Anne Vallee (Triangle Island)

1995 TRIANGLE ISLAND REPORT

The impact of glaucous-winged gull predation and kleptoparasitism on other breeding seabirds at Triangle Island

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Overview

I conducted a pilot study of the effects of glaucous-winged gulls on tufted puffins breeding on Triangle Island. This work was based on a proposal submitted in January of 1995 to the CWS/NSERC Wildlife Ecology Research Chair Research Network Program by Ian Jones and Grant Gilchrist who subsequently accepted employment elsewhere. My involvement with the project began in March, 1995 when I accepted a summer position to conduct the project according to the schedule and terms set out in the earlier proposal. In addition to support awarded through the Network Program, the Wildlife Ecology Chair provided support for my husband, Robert St. Clair, to assist with the project during July and August.

The original proposal targeted three species, tufted puffins, common murres and bald eagles for a study of their interactions with glaucous-winged gulls. Because another researcher, Julia Parrish, conducted a behavioural study at the same site in 1995 on common murres and bald eagles, I focused my work on the effects of gulls on tufted puffins. The design, methods, preliminary results and tentative plans for this study are outlined below.

Introduction

Populations of glaucous-winged gulls have increased across coastal BC in recent years while populations of many other seabirds, including tufted puffins, have exhibited variable reproductive success, failing completely in some years. Triangle Island hosts the largest tufted puffin population in BC, yet that population apparently suffered almost complete reproductive failure in 1994. Previous work on the population by CWS biologists suggest that annual reproductive success is often low, with very good years occurring at the rate of about one in five. Glaucous-winged gulls depredate the eggs and chicks of tufted puffins and kleptoparasitise fish from adults returning with food for their chicks. The recent increases in gull populations throughout BC may worsen this impact. The main impetus of this study, therefore, was to determine the effect of gulls on puffins breeding on Triangle Island and to estimate the importance of this effect on the overall breeding performance of puffins. Specific objectives were as follows:

1. Determine the proportion and breeding status of gulls that exhibit kleptoparasitism and predation (hereafter *gull foraging tactics*);

2. Determine the topographical, meteorological and seasonal conditions associated with kleptoparasitism and predation (hereafter *correlates of kleptoparasitism*);

3. Determine potential diet differences between kleptoparasitic and non-parasitic gulls (hereafter *diet information*); and

4. Monitor potential differences in chick growth and adult reproductive success for both gulls and puffins as a function of the opportunity for kleptoparasitism and topographical attributes of nest location (hereafter *puffin* or *gull reproductive success* and *topographical effects*).

Methods

Both puffins and gulls are most abundant and accessible on Puffin Rock which forms the southwest corner of Triangle Island. This location served as the exclusive study site although it did not permit examination of either species in the absence of effects by the other. The SE face of the SW arm of Puffin Rock was used for behavioral and growth studies; diet information was collected on the east face of the SE arm. On the SE face, a grid of 40x100 m was marked with yellow flags to quantify topographical (slope, elevation, aspect) differences. Specific methods are outlined by reference to the objectives listed above. Because these methods were largely preliminary and will serve as a basis for future work, I will include brief discussions of their effectiveness.

Gull foraging tactics. During June, I marked each accessible gull nest with an orange flag placed 1-2 m SW of the nest. Study nests were located along the ridge and upper SE slope of the SW arm; I avoided nests near nesting murres (SW face and lower SE face). Several methods were employed in my (largely unsuccessful) attempts to capture gulls for subsequent identification of individuals. Night-lighting and noosing were completely ineffectual (gulls were too wary) as were attempts to catch gulls at their nests with padded leg-hold traps (the traps may have been too loose). Three gulls were caught by baiting traps at popular resting sites later in the season, but these sites too seemed to be avoided after unsuccessful trapping attempts (traps were frequently found tripped, suggesting gulls were able to pull their legs out of the padded traps and learned to associate fish bait with traps). Twice I saw a gull with a broken foot flying over the observation slope and this may have been caused by a trap. Trapping was also not conducive with observation periods which commenced after hatching.

I marked the captured gulls with a combination of four leg bands including one USFW metal band with a nylon streamer attached, one lettered plastic band, and two electrical tape bands. All were highly visible throughout the season. I used acrylic paint to make additional marks on the head and breast, but these did not last well and patagial tags (used in many gull studies) may provide a better means of identifying gulls on the ground (where tall grass obscures their legs). I took several morphological measurements (bill depth, culmen length, wing chord, tarsus length) with the intention of using discriminant function analysis to sex captured individuals.

Correlates of kleptoparasitism. Most of the 40x100 m grid was visible from a plywood blind set at the top of a natural amphitheatre between the SW and SE arms of Puffin Rock. From here Bob and I conducted behavioral observations throughout the puffin chick rearing period (29 June through 16 August), concentrating our effort on the lower 20 grid squares (hereafter 'lower slope'). We took turns observing for 2 or 3 hour periods, aiming to distribute effort roughly equally among the daylight hours (0600 h to 2200 h). During observation periods, two counts were made hourly; the number of puffins on the ground and the number of puffins returning with and without fish during a 10 min. period. These counts were made at the same set of (10x10 m) grid squares throughout the season with additional comparative counts made at other grid squares periodically. Each 10 minutes, we noted the position of all gulls in the lower slope (where gulls did not nest) and recorded all attempted and successful kleptoparasitism and predation events. The location of each of these events was referenced by the nearest grid flag.

Weather conditions (shaded temperature, qualitative estimate of wind direction and speed) were noted each hour during observations. These will be supplemented by the weather reports from the automated buoy at Sartine Island. Because previous seabird failures have been associated with ENSO events, I also recorded sea temperatures in South Bay throughout the puffin chick rearing period. These were recorded at the surface and 3 m depth at 35 minute intervals by HOBO data loggers.

Diet information. I attempted to quantify gull diet by collecting pellets of indigestible material found near nests and by identifying the regurgitated food of chicks. Puffin diet (for comparison) was determined by blocking burrows with pieces of cedar shingle, identifying the dropped food loads, and leaving all but a few unidentifiable species for the chick to eat. Unknown species were collected for subsequent identification. While these methods would permit some analysis of seasonal differences in puffin and gull diet, they will not allow me to assess differences in the diets of kleptoparasitic and non-kleptoparasitic gulls as too few individuals were marked. I suspect that such information would require a huge time investment (for both trapping and pellet retrieval) that may be better spent on other objectives.

Gull reproductive success. I had initially intended to obtain repeated measures of gull chick growth at marked nests, but found that chicks were very difficult to find in the tall grasses surrounding nests. Chicks often hid in burrows, further frustrating their retrieval. Instead, I measured (mass, wing chord, foot, tarsus) each chick within a day of hatching, fastened a temporary band of electrical tape, and then attempted to capture and measure it at least once subsequently when it was old enough to have a metal band applied. Although it would be possible to conduct a detailed growth study of these gulls (by, for instance, attaching a piece of metal to the tape band and locating chicks with a metal detector), this also seemed an inefficient use of resources (see the general discussion below). The reduced method of measuring chick growth will permit comparison to other glaucous-winged gull populations as an additional means of quantifying reproductive success.

Puffin reproductive success. Because puffins are known to desert their nests if they are disturbed during incubation, I did not attempt to determine the hatching dates of chicks. Instead, we located an active burrow as close as possible to each grid flag approximately a week after puffin hatching began (30 June through 4 July). We marked each of these burrows with a blue flag and measured the chick within every 10 days until it died or disappeared. We also measured (as much as possible) all dead chicks found on the study slope and elsewhere to estimate minimum successful fledging size.

Topographical effects. We took a series of topographical measurements at the end of the season to compare with the growth and reproductive success of both puffins and gulls. At each grid flag, we measured the elevation difference and distance to the adjacent flag and the magnitude of the SE slope (and the maximum slope if the aspect was not SE). For each marked puffin burrow, we measured the height of the grass surrounding the burrow, the number of puffin burrows within a 5 m radius, and its position (elevation difference, distance and direction) relative to its corresponding grid flag. For each gull nest, we measured the distance to its nearest neighbour (to calculate a minimum estimate of territory size) and the distance and direction to the nearest grid flag.

Preliminary Results

The results that follow are based mainly on qualitative assessments and basic quantitative descriptions. I will complete more detailed analysis this fall and use these data as the basis for proposals to continue the project next year.

Gull foraging tactics. Only three gulls were captured and marked, but these remained in the vicinity of the SE slope throughout the season. Two of the three appeared to be non-breeding birds, spending large amounts of time standing on the lower slope, but seldom succeeding at kleptoparasitism attempts. The third was a breeding bird that was observed only in the vicinity of its own nest and was never observed kleptoparasitising puffins.

Correlates of Kleptoparasitism. We observed the lower slope for a total of 175.5 h, with each daylight hour represented by 10.5 to 12 h of observation time (except for only 9 h between 2100 h and 2200 as it was too dark to observe after 2130 h by August). We noticed general peaks in gull activity in the morning and evening. Gull activity was further influenced by weather; strong NW winds seemed to discourage activity at this site whereas strong SE winds heightened it. The number of puffins on the slope also appeared to be strongly influenced by time of day with most puffins occupying the slope in the early morning and late evening. Puffins were also more abundant early in the season (before the third week in July) than later. The number of puffins returning with fish exhibited slight morning and evening peaks, but continued throughout the day. Gull activity seemed more dependent on total puffin return rates than on relative changes in the number returning with fish. Our qualitative impressions during observations were that gulls were seldom successful in their kleptoparasitism attempts and only a small proportion of the puffins returning with fish were actually attacked. We also observed little predation, only once seeing a gull dig out and consume a puffin chick on the observation slope. Gulls were seen eating or attempting to eat puffin chicks elsewhere on three other occasions, but we could not tell whether the chick was already dead (i.e. scavenging vs. predation).

Diet information. We examined 60 regurgitated (pellets and chick vomit) or uneaten samples of gull food in the vicinity of gull nests. Early pellets consisted mainly of barnacle species whereas later ones often contained fish and, occasionally, bird skeletons. Uneaten food near nests included murre egg shells, fish parts, starfish, a vole and a partially-eaten puffin chick.

In addition to quantifying puffin bill loads during observation periods, we attempted to collect puffin food samples at burrows. We blocked between 19 to 50 burrows on each of three occasions on 22 July, 27 July, and 16 August. The proportion of burrows at which bill loads were dropped varied from 5% on the first date, to 16% on the second and zero on the third. Early morning seemed to be the best time to block burrows. This method seemed to yield very precise information with little disturbance to the animals.

Gull success. A total of 99 eggs were laid at 40 nests resulting in a mean clutch size of 2.47. Of these eggs, 75 chicks hatched at 34 nests. Hatching success was thus 80% on a per egg basis and 85% of nests produced at least one chick. Of the 75 chicks provided with tape bands, 50 were recaptured and fitted with metal bands. An additional 11 unmarked chicks were banded with metal bands in the vicinity of marked nests and these may have represented, in part, chicks that lost their tape bands. Six chicks of known identity were found dead, four with metal bands (these are indicated on the banding forms). We cannot provide a precise estimate of fledging success because of difficulties capturing chicks, but it appeared to be very high.

I also monitored by observation alone the reproductive success of 21 gull nests on the far end of the SW arm where steep slope and proximity to murres made it impossible to census nests. Here, 21 nests were attended by 31 chicks in late August (mean = 1.4 chicks per nest). Unfortunately, I did not map gull nests in this area early enough to know how many nests might have failed completely. Because chicks here were more readily observable from the blind (the grass was much shorter), it was possible to monitor reproductive success over a longer period, albeit with less precision before hatching, than was possible for the census nests.

Puffin success. We grubbed 31 puffin burrows between 30 June and 4 July to monitor puffin chick growth. Four empty burrows were replaced on the first weekly check on 14 July and 10 more were added, for a total of 41 burrows containing chicks on that date. To estimate the reproductive success of puffins, we considered chicks fledged if they were 250 g or greater when last measured. Of these, 33 may have fledged (81%), one died in its burrow between 14-21 July, one was apparently killed by a peregrine on 11 August (fresh remains found with characteristic decapitation), five were found dead and emaciated in or near their burrows at the end of August, and one emaciated chick was "adopted" by the camp in late August. Thus, 14% (6/41) appeared to be deserted by their parents late in the season, causing the bulk of the mortality we could detect. This mortality seemed to be widespread; we found an additional 38 dead chicks on and near the observation slope during this period.

Topographical effects. Most of the observation slope had a SE aspect and its slope varied from 10° to 60°. The elevation difference between the top and bottom of the observation area was approximately 12 m. I have not yet analyzed the effects of topography on rates of kleptoparasitism or puffin growth, but there are no very obvious trends thus far (i.e. gulls were not restricted from using very steep slope and puffin success was not markedly greater on the lower slope).

General Discussion

Overall, the effect of gull kleptoparasitism and predation on puffins seemed to be low. Puffin success in the 1995 season seemed to be much more dependent on the delivery capability of parents which, from the bill load observations and samples, appeared to vary considerably. Our maximum estimate of puffin fledging success (81%) is clearly very high for this population and it would be interesting to know how these dynamics -- rates of gull kleptoparasitism and puffin parental provisioning -- change in poor food years. Gulls also had a very successful year and the ease with which they forage will also undoubtedly affect rates of kleptoparasitism. Further observation in another season(s) would provide a better understanding of the typical effects of gull kleptoparasitism.

Despite the very few marked gulls, it appeared that there was some specialisation among individuals to a kleptoparasitic diet. Moreover, some gulls seemed considerably more successful at kleptoparasitism than did others and identification of these individuals would allow one to quantify variation in success rates among kleptoparasitic individuals. Nonetheless, trapping gulls is time intensive and involves a lot of activity on the slope which causes cumulative damage to burrows. Many of the individuals breeding along the ridge appeared to be most active on its NW side whereas observations encompassed only the SE slope. Thus, trapping of all gulls breeding in the area would involve a large effort per observable individual. Trapping by bait later targets kleptoparasitic gulls, but the disturbance it causes precludes observation. I intend to discuss gull trapping with Grant Gilchrish, who has trapped glaucous gulls successfully with the same method, to assess the relative merits of future trapping efforts.

The monitoring of gull reproductive success yielded marginal data because chicks could not easily be found beyond a few days past hatching. I believe that the observational data based on mapped nests would yield better estimates of reproductive success with no disturbance to the habitat of the burrowing seabirds. This method would not permit knowledge of clutch sizes and hatching success, but would lend itself well to annual comparisons of gull reproductive success to fledging. In retrospect, I feel that the near-daily visits to the census nest area during hatching and chick-rearing did not yield data of sufficient quality to merit the inevitable damage it caused to burrows (see discussion below).

Puffin reproductive success was much easier to measure than gull success and, I believe, resulted in better data. It was unfortunate, given the substantial mortality caused late in the season by desertion, that chick ages were not known. I suspect it would be possible to gain this information without desertion by checking burrows during their expected hatch dates with a fiberscope as has been done with common puffins. This year's design, which required walking all over the SE slope once a week to measure relatively few chicks would be worth continuing only if it appeared that there were trends in topographical effects on chick growth. If it were continued, it might be reduced to a less frequent schedule and still yield comparable data.

The substantial variation in puffin bill loads (both size and composition) was surprising and suggests a productive area in which to concentrate further effort. This variation may be key to understanding the frequent poor success of puffins at this site. Much similar work on parental provisioning has already been done with alcids and I will need to conduct a thorough literature search before deciding how (and if) this part of the study should be expanded. Worthwhile aspects may include: (1) Determining incubation constancy. Puffins seemed to be very asynchronous in hatching this year. Given the apparent desertion late in the season, it would be interesting to know if asynchrony results from differences in breeding onset or differences in incubation length. (2) Determining rates of parental food delivery. Repeated food sampling of known age chicks or, ideally, an automated system of monitoring chick weight gain, would provide precise information about the extent of variation in provisioning rates. (3) If otherwise feasible, more intensive efforts in measuring chick provisioning should be conducted in a relatively small area where "safe" footsteps could be marked to limit disturbance to burrows.

Damage to burrows on puffin rock. Although good general policies are already in place to protect the nesting habitat on puffin rock, it was apparent to us that cumulative damage is occurring, particularly on the SE slope of the SW arm. This area was the site of Ann Vallee's (early 1980's) study, served for CWS monitoring plots and transects, and was used for pilot trapping and observational studies in 1994. We found weathered pieces of wood that had apparently been used to repair burrows previously on all accessible parts of the slope. We also made several (perhaps 3 dozen or more) burrow repairs in the course of our study, mostly late in the breeding season. Many of these were to previously damaged sites that had gradually collapsed over time. Because burrows tended to become more fragile as the summer progressed, it was difficult to anticipate this problem when protocols were established earlier. In retrospect, we felt that movement on this and other puffin nesting slopes should be curtailed somewhat. The new blind site above the amphitheatre makes it possible to conduct observations of puffins, gulls, and murres without entering the fragile tufted hair grass nesting habitat.

Some logistical suggestions

Overall, Bob and I were tremendously impressed with the logistical support at Triangle Island. The site is spectacular biologically yet relatively accessible, providing an ideal research setting. The hut is well-designed, well-equipped and very comfortable. Many of its features and contents are extraordinary, but none struck us as overly extravagant. A few things that might make the camp run more smoothly are outlined below.

1. *Personal space.* The common area is adequate, but very crowded for six people and everyone needs some space of their own. The small backpacking tents used this year are not really sufficient for this, particularly since the older one leaked badly by the end of the season. Larger, high quality tents combined with designated space in the hut for the tent people would extend the practicality of having six people on site. Metal or plastic lockers, installed in the southeast corner might achieve this space with little loss of living area. The construction of a mud room (where wet boots and coats could be left) outside the current door would also increase living space and keep the hut much cleaner.

2. *Propane transfer.* Transferring propane on and off Vancouver Island seemed to be as much of a problem as getting it to Triangle. Perhaps some arrangement could be made to have propane refilled in Victoria or Port McNeil, rather than Vancouver. If the helicopter is to be used to transport propane, it will be necessary to use only the small cylinders and to transfer only one or two cylinders at a time.

3. *Fixed radio schedule.* Establishment of a fixed radio schedule (say once or twice per week) with SFU would alleviate some of the (mostly minor) confusion that arose in camp. This might also avoid the more costly daytime calls that were often made to clarify various protocols. Such a procedure would be particularly valuable when the project coordinator (Doug Bertram next year) is not on site.

4. *Ongoing maintenance and management.* Because of its isolation and harsh conditions, the Triangle project requires a battery of expensive equipment, supplies, and logistical arrangements. In the 1995 season, these were not always used in the most cost-effective manner, largely because of the inevitable confusion stemming from personnel changes. Nonetheless, means of streamlining maintenance, re supply and transportation are likely critical to the viability of the project. For this, maintaining a project coordinator (Doug Bertram as of January 1996) and ensuring interannual personnel continuity on site seem essential.

5. *Passerine banding.* As we discussed on September 5, all of the camp inhabitants in August 1995 felt that the passerine migration monitoring program was not easily meshed with seabird research objectives. We felt that this project does not make the best use of Triangle's limited facilities and respectfully recommend discontinuing it.

Factors Limiting the Reproductive Success of Tufted Puffins on Triangle Island

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Overview

The Ecological Reserve of Triangle Island is an important breeding site for several Pacific seabirds and hosts British Columbia's largest population of tufted puffins (*Fratercula cirrhata*). Despite an estimated size of 25 000 birds (Vermeer 1979), this population experiences frequent reproductive failures (Rodway *et al.* 1990) which threaten tufted puffin viability in B.C. Previous workers suggested that these reproductive failures are linked to increases in populations of kleptoparasitic glaucous-winged gulls (*Larus glaucescens*; Jones and Gilchrist 1995), and that vulnerability to kleptoparasitism generally is influenced by foraging success (Rice 1985) and nesting slope topography (Nettleship 1972; Wilson 1993). To explore these links, CCS studied the effects of gulls on tufted puffins breeding on Puffin Rock, Triangle Island in 1995, monitoring the reproductive success of both puffins and gulls. Preliminary results (summarized in a year-end report submitted to the Wildlife Ecology Chair in October 1995) suggested that predation and kleptoparasitism had little effect on the breeding success of puffins in a successful year. In contrast to 1994 when puffins failed almost completely and kleptoparasitism rates appeared to be high (G. Gilchrist, pers. comm.), puffins were very successful in 1995 (81% of hatched chicks fledged) and fewer than 5% of puffins returning with fish were attacked by gulls. Most of the chick mortality we detected (6/8 deaths) was apparently caused by poor parental provisioning late in the season. Although the mass and composition of parental deliveries are known to be highly variable in puffins (Hatch and Sanger 1992), little is known about how provisioning varies with time, chick age, or parental ability. Work with Atlantic puffins (*Fratercula artica*) suggests that parents have only limited abilities to recognise and respond to variation in chick needs (Johnsen *et al.* 1994). Identifying the factors that limit puffin reproductive success on Triangle Island is an important first step to conserving populations of puffins and other seabirds in B.C.

Research Plan

Objectives: Complementing work conducted in 1995, we propose a study of three parts: (1) quantify the extent of gull kleptoparasitism by monitoring rates of gull attacks relative to puffin fish deliveries; (2) determine the effect of nest site topography on gull and puffin reproductive success by quantifying the fledging success of both species over a range of slopes and elevations; and (3) evaluate the effect of variation in parental provisioning on puffin chick growth, fledging time, and survival by measuring and augmenting the feeding and growth rates of known-age chicks.

Methods: (1) During the chick-rearing period, observations from a blind will be concentrated in the morning and early evening when rates of kleptoparasitism are greatest. Puffin density, return rates, and attack rates will be quantified relative to an existing 40 x 100 m grid on one nesting slope and compared to 1995 data. (2) Puffin reproductive success will be monitored at 40 burrows spaced approximately equally across the same grid. Burrows will be grubbed (at existing grid flags) after hatching and checked again prior to fledging for the presence of a chick. Gull reproductive success will be monitored by spotting scope observation only (suitable nests will be mapped during

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