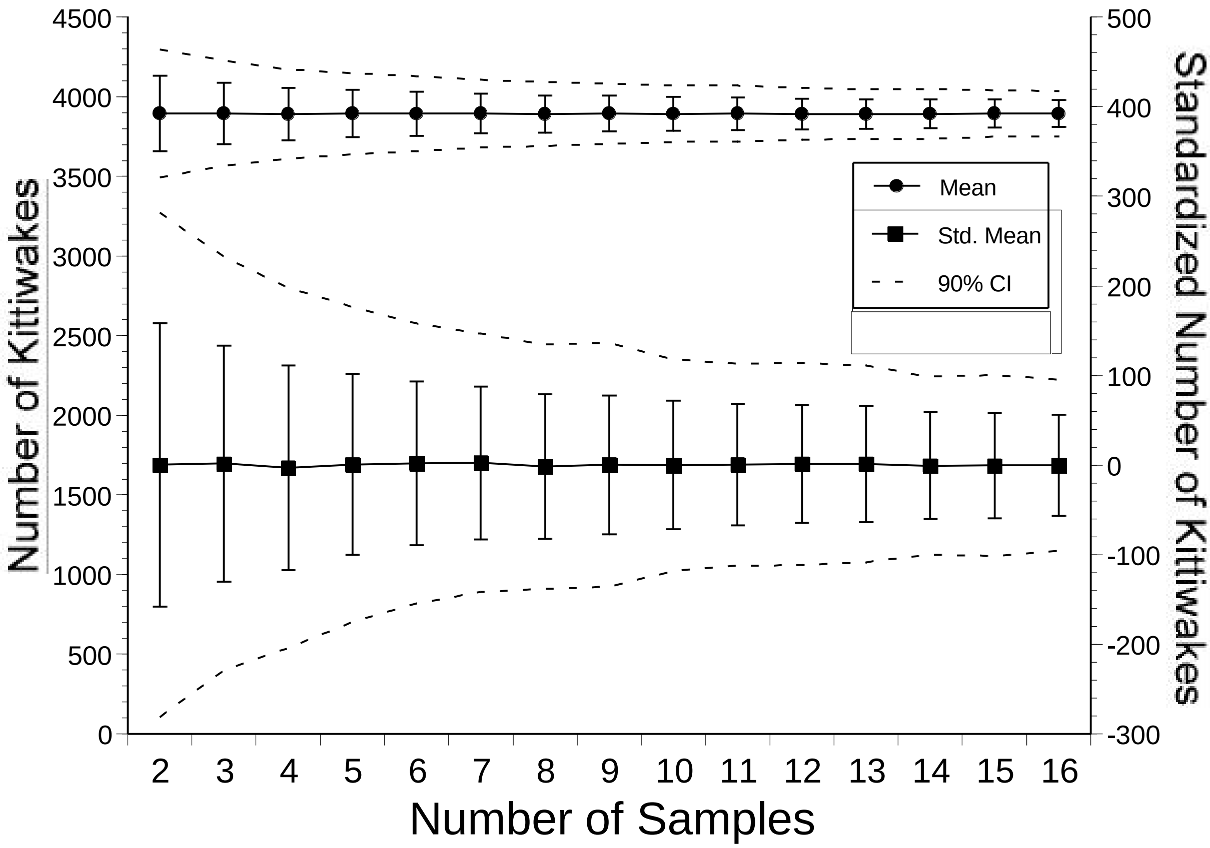
FIGURES

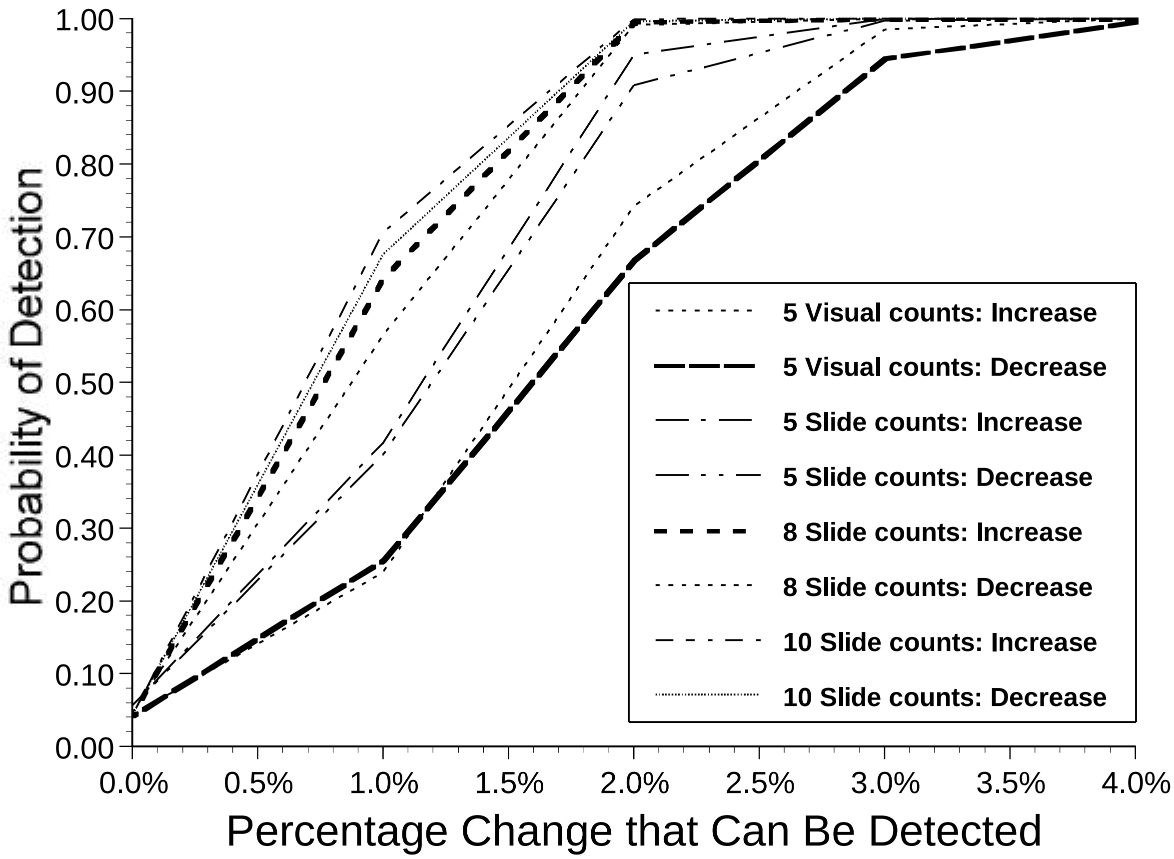
Fig. 2.1. Comparison of visual and slide counts for both nests and individuals in 1993. The mean and standard error of the mean are shown; $n = 5$ pairs for each category. There were no differences between the two census techniques.

Fig. 2.2. Bootstrap examination of the effect on population counts of numbers of censuses conducted. The upper lines (and left-hand axis) show the population counts with 90% confidence intervals at each sample size. The lower lines (and right-hand axis) show the standardized population counts with 90% confidence intervals. The standardized axis refers to counts above or below the mean. Means ± SD are also depicted.

Fig. 2.3. Power analysis of visual vs. slide counts as well as different numbers of slide-based censuses. The probability of detecting a significant change (either increase or decrease) in population size at the 0.05 level, two-tailed, is shown.


4000
3500
3000
2500
2000
1500
1000
500
0
Kittiwakes
Nests
Slide Counts
Visual Counts


Number of Kittiwakes
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Standardized Number of Kittiwakes
500
400
300
200
100
0
-100
-200
-300
Mean
Std. Mean
90% CI
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Number of Samples


1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Probability of Detection
0.0%
0.5%
1.0%
1.5%
2.0%
2.5%
3.0%
3.5%
4.0%
Percentage Change that Can Be Detected
5 Visual counts: Increase
5 Visual counts: Decrease
5 Slide counts: Increase
5 Slide counts: Decrease
8 Slide counts: Increase
8 Slide counts: Decrease
10 Slide counts: Increase
10 Slide counts: Decrease

Appendix F: Timeline for Annual Monitoring of Black-legged Kittiwakes

1 May	Purchasing: film, waterproof paper, pens/pencils.
	Check availability and readiness of other field gear (see Appendix G); purchase if necessary.
	Prepare data sheets – photography, chick and slide counts.
Last week of May	Photograph Riggs Glacier colony – if avoiding non-motorized waters in upper East Arm after 1 June.
May-June	Take advantage of otherwise-scheduled trips into Johns Hopkins Inlet (closed 1 May to 30 June) to photograph Kashoto Glacier colony, if this colony is still active. Also photograph, as ice and destination permit: Johns Hopkins Glacier and Gilman Glacier colonies.
May-August	Take advantage of otherwise scheduled trips to the Cross Sound and Outer Coast areas to photograph – or visually survey, including chick counts if after 3rd week in July – colonies there (East Fern Harbor Rock, Middle Passage Rock, Taylor Islet, two separate rocks/islets near Cape Spencer, Astrolabe Point, Sugarloaf Island, Boussole Head, Cenotaph Island).
10-25 June	Photograph South Marble Island, Lone Island, Gloomy Knob, and Margerie Glacier colonies.
1 July	Mail out exposed film rolls for development.
23 July - 15 August	Make two to three chick counts at kittiwake colonies, timed approximately one week apart.
1 July – 15 August	If any Johns Hopkins Inlet colonies remain uncensused, photograph and/or make chick counts (– mail film).
31 August	Revisit colonies with chicks to ascertain youngest nestling survival or abandonment.
September-October	Archive field notes and data sheets from photography and chick counts.
	Label each slide with project ID, year, and roll number.

Count birds and nests from slides.

Archive both slides and slide data sheets.

Enter bird, nest, and chick count data into databases.

Appendix G: Checklist of Equipment Needed for Annual Kittiwake Monitoring

- Write-In-The-Rain or DuraCopy **paper** for xeroxing photo and chick count data sheets.

Colony Photography (at least two people)

- ~20 double-sided colony photography **data sheets** on waterproof paper.
- Several black Ultra Fine Point Sharpie **pens** and/or **pencils**.
- **Field notebook**.
- ~20 rolls of 36-exposure Kodachrome 200 ASA (and possibly 400 ASA) color slide **film**.
- 35 mm **camera** with 75-210 (or equivalent) **zoom lens**. Preferably camera would be automatic, including automatic focussing.
- **Stronger zoom lens** to document highest nesting areas.
- Protective (padded and waterproof) **case** for camera and lenses.
- **Binoculars**, 8x30 to 10x40, high quality: one pair per person.
- **Protocol Handbook** for kittiwake monitoring.
- Field copy of **colony and plot boundary photographs**.
- **Waterproof bags** for all gear (except camera).

Chick Counts (at least two people)

- ~2 double-sided chick count **data sheets** per colony per visit, on waterproof paper.
- Several black Ultra Fine Point Sharpie **pens** and/or **pencils**.
- **Field notebook**.
- **Binoculars**, 8x30 to 10x40, high quality: one pair per person.
- **Protocol Handbook** for kittiwake monitoring.
- Field copy of **colony and plot boundary photographs**.
- One multi-field mechanical counter, or two to three single '**tally-whackers**.'
- **Waterproof bags** for all gear.

Slide-based Counting of Birds and Nests (one or two people)

- Data **slides**, developed, numbered, and labeled.

- Single-sided nest and bird count **data sheets**, on regular paper, ~10 per count set for the Margerie Glacier colony, ~1 or 2 per count set for smaller colonies.
- One or two empty **slide carousels**.
- One or two **slide projectors** with zoom lens, remote frame advance, and remote focussing.
- Unused darkened **room** with long projection distance and large white **dry-erase board**, multiple colors of **dry-erase markers**.

Appendix H: List of Black-legged Kittiwake Colonies in Glacier Bay

Kittiwake colonies within Glacier Bay proper

- Margerie Glacier
- Kashoto Glacier – declining since 1995; may not still have kittiwakes nesting
- Johns Hopkins Glacier: extremely difficult to reach due to icebergs & glacier
- Gilman Glacier: extremely difficult to reach due to icebergs & glacier
- Gloomy Knob
- Lone Island – declining since 1995; may still have kittiwakes nesting
- Riggs Glacier
- South Marble Island – 2 separate groupings: one at far left, one near sea lion haulout

Kittiwake colonies on Outer Coast and in Cross Sound area:

- Middle Passage Rock – in Inian Islands, not within Park boundaries
- East Fern Harbor Rock – maybe
- Taylor Islet – probably abandoned
- Two separate islets/rocks near Cape Spencer
- Sugarloaf Island/Astrolabe Point – probably abandoned
- Boussole Head
- Cenotaph Island

Appendix I: FGDC Metadata

INCLUDING DATABASE FIELD DEFINITIONS

June, 1998 note: These Metadata were last entered nearly three years ago and thus require updating to reflect certain changes to the databases since that time. However, they provide nearly all of the database structure and field definitions that are needed for data entry.

```
                  GLBA Metadata Information File
As of:  8/14/95 8:38:11 AM

----------------------- Project Information ----------------------------
----
Project: Kittiwakes
Owner  : Elizabeth Ross Hooge
Created: 6/1/92 8:35:18 AM
Summary:
     A project to research and develop Black-legged Kittiwake
     colony monitoring techniques, to monitor Glacier Bay
     National Park's kittiwake population and reproductive
     trends, and to study their foraging ecology.  Techniques
     for monitoring include visual counts of birds, nests, and
     chicks, as well as photographic (35 mm slide) counts of
     birds at colonies.  Foraging ecology techniques include
     radio-tracking of individual kittiwakes, surveys of
     foraging kittiwakes, and oceanographic measurements of
     foraging vs. non-foraging sites.
GLBA Path: K:\PROJECTS\KITTIWAK

----------------------- GLBA File Information --------------------------
------
GLBA File Name: k:\projects\kittiwak\data\adults.dbf
GLBA Last Update By: Elizabeth Ross Hooge
GLBA Last Update On:7/14/95 12:10:42 PM
------------------------------------------------------------------------
------

Identification Information
     Originator (7.1.1):
       Elizabeth Ross Hooge
     Publication Date (7.1.2):
       Not Available

  Citation Information:
     Title(1.1):
       Adult kittiwake counts at Glacier Bay colonies
     Abstract(1.2.1):
       This database contains the colony counts for Glacier Bay
       National Park's Black-legged Kittiwakes, from 1992 through
       the present.  Only adult birds in attendance at a colony
       are counted.  Colonies at Margerie Glacier, Kashoto
       Glacier, Lone Island, and South Marble Island are included.
       There was a decrease from 1991 (1991 data are not yet
       included in this database, however) to 1993 at Margerie
       Glacier, the Park's largest colony, followed by the highest
       attendance yet recorded in 1994.  There are multiple
       entire-colony counts for each year at Margerie Glacier, at
       least five per year until 1994, when photographic
       monitoring first started to replace the visual counts after
```

research showed the photographs to be equally accurate, with less effort expended. Visual counting potentially may not occur in subsequent years at any of the colonies due to the success and ease of the photographic technique.

Purpose(1.2.2):

Black-legged Kittiwakes in the Gulf of Alaska have recently experienced widespread population declines and frequent reproductive failures, as evidenced by monitoring occurring at many colonies throughout the region. This project aims to monitor Glacier Bay's kittiwakes using methodologies consistent with these other studies so that comparisons can be made, and to develop a photographic monitoring technique that requires less effort than previous techniques had. This new monitoring technique will then be available for use by other National Parks in Alaska interested in monitoring kittiwakes. The Park is interested, in light of the nearby recent population and reproductive declines, in knowing and monitoring the status and trends of the kittiwake colonies within the Park.

Time Period of Content(1.3):

6/1/92 - present

Status

Progress(1.4.1):

In Work

Maintenance and Update Frequency(1.4.2):

Annually

Spatial Domain

Description of Geographic Extent(1.5.0):

This database includes adult kittiwake counts from most of the colonies known to exist in Glacier Bay National Park. At the present, no data are entered for any of the outer (Gulf of Alaska) coast colonies, so this database includes colonies from Lone Island and South Marble Island in the middle of Glacier Bay proper, up through Tarr Inlet and Johns Hopkins Inlet. No colonies are currently known from Glacier Bay's East Arm, although there is a report of a new Black-legged Kittiwake colony at the Riggs Glacier in the East Arm, in the summer of 1995 (as of present this new colony has not yet been counted).

Bounding Coordinates:

West Bounding Coordinate(1.5.1.1):

13710.00

East Bounding Coordinate(1.5.1.2):

13546.00

North Bounding Coordinate(1.5.1.3):

5940.00

South Bounding Coordinate(1.5.1.4):

5820.00

Keywords

Theme Keyword Thesaurus(1.6.1.1):

None

Theme Keyword(1.6.1.2):

Ecology

Population

Productivity
Census
Distribution
Natural Resources
Bird
Colony
Seabird
Glacier Bay National Park

Access Constraints(1.7):

Some Glacier Bay Ecosystem Project data sets may contain data with access constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. Data sets which are not complete may have access constraints until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any access constraints.

Use Constraints(1.8):

Some Glacier Bay Ecosystem Project data sets may contain data with use constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. In addition some data sets are collaborative efforts with outside researchers and represent unpublished work for which we request respect for intellectual property rights. Some data sets are not complete and if access is given the use may be restricted until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any use constraints.

Data Quality Information

Attribute Accuracy:

Attribute Accuracy Report(2.1.1):

The counts of adult kittiwakes at a colony are subject to observer error. Observers unfamiliar with binoculars, birds, seabird colonies, and these kittiwake colonies in particular, require more time and are less accurate in their counting. In addition to observer error, other factors affecting the accuracy and quality of counts include inclement weather and predators. Precipitation causes binoculars to fog up, making counting difficult. Predators such as Bald Eagles, Golden Eagles, Peregrine Falcons, and Ravens cause disturbance and flushing of the kittiwakes from the colony. Such disurbances, if prolonged, cause many kittiwakes not to return to their cliff nests, which can alter colony counts significantly. We attempted not to count in very rainy weather, and not to count when predator disturbance of a plot was evident. The 5% agreement of a count (described in the Methodology - Process Steps section) was designed as an attempt to eliminate some observer error.

Completeness Report(2.3):

This database contains all the recorded data from the Resource Management/Research/NBS collaborative kittiwake project's colony counts from the summer of 1992 through present (incl. summer 1994). Data from 1991 still need to be entered. However, this database will continue to be updated annually with any new visual adult kittiwake colony counts.

Lineage

Process Step:

Process Description(2.5.2.1):

Adult Black-legged Kittiwakes were counted visually, mostly with binoculars, but with the unaided eye if the observers were close enough. Only adult birds in attendance at a colony are counted. Each colony was divided into plots based on naturally-occurring features on the cliff faces (see kwbndary.doc), and then each plot was counted separately for ease of counting; all the plots were later summed for a total colony count. Two observers each counted a plot separately but simultaneously; if the two observers' initial counts of a plot did not agree to within 5% of each other, they counted again (separately and simultaneously again) until they did agree to 5%, or until they had counted for a total of 5 times, whichever came first. In later analyses, the count for each plot was calculated as the average of the two observers' 5%-agreed counts, unless no 5% agreement was reached after 5 full plot counts. In the latter case, all of the counts were averaged together for a plot count. However, these averages are NOT represented within this database -- this was purely a post-data-entry (analysis) step. The entire colony at Margerie Glacier, the Park's largest colony (i.e. each and every plot in the colony) was usually counted five times until 1994 when photographic monitoring started to replace these visual counts.

Spatial Data Organization Information

Planar Coordinate Encoding Method(4.1.2.4.1):

Coordinate Pair

Entity and Attribute Information

Entity Type:

Entity Type Label(5.1.1.1):

Adult kittiwake count

Entity Type Definition(5.1.1.2):

Each record in this database consists of one count, by two observers, of the number of adult Black-legged Kittiwakes in attendance on the specified plot at the specified colony, at the specified time on the specified date.

Attribute:

Attribute Label (5.1.2.1):

COLONY

Attribute Definition (5.1.2.2):

Colony name/location.

Attribute Definition Source (5.1.2.3):

None

Attribute Domain Type:

Enumerated
Enumerated Domain Value (5.1.2.4.1.1):
Margerie Glacier
Enumerated Domain Def (5.1.2.4.1.2):
Colony located just south of the Margerie Glacier, at the head of Tarr Inlet, in Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
Lone Island
Enumerated Domain Def (5.1.2.4.1.2):
Colony located on the north shore (cliff face) of Lone Island, in the center of Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
Kashoto Glacier
Enumerated Domain Def (5.1.2.4.1.2):
Colony located just north of the Kashoto Glacier, near the mouth of Johns Hopkins Inlet, in Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
South Marble Island
Enumerated Domain Def (5.1.2.4.1.2):
The seabird colony on the eastern (cliff-face) shore of South Marble Island. A few kittiwakes nested at the south end of this seabird colony in the summer of 1994. Many seabird species nest there, but kittiwakes had not previously been noted.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Attribute Label (5.1.2.1):
PLOT
Attribute Definition (5.1.2.2):
Number of the plot counted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Code Set
CodeSet Name (5.1.2.4.3.1):
Photo notebook; kwbndary.doc

Attribute Label (5.1.2.1):
DATE
Attribute Definition (5.1.2.2):
Date on which count was conducted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Date is represented as month/date/year. Data begin in

1992, and continue through 1994 and will include any subsequent years in which visual counts of adult kittiwake colony attendance are made. 1991 data still need to be entered.

Attribute Label (5.1.2.1):
NAME_OBS_A
Attribute Definition (5.1.2.2):
Name of Observer A.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Full name of one of the two observers.

Attribute Label (5.1.2.1):
NAME_OBS_B
Attribute Definition (5.1.2.2):
Name of Observer B.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Full name of the second of the two observers.

Attribute Label (5.1.2.1):
COUNT_NUM
Attribute Definition (5.1.2.2):
Number of the count of this plot, for this count set.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
8

Attribute Label (5.1.2.1):
BEGIN_TIME
Attribute Definition (5.1.2.2):
Time of day that this plot count was begun by both observers.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
07:00
Range Domain Maximum (5.1.2.4.2.2):
21:00

Attribute Label (5.1.2.1):
END_TIME

Attribute Definition (5.1.2.2):
  Time of day that this plot count was finished (by both observers).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
    Range Domain Minimum (5.1.2.4.2.1):
      07:00
    Range Domain Maximum (5.1.2.4.2.2):
      21:00

Attribute Label (5.1.2.1):
  TOT_BIRD_A
Attribute Definition (5.1.2.2):
  Total number of adult kittiwakes counted by Observer A on this plot.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Total number of adult kittiwakes counted by Observer A on this plot.

Attribute Label (5.1.2.1):
  TOT_BIRD_B
Attribute Definition (5.1.2.2):
  Total number of adult kittiwakes counted by Observer B on this plot.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Total number of adult kittiwakes counted by Observer B on this plot.

Attribute Label (5.1.2.1):
  ACCEPTED
Attribute Definition (5.1.2.2):
  Whether or not this plot count was accepted as "good" under the 5% rule.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Enumerated
    Enumerated Domain Value (5.1.2.4.1.1):
      Y
    Enumerated Domain Def (5.1.2.4.1.2):
      "Yes," this particular plot count was accepted as "good" under the 5% rule; i.e. Oberver A and B's independent counts did agree to within 5%, and therefore this count is

a good one, and no further plot counts need to be made for this count set.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
N
Enumerated Domain Def (5.1.2.4.1.2):
"No," this particular plot count was NOT accepted as "good" under the 5% rule. Oberver A and B's independent counts did not agree to within 5%; therefore another plot count IS needed for this count set unless the limit of 5 has already been reached.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Attribute Label (5.1.2.1):
YEAR
Attribute Definition (5.1.2.2):
Year in which this plot count was conducted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Anno domini.

Attribute Label (5.1.2.1):
COUNT_SET
Attribute Definition (5.1.2.2):
Number of the whole-colony count set to which this plot count contributes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
9

Attribute Label (5.1.2.1):
COMMENTS
Attribute Definition (5.1.2.2):
Comments, or notes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken during the colony adult counts. These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
COMM_CONT

Attribute Definition (5.1.2.2):
  Comments, or notes: continued (2nd field of notes).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Comments, or notes, taken during the colony adult counts (2nd field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
  COMMENTS_3
Attribute Definition (5.1.2.2):
  Comments, or notes: continued (3rd field of notes).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Comments, or notes, taken during the colony adult counts (3rd field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
  COMMENTS_4
Attribute Definition (5.1.2.2):
  Comments, or notes: continued (4th field of notes).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Comments, or notes, taken during the colony adult counts (4th field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
  COMMENTS_5
Attribute Definition (5.1.2.2):
  Comments, or notes: continued (5th field of notes).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Comments, or notes, taken during the colony adult counts (5th field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Distribution Information
  Distributor(6.1):
    Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)
  Distribution Liability(6.3):
    Although these data have been processed successfully on a computer system at the National Biological Service, no

```
    warranty expressed or implied is made regarding the
    accuracy or utility of the data on any other system or for
    general or scientific purposes, nor shall the act of
    distribution constitute any such warranty. This disclaimer
    applies both to individual use of the data and aggregate
    use with other data.  It is strongly recommended that these
    data are directly acquired from a National Biological
    Service server, and not indirectly through other sources
    which may have changed the data in some way.  It is also
    strongly recommended that careful attention be paid to the
    contents of the metadata file associated with these data.
    The National Biological Service shall not be held liable
    for improper or incorrect use of the data described and/or
    contained herein.
  Standard Order Process(6.4):
    (Interim Statement) The Glacier Bay Information Management
    Team is currently developing the methdologies for
    distribution of data sets.  Until standardized methods are
    developed please contact the Information Management System
    Administrator to obtain the latest information on methdods
    for obtaining data.

Section 7 -- Metadata Reference Information
  Metadata Date:
    7/14/95 12:07:39 PM

  Metadata Contact Person (7.4):
    Name: Elizabeth Ross Hooge
    Address Type: Both
    Address     : P.O. Box 140
    City        : Gustavus
    State/Provin: AK
    Postal Code : 99826
    Country     : USA
    Voice Phone : 907-697-2230
    Fax         : 907-697-2654
    E-Mail Addr :  Elizabeth_Ross_Hooge@NPS.GOV
    Affiliation : Glacier Bay National Park & Preserve
    Position    : Biotech (Graduate Student Ph.D.)

  Metadata Contact Organization (7.4):
    Name: NBS Glacier Bay Field Station
    Address Type: Mailing
    Address     : P.O. Box 140
    City        : Gustavus
    State/Provin: AK
    Postal Code : 99826
    Country     : USA
    Voice Phone : (907) 697-2230
    Fax         : None
    E-Mail Addr : GLBA_Information_Management@nps.gov
  Metadata Standard Name(7.5):
    FGDC Content Standards for Digital Geospatial Metadata
  Metadata Standard Version(7.6):
    June 8, 1994

----------------------- GLBA File Information -------------------------
------
```

GLBA File Name: k:\projects\kittiwak\data\slides.dbf
GLBA Last Update By: Elizabeth Ross Hooge
GLBA Last Update On:7/14/95 12:11:23 PM

Identification Information
Originator (7.1.1):
Elizabeth Ross Hooge
Publication Date (7.1.2):
Not Available

Citation Information:
Title(1.1):
Adult kittiwake counts *made from 35-mm slides* at Glacier Bay colonies
Abstract(1.2.1):
This database contains the colony counts, made from 35-mm slides, for Glacier Bay National Park's Black-legged Kittiwakes, from 1993 through the present. Only the colony at Margerie Glacier, the Park's largest colony, is thus far included in this slide-count database. Only adult birds in attendance at a colony are counted. There were more birds in attendance in 1994 than in 1993 at Margerie, as shown by the slides. When the numbers from the database file adults.dbf (visually-made censuses) are combined with these data, there was a decrease from 1991 to 1993 at Margerie Glacier, followed by the highest attendance yet recorded in 1994. There are 5 slide count sets of the Margerie Glacier colony for each year, in order to make statistical comparisons between years. The 5 slide count sets of Margerie Glacier in 1993 were not different statistically from the 5 visual count sets (see adults.dbf), so in subsequent years photography was used principally or exclusively, rather than using the old visual census methods, because this research showed the photographs to be equally accurate, with less effort expended.
Purpose(1.2.2):
Black-legged Kittiwakes in the Gulf of Alaska have recently experienced widespread poulation declines and frequent reproductive failures, as evidenced by monitoring occurring at many colonies throughout the region. This project aims to monitor Glacier Bay's kittiwakes using methodologies consistent with these other studies so that comparisons can be made. This particular database (slides.dbf) records our efforts to develop a photographic monitoring technique that requires less effort than previous techniques had. This new monitoring technique will then be available for use by other National Parks in Alaska interested in monitoring kittiwakes. The Park is interested, in light of the nearby recent population and reproductive declines, in knowing and monitoring the status and trends of the kittiwake colonies within the Park.
Time Period of Content(1.3):
6/1/93 - present

Status

Progress(1.4.1):
In Work
Maintenance and Update Frequency(1.4.2):
Annually

Spatial Domain
Description of Geographic Extent(1.5.0):
This database includes slide-based adult kittiwake counts only from Glacier Bay's largest colony, at the Margerie Glacier, located at the head of Tarr Inlet. In the future we anticipate making slide-based counts of more of the Park's colonies.

Bounding Coordinates:
West Bounding Coordinate(1.5.1.1):
13710.00
East Bounding Coordinate(1.5.1.2):
13546.00
North Bounding Coordinate(1.5.1.3):
5940.00
South Bounding Coordinate(1.5.1.4):
5820.00

Keywords
Theme Keyword Thesaurus(1.6.1.1):
None
Theme Keyword(1.6.1.2):
Bird
Census
Colony
Distribution
Ecology
Natural Resources
Population
Productivity
Seabird
Glacier Bay National Park
Access Constraints(1.7):
Some Glacier Bay Ecosystem Project data sets may contain data with access constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. Data sets which are not complete may have access constraints until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any access constraints.
Use Constraints(1.8):
Some Glacier Bay Ecosystem Project data sets may contain data with use constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. In addition some data sets are collaborative efforts with outside researchers and represent unpublished work for which we request respect for intellectual property rights. Some data sets are not complete and if access is given the use may be restricted until completion. Please contact the Information Management

Systems Administrator at the Glacier Bay Field Station for details on any use constraints.

Data Quality Information

Attribute Accuracy:

Attribute Accuracy Report(2.1.1):

This photographic censusing technique was developed to avoid many of the observer errors inherent in direct visual counting of kittiwake colonies. However, other potential errors include: 1) over- or under-exposure of the film, making kittiwakes difficult to discern from the projected slides, thus affecting the kittiwake count; 2) failure to photograph portions of some of the plots, thus reducing the total number of kittiwakes counted; 3) photographing portions of some of the plots from bad angles, making the kittiwakes difficult to discern and thus affecting the kittiwake count; 4) photographing during a time of low attendance such as during a predator disturbance. (Predators such as Bald Eagles, Golden Eagles, Peregrine Falcons, and Ravens cause disturbance and flushing of the kittiwakes from the colony. Such disurbances, if prolonged, cause many kittiwakes not to return to their cliff nests, which can alter colony counts significantly.) We used the automatic exposure meter on the camera to avoid exposure difficulties. We also standardized the frame compositions and angles for each plot to avoid missing part of the colony or photographing portions from bad visual angles. We also attempted not to photograph during or immediately following a predator disturbance at a plot. The 1993 data comparing the 5 direct visual adult counts with the 5 slide counts showed that the 2 counts were highly non-significantly different (i.e. statistically the two methods were not distinguishable one from the other), so we feel that this photographic technique is equal in accuracy and variance to the previously-used visual censuses.

Completeness Report(2.3):

This database contains all the slide counts made by the Resource Management/Research/NBS collaborative kittiwake project from the photograhy start date in summer of 1993 through present (including summer 1994). However, this database will continue to be updated annually with new slide counts made; in the future we anticipate making slide-based counts of more of the Park's colonies, not just the Margerie Glacier.

Lineage

Process Step:

Process Description(2.5.2.1):

Photographs of the colony were taken with a 35-mm camera and a 70-210 zoom lens. We used Kodachrome ASA 200 Professional 35-mm color slide film. The colony was divided into the same plots as used by all the other censuses (adults, nests, and chicks), based on naturally-occurring features on the cliff face (see kwbndary.doc). Each plot was then divided into several

(2-8) photographic shots. The entire colony (i.e. each and every plot) was photographed completely five separate times. Because of the expensive photographic equipment, we did not take photographs in very rainy weather. The film was sent out to be developed, then the slides were projected onto a wall in a dark room. One, or two persons together, then counted the number of adult kittiwakes in each plot.

Spatial Data Organization Information
Planar Coordinate Encoding Method(4.1.2.4.1):
Coordinate Pair

Entity and Attribute Information

Entity Type:
Entity Type Label(5.1.1.1):
Kittiwake slide count
Entity Type Definition(5.1.1.2):
Each record in this database consists of one slide-based count, by 1 or 2 observers, of the number of adult Black-legged Kittiwakes in attendance on the specified plot at the specified colony, during the specified time range on the specified date.

Attribute:

Attribute Label (5.1.2.1):
COLONY
Attribute Definition (5.1.2.2):
Colony name/location.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Enumerated
Enumerated Domain Value (5.1.2.4.1.1):
Margerie Glacier
Enumerated Domain Def (5.1.2.4.1.2):
Colony located just south of the Margerie Glacier, at the head of Tarr Inlet, in Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Attribute Label (5.1.2.1):
PLOT
Attribute Definition (5.1.2.2):
Number of the plot counted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Code Set
CodeSet Name (5.1.2.4.3.1):
Photo notebook; kwbndary.doc

Attribute Label (5.1.2.1):
DATE_PHOTO
Attribute Definition (5.1.2.2):

Date on which the photographs were taken.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Date is represented as month/date/year. Data begin in 1993, and continue through 1994 and will include any subsequent years in which slide counts are made.

Attribute Label (5.1.2.1):
TIME_BEGIN
Attribute Definition (5.1.2.2):
Time of day that the roll of film containing this plot count was begun.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
07:00
Range Domain Maximum (5.1.2.4.2.2):
21:00

Attribute Label (5.1.2.1):
TIME_END
Attribute Definition (5.1.2.2):
Time of day that the roll of film containing this plot count was finished.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
07:00
Range Domain Maximum (5.1.2.4.2.2):
21:00

Attribute Label (5.1.2.1):
DATE_COUNT
Attribute Definition (5.1.2.2):
Date on which the counting from projected slides was performed.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Date is represented as month/date/year. Data begin in 1993, and continue through 1994 and will include any subsequent years in which slide counts are made.

Attribute Label (5.1.2.1):
NAME_CNTR1
Attribute Definition (5.1.2.2):
Name of counter #1.

```
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       Full name of one of the two (if there were two) persons
       counting kittiwakes from the slides.

Attribute Label (5.1.2.1):
  NAME_CNTR2
Attribute Definition (5.1.2.2):
  Name of counter #2.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       Full name of the second of the two (if there were two)
       persons counting kittiwakes from the slides.

Attribute Label (5.1.2.1):
  ROLL_1_NUM
Attribute Definition (5.1.2.2):
  Number of the first roll of film used for this plot count.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       The identification number of the 1st (if there were 2 film
       rolls used), or only, roll of film used for this plot
       count. Roll identification numbers begin at 1 every year,
       with a prefix indicating the year (i.e. 94-01 is the 1st
       roll of film in 1994).

Attribute Label (5.1.2.1):
  R_1_FRAMES
Attribute Definition (5.1.2.2):
  The frames from Roll #1 that were used for this plot count.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
     Range Domain Minimum (5.1.2.4.2.1):
       1
     Range Domain Maximum (5.1.2.4.2.2):
       36


Attribute Label (5.1.2.1):
  ROLL_2_NUM
Attribute Definition (5.1.2.2):
  Number of the second roll of film used for this plot count.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
```

The identification number of the 2nd (if there were 2 film rolls used) roll of film used for this plot count. Roll identification numbers begin at 1 every year, with a prefix indicating the year (i.e. 94-02 is the 2nd roll of film taken in 1994).

Attribute Label (5.1.2.1):
R_2_FRAMES
Attribute Definition (5.1.2.2):
The frames from Roll #2 that were used for this plot count.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
36

Attribute Label (5.1.2.1):
NUM_KITTIW
Attribute Definition (5.1.2.2):
The number of adult kittiwakes on this plot.
Attribute Definition Source (5.1.2.3):
None
Attribute Units of Measure (5.1.2.5):
Each
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
The total number of adult kittiwakes counted by one counter, or two counters together, from the slide frames representing this plot.

Attribute Label (5.1.2.1):
YEAR
Attribute Definition (5.1.2.2):
Year in which this plot count was conducted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
This represents the year in which the photographs of the colony were taken, should there ever come an instance in which slides are counted in a different year than the photographs were taken.

Attribute Label (5.1.2.1):
COUNT_SET
Attribute Definition (5.1.2.2):
Number of the whole-colony slide count set to which this plot count contributes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range

Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
5

Attribute Label (5.1.2.1):
COMMENTS
Attribute Definition (5.1.2.2):
Comments, or notes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken either during the colony photography, or during the slide counting. These would thus include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
COMM_CONT
Attribute Definition (5.1.2.2):
Comments, or notes: continued (2nd field of notes).
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken either during the colony photography, or during the slide counting (2nd field of notes). These would thus include notes on our counting, as well as on observations of Comments, or notes, taken during the colony counting

Distribution Information
Distributor(6.1):
Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)
Distribution Liability(6.3):
Although these data have been processed successfully on a computer system at the National Biological Service, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from a National Biological Service server, and not indirectly through other sources which may have changed the data in some way. It is also strongly recommended that careful attention be paid to the contents of the metadata file associated with these data. The National Biological Service shall not be held liable for improper or incorrect use of the data described and/or contained herein.
Standard Order Process(6.4):

```
        (Interim Statement) The Glacier Bay Information Management
        Team is currently developing the methdologies for
        distribution of data sets.  Until standardized methods are
        developed please contact the Information Management System
        Administrator to obtain the latest information on methdods
        for obtaining data.

Section 7 -- Metadata Reference Information
     Metadata Date:
       7/14/95 3:12:48 PM

     Metadata Contact Person (7.4):
       Name: Elizabeth Ross Hooge
       Address Type: Both
       Address     : P.O. Box 140
       City        : Gustavus
       State/Provin: AK
       Postal Code : 99826
       Country     : USA
       Voice Phone : 907-697-2230
       Fax         : 907-697-2654
       E-Mail Addr :  Elizabeth_Ross_Hooge@NPS.GOV
       Affiliation : Glacier Bay National Park & Preserve
       Position    : Biotech (Graduate Student Ph.D.)

     Metadata Contact Organization (7.4):
       Name: NBS Glacier Bay Field Station
       Address Type: Mailing
       Address     : P.O. Box 140
       City        : Gustavus
       State/Provin: AK
       Postal Code : 99826
       Country     : USA
       Voice Phone : (907) 697-2230
       Fax         : None
       E-Mail Addr : GLBA_Information_Management@nps.gov
     Metadata Standard Name(7.5):
       FGDC Content Standards for Digital Geospatial Metadata
     Metadata Standard Version(7.6):
       June 8, 1994

----------------------- GLBA File Information -------------------------
------
GLBA File Name: k:\projects\kittiwak\data\chicks.dbf
GLBA Last Update By: Elizabeth Ross Hooge
GLBA Last Update On:7/14/95 12:11:16 PM
-----------------------------------------------------------------------
------

Identification Information
     Originator (7.1.1):
       Elizabeth Ross Hooge
     Publication Date (7.1.2):
       Not Available

  Citation Information:
     Title(1.1):
       Kittiwake chick counts at Glacier Bay colonies
```

Abstract(1.2.1):
This database contains the colony chick counts for Glacier Bay National Park's Black-legged Kittiwakes, from 1993 through the present. Colonies at Margerie Glacier and Kashoto Glacier are included. If one includes reproductive data from 1991 and 1992, not currently included in this database, chick production at Margerie Glacier, the Park's largest colony, was low in 1991 and 1992, skyrocketed in 1993, and was absolutely zero in the summer of 1994. There have usually been three entire-colony chick counts made at Margerie each year since 1992, on separate dates approximately one week apart, at the end of July and early August.

Purpose(1.2.2):
Black-legged Kittiwakes in the Gulf of Alaska have recently experienced widespread population declines and frequent reproductive failures, as evidenced by monitoring occurring at many colonies throughout the region. This project aims to monitor Glacier Bay's kittiwakes using methodologies consistent with these other studies so that comparisons can be made. The Park is interested, in light of the nearby recent population and reproductive declines, in knowing and monitoring the status and trends of the kittiwake colonies within the Park.

Time Period of Content(1.3):
7/1/93 - present

Status

Progress(1.4.1):
In Work

Maintenance and Update Frequency(1.4.2):
Annually

Spatial Domain

Description of Geographic Extent(1.5.0):
This database includes kittiwake chick counts from colonies within Glacier Bay. Currently only Margerie Glacier and Kashoto Glacier colonies, in Tarr and Johns Hopkins Inlets, respectively, are represented, but additional data from other colonies will be added in the future. No colonies are currently known from Glacier Bay's East Arm, although there is a report of a new Black-legged Kittiwake colony at the Riggs Glacier in the East Arm, in the summer of 1995 (as of present this new colony has not yet been counted). We do not have chick data from any of Glacier Bay's outer coast (Gulf of Alaska) colonies.

Bounding Coordinates:

West Bounding Coordinate(1.5.1.1):
13710.00

East Bounding Coordinate(1.5.1.2):
13546.00

North Bounding Coordinate(1.5.1.3):
5940.00

South Bounding Coordinate(1.5.1.4):
5820.00

Keywords

Theme Keyword Thesaurus(1.6.1.1):
None
Theme Keyword(1.6.1.2):
Bird
Census
Colony
Distribution
Ecology
Natural Resources
Population
Productivity
Seabird
Glacier Bay National Park
Access Constraints(1.7):
Some Glacier Bay Ecosystem Project data sets may contain data with access constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. Data sets which are not complete may have access constraints until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any access constraints.
Use Constraints(1.8):
Some Glacier Bay Ecosystem Project data sets may contain data with use constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. In addition some data sets are collaborative efforts with outside researchers and represent unpublished work for which we request respect for intellectual property rights. Some data sets are not complete and if access is given the use may be restricted until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any use constraints.

Data Quality Information

Attribute Accuracy:
Attribute Accuracy Report(2.1.1):
The counts of kittiwake chicks at a colony are subject to observer error. Observers unfamiliar with binoculars, birds, seabird colonies, and this kittiwake colony in particular, require more time and are less accurate in their counting. In addition to observer error, other factors affecting the accuracy and quality of counts include inclement weather and predators. Precipitation causes binoculars to fog up, making counting difficult. Because of this, we attempted not to count in very rainy weather. In addition, predators such as Bald Eagles, Golden Eagles, Peregrine Falcons, and Ravens cause disturbance and flushing of the kittiwakes from the colony. Such disurbances, if prolonged, cause many (adult) kittiwakes not to return to their cliff nests, which makes chicks more visible to the observer than when they are being brooded by their parents. This introduces additional variation into the data. By having two observers counting

chicks and requiring complete agreement about chick number, we attempt to reduce some of the human errors.

Completeness Report(2.3):

This database currently contains chick counts only from the summer of 1993, for only two of the Park's colonies. Data from 1991 and 1992, and for other colonies, should be entered in the future, and the "zero productivity" of 1994 also will be entered. Also, this database will continue to be updated annually with chick counts made by the kittiwake monitoring project.

Lineage

Process Step:

Process Description(2.5.2.1):

Black-legged Kittiwake chicks were counted visually, mostly with binoculars, but with the unaided eye if the observers were close enough. Each colony was divided into plots based on naturally-occurring features on the cliff faces (see kwbndary.doc), and then the chicks of each plot was counted separately for ease of counting; all the plots were later summed for a total colony chick count. All chicks that we could see, from downy newly-hatched chicks, to nearly-fledging big chicks, were counted. Two observers counted a plot either separately or together; if the two observers counted separately, the chick count was not recorded until complete agreement between the two counters was reached. Chicks from the entire colony at Margerie Glacier, the Park's largest colony, were generally counted three separate times. These three separate occasions were each separated by approximately one week, in late July and early August, in order to count the maximum number of chicks produced.

Spatial Data Organization Information

Entity and Attribute Information

Entity Type:

Entity Type Label(5.1.1.1):

Kittiwake chick count

Entity Type Definition(5.1.1.2):

Each record in this database consists of one count, by two observers, of the number of Black-legged Kittiwake chicks visible on the specified plot at the specified colony, at the specified time on the specified date.

Attribute:

Attribute Label (5.1.2.1):

COLONY

Attribute Definition (5.1.2.2):

Colony name/location.

Attribute Definition Source (5.1.2.3):

None

Attribute Domain Type:

Enumerated

Enumerated Domain Value (5.1.2.4.1.1):

Margerie Glacier
Enumerated Domain Def (5.1.2.4.1.2):
Colony located just south of the Margerie Glacier, at the head of Tarr Inlet, in Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
Kashoto Glacier
Enumerated Domain Def (5.1.2.4.1.2):
Colony located just north of the Kashoto Glacier, near the mouth of Johns Hopkins Inlet, in Glacier Bay.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Attribute Label (5.1.2.1):
PLOT
Attribute Definition (5.1.2.2):
Number of the plot counted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Code Set
CodeSet Name (5.1.2.4.3.1):
Photo notebook; kwbndary.doc

Attribute Label (5.1.2.1):
DATE
Attribute Definition (5.1.2.2):
Date on which chick count was conducted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Date is represented as month/date/year. Data begin in 1993, but do not yet include data from 1991, 1992, nor 1994. Data will continue to be added from subsequent years in which chick counts are made.

Attribute Label (5.1.2.1):
NAME_OBS_A
Attribute Definition (5.1.2.2):
Name of Observer A
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Full name of one of the two observers.

Attribute Label (5.1.2.1):
NAME_OBS_B
Attribute Definition (5.1.2.2):
Name of Observer B
Attribute Definition Source (5.1.2.3):
None

```
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       Full name of the second of the two observers.

Attribute Label (5.1.2.1):
  BEGIN_TIME
Attribute Definition (5.1.2.2):
  Time of day that this plot count was begun by both
  observers.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
     Range Domain Minimum (5.1.2.4.2.1):
       07:00
     Range Domain Maximum (5.1.2.4.2.2):
       21:00


Attribute Label (5.1.2.1):
  END_TIME
Attribute Definition (5.1.2.2):
  Time of day that this plot count was finished (by both
  observers).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
     Range Domain Minimum (5.1.2.4.2.1):
       07:00
     Range Domain Maximum (5.1.2.4.2.2):
       21:00


Attribute Label (5.1.2.1):
  TOT_SINGLE
Attribute Definition (5.1.2.2):
  Total number of chicks seen as singletons.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       This is the total number of chicks in one-chick
       nests/broods.  Thus it is also equal to the number of nests
       that had one chick

Attribute Label (5.1.2.1):
  TOT_TWINS
Attribute Definition (5.1.2.2):
  Total number of chicks seen as twins.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
```

Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      This is the total number of chicks seen in 2-chick nests.
      Thus, to obtain the total number of 2-chick broods, divide
      this number by 2.

Attribute Label (5.1.2.1):
  TOT_TRIPLE
Attribute Definition (5.1.2.2):
  Total number of chicks seen as triplets.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      This is the total number of chicks seen in 3-chick nests.
      Thus, to obtain the total number of 3-chick broods, divide
      this number by 3.

Attribute Label (5.1.2.1):
  YEAR
Attribute Definition (5.1.2.2):
  Year in which this chick count was conducted.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Anno domini.

Attribute Label (5.1.2.1):
  COUNT_SET
Attribute Definition (5.1.2.2):
  Number of the whole-colony count set to which this plot
  chick count contributes.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
    Range Domain Minimum (5.1.2.4.2.1):
      1
    Range Domain Maximum (5.1.2.4.2.2):
      4

Attribute Label (5.1.2.1):
  COMMENTS
Attribute Definition (5.1.2.2):
  Comments, or notes.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Unrepresentable
    Unrepresentable Domain (5.1.2.4.4):
      Comments, or notes, taken during the colony chick counts.
      These include notes on our counting, as well as on
      observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
COMM_CONT
Attribute Definition (5.1.2.2):
Comments, or notes: continued (2nd field of notes).
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken during the colony chick counts (2nd field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Distribution Information
Distributor(6.1):
Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)
Distribution Liability(6.3):
Although these data have been processed successfully on a computer system at the National Biological Service, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from a National Biological Service server, and not indirectly through other sources which may have changed the data in some way. It is also strongly recommended that careful attention be paid to the contents of the metadata file associated with these data. The National Biological Service shall not be held liable for improper or incorrect use of the data described and/or contained herein.
Standard Order Process(6.4):
(Interim Statement) The Glacier Bay Information Management Team is currently developing the methdologies for distribution of data sets. Until standardized methods are developed please contact the Information Management System Administrator to obtain the latest information on methdods for obtaining data.

Section 7 -- Metadata Reference Information
Metadata Date:
7/14/95 3:34:42 PM

Metadata Contact Person (7.4):
Name: Elizabeth Ross Hooge
Address Type: Both
Address : P.O. Box 140
City : Gustavus
State/Provin: AK
Postal Code : 99826
Country : USA
Voice Phone : 907-697-2230
Fax : 907-697-2654

```
    E-Mail Addr :  Elizabeth_Ross_Hooge@NPS.GOV
    Affiliation : Glacier Bay National Park & Preserve
    Position    : Biotech (Graduate Student Ph.D.)

  Metadata Contact Organization (7.4):
    Name: NBS Glacier Bay Field Station
    Address Type: Mailing
    Address     : P.O. Box 140
    City        : Gustavus
    State/Provin: AK
    Postal Code : 99826
    Country     : USA
    Voice Phone : (907) 697-2230
    Fax         : None
    E-Mail Addr : GLBA_Information_Management@nps.gov
  Metadata Standard Name(7.5):
    FGDC Content Standards for Digital Geospatial Metadata
  Metadata Standard Version(7.6):
    June 8, 1994

----------------------- GLBA File Information --------------------------
------
GLBA File Name: k:\projects\kittiwak\data\nests.dbf
GLBA Last Update By: Elizabeth Ross Hooge
GLBA Last Update On:7/14/95 12:11:38 PM
------------------------------------------------------------------------
------

Identification Information
  Originator (7.1.1):
    Elizabeth Ross Hooge
  Publication Date (7.1.2):
    Not Available

 Citation Information:
  Title(1.1):
    Kittiwake nest counts at Glacier Bay colonies
  Abstract(1.2.1):
    This database contains the colony nest counts and egg
    counts for Glacier Bay National Park's Black-legged
    Kittiwakes, from 1992 through the present.  Only nests with
    an adult in attendance and with freshly-added nesting
    material are counted.  Colonies at Margerie Glacier,
    Kashoto Glacier, Lone Island, and South Marble Island are
    included.  Mirroring the adult kittwake counts (see
    adults.dbf), there was a decrease in active nests from 1991
    (1991 data are not yet included in this database, however)
    to 1993 at Margerie Glacier, the Park's largest colony,
    followed by the highest number of nests yet recorded in
    1994.  There are multiple entire-colony nest counts for
    each year at Margerie Glacier, at least five per year until
    1994, when photographic monitoring of adult numbers first
    started to replace the visual counts of adults after
    research showed the photographs to be equally accurate,
    with less effort expended.  Subsequent to that, beginning
    in 1994, only 3 nest counts per year were conducted at
    Margerie Glacier.
  Purpose(1.2.2):
```

Black-legged Kittiwakes in the Gulf of Alaska have recently experienced widespread population declines and frequent reproductive failures, as evidenced by monitoring occurring at many colonies throughout the region. This project aims to monitor Glacier Bay's kittiwakes using methodologies consistent with these other studies so that comparisons can be made, and to develop a photographic monitoring technique that requires less effort than previous techniques had. This new monitoring technique will then be available for use by other National Parks in Alaska interested in monitoring kittiwakes. The photographic monitoring, however, is expected only to replace the visual counts of adults, not of the nests, as nests are very difficult to discern from projected slides. The Park is interested, in light of the nearby recent population and reproductive declines, in knowing and monitoring the status and trends of the kittiwake colonies within the Park. The number of active nests, in addition to the number of adults, is an important parameter of breeding kittiwake colonies.

Time Period of Content(1.3):
6/1/92 - present

Status
Progress(1.4.1):
In Work
Maintenance and Update Frequency(1.4.2):
Annually

Spatial Domain
Description of Geographic Extent(1.5.0):
This database includes kittiwake nest counts from most of the colonies known to exist in Glacier Bay National Park. At the present, no data are entered for any of the outer (Gulf of Alaska) coast colonies, so this database includes colonies from Lone Island and South Marble Island in the middle of Glacier Bay proper, up through Tarr Inlet and Johns Hopkins Inlet. No colonies are currently known from Glacier Bay's East Arm, although there is a report of a new Black-legged Kittiwake colony at the Riggs Glacier in the East Arm, in the summer of 1995 (as of present this new colony has not yet been counted).

Bounding Coordinates:
West Bounding Coordinate(1.5.1.1):
13710.00
East Bounding Coordinate(1.5.1.2):
13546.00
North Bounding Coordinate(1.5.1.3):
5940.00
South Bounding Coordinate(1.5.1.4):
5820.00

Keywords
Theme Keyword Thesaurus(1.6.1.1):
None
Theme Keyword(1.6.1.2):
Bird
Census

Colony
Distribution
Ecology
Natural Resources
Population
Productivity
Seabird
Glacier Bay National Park

Access Constraints(1.7):
Some Glacier Bay Ecosystem Project data sets may contain data with access constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. Data sets which are not complete may have access constraints until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any access constraints.

Use Constraints(1.8):
Some Glacier Bay Ecosystem Project data sets may contain data with use constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. In addition some data sets are collaborative efforts with outside researchers and represent unpublished work for which we request respect for intellectual property rights. Some data sets are not complete and if access is given the use may be restricted until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any use constraints.

Data Quality Information

Attribute Accuracy:

Attribute Accuracy Report(2.1.1):
The counts of kittiwake nests at a colony are subject to observer error. Observers unfamiliar with binoculars, birds, seabird colonies, nests, and these kittiwake colonies in particular, require more time and are less accurate in their counting. Difficulty in defining a nest vs. an inadequate nesting attempt increases inter-observer error. In addition to observer error, other factors affecting the accuracy and quality of counts include inclement weather and predators. Precipitation causes binoculars to fog up, making counting difficult. Predators such as Bald Eagles, Golden Eagles, Peregrine Falcons, and Ravens cause disturbance and flushing of the kittiwakes from the colony. Such disurbances, if prolonged, cause many kittiwakes not to return to their cliff nests, which can alter colony counts significantly (since we only count a nest as active if an adult kittiwake is observed in attendance at it). We attempted not to count in very rainy weather, and not to count when predator disturbance of a plot was evident. The 5% agreement of a count (described in the Methodology - Process Steps section) was designed as an attempt to eliminate some observer error.

Completeness Report(2.3):

This database contains all the recorded data from the Resource Management/Research/NBS collaborative kittiwake project's colony nest counts from the summer of 1992 through present (including summer 1994). Data from 1991 still need to be entered. However, this database will continue to be updated annually with new visual kittiwake nest counts.

Lineage

Process Step:
Process Description(2.5.2.1):
Black-legged Kittiwake nests were counted visually, mostly with binoculars, but with the unaided eye if the observers were close enough. Only nests with an adult in attendance and with freshly-added nesting material are counted. Each colony was divided into plots based on naturally-occurring features on the cliff faces (see kwbndary.doc), and then the nests on each plot were counted separately for ease of counting; all the plots were later summed for a total colony count. Two observers each counted a plot separately but simultaneously; if the two observers' initial counts of a plot did not agree to within 5% of each other, they counted again (separately and simultaneously again) until they did agree to 5%, or until they had counted for a total of 5 times, whichever came first. In later analyses, the nest count for each plot was calculated as the average of the two observers' 5%-agreed counts, unless no 5% agreement was reached after 5 full plot counts. In the latter case, all of the counts were averaged together for a plot count. However, these averages are NOT represented within this database -- this was purely a post-data-entry (analysis) step. The entire colony at Margerie Glacier, the Park's largest colony (i.e. each and every plot in the colony) was usually counted five times until 1994 when photographic monitoring started to replace the visual adult kittiwake counts. In 1994, and in subsequent years we expect, only 3 nest counts were made.

Spatial Data Organization Information

Entity and Attribute Information

Entity Type:
Entity Type Label(5.1.1.1):
Kittiwake nest count
Entity Type Definition(5.1.1.2):
Each record in this database consists of one count, by two observers, of the number of active Black-legged Kittiwake nests in the specified plot at the specified colony, at the specified time on the specified date.

Attribute:

Attribute Label (5.1.2.1):
COLONY
Attribute Definition (5.1.2.2):
Colony name/location.

```
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Enumerated
     Enumerated Domain Value (5.1.2.4.1.1):
       Margerie Glacier
     Enumerated Domain Def (5.1.2.4.1.2):
       Colony located just south of the Margerie Glacier, at the
       head of Tarr Inlet, in Glacier Bay.
     Enumerated Domain Def Source (5.1.2.4.1.3):
       None

     Enumerated Domain Value (5.1.2.4.1.1):
       Lone Island
     Enumerated Domain Def (5.1.2.4.1.2):
       Colony located on the north shore (cliff face) of Lone
       Island, in the center of Glacier Bay.
     Enumerated Domain Def Source (5.1.2.4.1.3):
       None

     Enumerated Domain Value (5.1.2.4.1.1):
       Kashoto Glacier
     Enumerated Domain Def (5.1.2.4.1.2):
       Colony located just north of the Kashoto Glacier, near the
       mouth of Johns Hopkins Inlet, in Glacier Bay.
     Enumerated Domain Def Source (5.1.2.4.1.3):
       None

     Enumerated Domain Value (5.1.2.4.1.1):
       South Marble Island
     Enumerated Domain Def (5.1.2.4.1.2):
       The seabird colony on the eastern (cliff-face) shore of
       South Marble Island.  A few kittiwakes nested at the south
       end of this seabird colony in the summer of 1994.  Many
       seabird species nest there, but kittiwakes had not
       previously been noted.
     Enumerated Domain Def Source (5.1.2.4.1.3):
       None


Attribute Label (5.1.2.1):
  PLOT
Attribute Definition (5.1.2.2):
  Number of the plot counted.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Code Set
     CodeSet Name (5.1.2.4.3.1):
       Photo notebook; kwbndary.doc

Attribute Label (5.1.2.1):
  DATE
Attribute Definition (5.1.2.2):
  Date on which nest count was conducted.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
```

Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Date is represented as month/date/year. Data begin in 1992, and continue through 1994 and will include any subsequent years in which visual counts of adult kittiwake colony attendance are made. 1991 data still need to be entered.

Attribute Label (5.1.2.1):
NAME_OBS_A
Attribute Definition (5.1.2.2):
Name of Observer A
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Full name of one of the two observers.

Attribute Label (5.1.2.1):
NAME_OBS_B
Attribute Definition (5.1.2.2):
Name of Observer B.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Full name of the second of the two observers.

Attribute Label (5.1.2.1):
COUNT_NUM
Attribute Definition (5.1.2.2):
Number of the count of this plot, for this count set.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
8

Attribute Label (5.1.2.1):
BEGIN_TIME
Attribute Definition (5.1.2.2):
Time of day that this plot count was begun by both observers.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
07:00
Range Domain Maximum (5.1.2.4.2.2):
21:00

```
Attribute Label (5.1.2.1):
  END_TIME
Attribute Definition (5.1.2.2):
  Time of day that this plot count was finished (by both
  observers).
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Range
     Range Domain Minimum (5.1.2.4.2.1):
       07:00
     Range Domain Maximum (5.1.2.4.2.2):
       21:00


Attribute Label (5.1.2.1):
  TOT_NEST_A
Attribute Definition (5.1.2.2):
  Total number of kittiwake nests counted by Observer A on
  this plot.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       Total number of kittiwake nests counted by Observer A on
       this plot.

Attribute Label (5.1.2.1):
  TOT_NEST_B
Attribute Definition (5.1.2.2):
  Total number of kittiwake nests counted by Observer B on
  this plot.
Attribute Definition Source (5.1.2.3):
  None
Attribute Units of Measure (5.1.2.5):
  Each
Attribute Domain Type:
  Unrepresentable
     Unrepresentable Domain (5.1.2.4.4):
       Total number of kittiwake nests counted by Observer B on
       this plot.

Attribute Label (5.1.2.1):
  ACCEPTED
Attribute Definition (5.1.2.2):
  Whether or not this plot count was accepted as "good" under
  the 5% rule.
Attribute Definition Source (5.1.2.3):
  None
Attribute Domain Type:
  Enumerated
     Enumerated Domain Value (5.1.2.4.1.1):
       Y
     Enumerated Domain Def (5.1.2.4.1.2):
```

"Yes," this particular plot count was accepted as "good" under the 5% rule; i.e. Oberver A and B's independent counts did agree to within 5%, and therefore this count is a good one, and no further plot counts need to be made for this count set.

Enumerated Domain Def Source (5.1.2.4.1.3):
None

Enumerated Domain Value (5.1.2.4.1.1):
N
Enumerated Domain Def (5.1.2.4.1.2):
"No," this particular plot count was NOT accepted as "good" under the 5% rule. Oberver A and B's independent counts did not agree to within 5%; therefore another plot count IS needed for this count set unless the limit of 5 has already been reached.
Enumerated Domain Def Source (5.1.2.4.1.3):
None

Attribute Label (5.1.2.1):
YEAR
Attribute Definition (5.1.2.2):
Year in which this plot count was conducted.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Anno domini.

Attribute Label (5.1.2.1):
COUNT_SET
Attribute Definition (5.1.2.2):
Number of the whole-colony nest count set to which this plot count contributes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Range
Range Domain Minimum (5.1.2.4.2.1):
1
Range Domain Maximum (5.1.2.4.2.2):
9

Attribute Label (5.1.2.1):
EGGS_SEEN
Attribute Definition (5.1.2.2):
Total number of eggs seen in the nests that were checked.
Attribute Definition Source (5.1.2.3):
None
Attribute Units of Measure (5.1.2.5):
Each
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
This total number of eggs seen only represents those nests

that were visually checked (see the field labelled "nests_chkd" for the total number of nests that were checked visually).

Attribute Label (5.1.2.1):
NESTS_CHKD
Attribute Definition (5.1.2.2):
Total number of nests checked visually for eggs.
Attribute Definition Source (5.1.2.3):
None
Attribute Units of Measure (5.1.2.5):
Each
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
The field labelled "eggs_seen" records how many total eggs were seen in these nests that were checked visually.

Attribute Label (5.1.2.1):
COMMENTS
Attribute Definition (5.1.2.2):
Comments, or notes.
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken during the colony nest counts. These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
COMM_CONT
Attribute Definition (5.1.2.2):
Comments, or notes: continued (2nd field of notes).
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken during the colony nest counts (2nd field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Attribute Label (5.1.2.1):
COMMENTS_3
Attribute Definition (5.1.2.2):
Comments, or notes: continued (3rd field of notes).
Attribute Definition Source (5.1.2.3):
None
Attribute Domain Type:
Unrepresentable
Unrepresentable Domain (5.1.2.4.4):
Comments, or notes, taken during the colony nest counts (3rd field of notes). These include notes on our counting, as well as on observations of the kittiwakes at the colony.

Distribution Information

Distributor(6.1):
Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)

Distribution Liability(6.3):
Although these data have been processed successfully on a computer system at the National Biological Service, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from a National Biological Service server, and not indirectly through other sources which may have changed the data in some way. It is also strongly recommended that careful attention be paid to the contents of the metadata file associated with these data. The National Biological Service shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Standard Order Process(6.4):
(Interim Statement) The Glacier Bay Information Management Team is currently developing the methdologies for distribution of data sets. Until standardized methods are developed please contact the Information Management System Administrator to obtain the latest information on methdods for obtaining data.

Section 7 -- Metadata Reference Information

Metadata Date:
7/14/95 3:39:56 PM

Metadata Contact Person (7.4):
Name: Elizabeth Ross Hooge
Address Type: Both
Address : P.O. Box 140
City : Gustavus
State/Provin: AK
Postal Code : 99826
Country : USA
Voice Phone : 907-697-2230
Fax : 907-697-2654
E-Mail Addr : Elizabeth_Ross_Hooge@NPS.GOV
Affiliation : Glacier Bay National Park & Preserve
Position : Biotech (Graduate Student Ph.D.)

Metadata Contact Organization (7.4):
Name: NBS Glacier Bay Field Station
Address Type: Mailing
Address : P.O. Box 140
City : Gustavus
State/Provin: AK
Postal Code : 99826
Country : USA
Voice Phone : (907) 697-2230
Fax : None
E-Mail Addr : GLBA_Information_Management@nps.gov

```
     Metadata Standard Name(7.5):
       FGDC Content Standards for Digital Geospatial Metadata
     Metadata Standard Version(7.6):
       June 8, 1994

----------------------- GLBA File Information --------------------------
------
GLBA File Name: k:\projects\kittiwak\data\kw_locat.dbf
GLBA Last Update By:
GLBA Last Update On:
------------------------------------------------------------------------
------

Identification Information
     Originator (7.1.1):
       Elizabeth Ross Hooge
     Publication Date (7.1.2):
       Not Available

  Citation Information:

Status

Spatial Domain

  Bounding Coordinates:

Keywords
     Theme Keyword Thesaurus(1.6.1.1):
       None
     Theme Keyword(1.6.1.2):
     Access Constraints(1.7):
       Some Glacier Bay Ecosystem Project data sets may contain
       data with access constraints.  Such areas include sensitive
       information on the locations of endangered species or
       cultural artifacts and data which contain private or
       confidential information. Data sets which are not complete
       may have access constraints until completion. Please
       contact the Information Management Systems Administrator at
       the Glacier Bay Field Station for details on any access
       constraints.
     Use Constraints(1.8):
       Some Glacier Bay Ecosystem Project data sets may contain
       data with use constraints.  Such areas include sensitive
       information on the locations of endangered species or
       cultural artifacts and data which contain private or
       confidential information. In addition some data sets are
       collaborative efforts with outside researchers and
       represent unpublished work for which we request respect for
       intellectual property rights.  Some data sets are not
       complete and if access is given the use may be restricted
       until completion. Please contact the Information Management
       Systems Administrator at the Glacier Bay Field Station for
       details on any use constraints.

Data Quality Information

  Attribute Accuracy:
```

Lineage

Process Step:

Spatial Data Organization Information

Entity and Attribute Information

Entity Type:

Attribute:

Distribution Information
Distributor(6.1):
Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)
Distribution Liability(6.3):
Although these data have been processed successfully on a computer system at the National Biological Service, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from a National Biological Service server, and not indirectly through other sources which may have changed the data in some way. It is also strongly recommended that careful attention be paid to the contents of the metadata file associated with these data. The National Biological Service shall not be held liable for improper or incorrect use of the data described and/or contained herein.
Standard Order Process(6.4):
(Interim Statement) The Glacier Bay Information Management Team is currently developing the methdologies for distribution of data sets. Until standardized methods are developed please contact the Information Management System Administrator to obtain the latest information on methdods for obtaining data.

Section 7 -- Metadata Reference Information
No Metadata for this File
Metadata Standard Name(7.5):
FGDC Content Standards for Digital Geospatial Metadata
Metadata Standard Version(7.6):
June 8, 1994

---------------------- GLBA File Information ------------------------------
GLBA File Name: k:\projects\kittiwak\data\capture.dbf
GLBA Last Update By:
GLBA Last Update On:

Identification Information
Originator (7.1.1):
steve whitney
Publication Date (7.1.2):
Not Available

Citation Information:

Status

Spatial Domain

Bounding Coordinates:

Keywords
Theme Keyword Thesaurus(1.6.1.1):
None
Theme Keyword(1.6.1.2):
Access Constraints(1.7):
Some Glacier Bay Ecosystem Project data sets may contain data with access constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. Data sets which are not complete may have access constraints until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any access constraints.
Use Constraints(1.8):
Some Glacier Bay Ecosystem Project data sets may contain data with use constraints. Such areas include sensitive information on the locations of endangered species or cultural artifacts and data which contain private or confidential information. In addition some data sets are collaborative efforts with outside researchers and represent unpublished work for which we request respect for intellectual property rights. Some data sets are not complete and if access is given the use may be restricted until completion. Please contact the Information Management Systems Administrator at the Glacier Bay Field Station for details on any use constraints.

Data Quality Information

Attribute Accuracy:

Lineage

Process Step:

Spatial Data Organization Information

Entity and Attribute Information

Entity Type:

Attribute:

Distribution Information

Distributor(6.1):

Information Management System Administrator,National Biological Service, Box 140, Glacier Bay Field Station, Gustavus, AK 99826, (907-697-2230)

Distribution Liability(6.3):

Although these data have been processed successfully on a computer system at the National Biological Service, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from a National Biological Service server, and not indirectly through other sources which may have changed the data in some way. It is also strongly recommended that careful attention be paid to the contents of the metadata file associated with these data. The National Biological Service shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Standard Order Process(6.4):

(Interim Statement) The Glacier Bay Information Management Team is currently developing the methdologies for distribution of data sets. Until standardized methods are developed please contact the Information Management System Administrator to obtain the latest information on methdods for obtaining data.

Section 7 -- Metadata Reference Information

No Metadata for this File

Metadata Standard Name(7.5):

FGDC Content Standards for Digital Geospatial Metadata

Metadata Standard Version(7.6):

June 8, 1994

Black-Legged Kittiwake Monitoring Handbook

Hooge, Yerxa, & Hooge 1998