Nesting Ecology of Black Brant in Alaska

Population fluctuations of Black Brant (Branta bernicla nigricans) are little understood and although many biologists have attempted to solve this problem, none have found a satisfactory answer. Hunting mortality, wintering ground losses, and breeding ground mortality are three of the most discussed and probable causes of the fluctuations in brant numbers. However, mortality studies of brant losses due to hunting, which were based on previous banding, now appear to be of uncertain value--this is because mortality to local brant during banding operations and subsequent band loss has apparently highly biased results of past banding. No accurate or adequate method has been devised to census wintering populations of brant, let alone determine mortality in these populations. Various attempts to uncover factors effecting the breeding populations of Black Brant on the Yukon-Kuskokwim nesting grounds have met with little success; however, early pilot studies served to point out two important features of the Delta nesting grounds: (1) there is always the possibility of storm losses to nesting brant due to the location of the nesting habitat, (2) avian predation appeared to be severe and of serious consequence at times. Little was known about the distribution, numbers, and mortality of breeding Black Brant in this area. Moreover, methods for determining age, survival ofyoung, and production estimation were undeveloped. These unsolved problems led to the initiation of a Black Brant job under the State Federal Aid program. This project was active from the summer of 1961 until this past summer. Basically, the job objectives were designed to determine the unknown factors outlined previously.

Field headquarters for the brant study was located at Old Chevak, an abandoned Eskimo village site about 20 miles above the mouth of the Kashunuk River on the Yukon-Kuskokwim Delta. The major nesting grounds of the Black Brant in Alaska encompasses that portion of the Yukon-Kuskokwim Delta which borders the Bering Sea from Igiak Bay south to Hazen Bay. The nesting area is a narrow strip of tidal flats barely rising above the mean high tide level, varying from a few hundred yards to a mile from the open water. It is bounded on the shoreward limits by a drift line which is actually a storm tide line. This area often abuts on the tundra. The distinct feature of these flats which constitute the nesting area is a simple plant community consisting largely of a single species of sedge and beach rye. Late in the summer this vegetation acquires a characteristic appearance--a bright emerald green which may more aptly be described as looking like a well kept lawn. In all, the actual area used by nesting brant probably does not exceed fifty square miles.

Our first task upon arrival on the nesting grounds early in June of 1961, was to select a study area and to make a complete nest search of this area. An aerial breeding pair survey was also flown, but found to be entirely unsatisfactory due to the proclivity of brant to flush far ahead of the survey aircraft. Travel between the camp and the study area was by outboard or airplane. A 231-acre study area situated about four miles above the mouth of the Kashunuk River was finally selected as a representative brant nesting area. This area was originally one of three areas studied by Olsen in 1951: therefore, some comparative data were available.

In order to reduce confusion and facilitate rapid coverage of this area, large tripods were constructed on each corner of the area. Markers were also placed every so often along the boundary of the study area to serve as points of reference when walking back and forth searching for nests. Each searcher covered approximately 25 feet on each side of his line of travel. Nesting waterfowl were easily located in the short, scanty cover, thus allowing coverage of such a wide swath. Most nests were not marked by marker poles, but each was assigned a number which was written on the eggs with a Cado or Magic Marker. This eliminated counting nests twice.

A sample of at least 100 nests was selected randomly each year (except 1963) to determine hatching success, clutch size, and so on. These were marked with 3-foot aluminum poles painted with glow paint to facilitate relocation. Each pole was also numbered to correspond with a nest history card. Nesting composition and densities for the three years of study are presented in Table 1.

Table 2. Comparison of nesting densities and composition on the Kashunuk River study area.

Species	1961	1962	1963
Black brant	260	332	293
Cackling goose	49	67	60
Emperor goose	0	1	1
Unidentified goose	0	4	2
Spectacled eider	36	26	22
Common eider	2	1	1
Steller's eider	1	5	1
Pintail	7	3	5
Old squaw	0	2	3
Greater scaup	0	1	1
Little brown crane	0	0	1
Total	355	442	390

Because we were from two to three weeks late arriving on the nesting area, the average clutch size of 3.6 eggs as observed cannot be considered an accurate figure due to egg loss and predation occurring prior to our finding of the nests. Hatching success of eggs found in

1961 and 1962 varied from 90 per cent to 86 per cent, respectively, with an average of 3.3. downies hatching in 1961 and 3.5 young hatching in 1962. The peak of hatch between years varied about one week, occurring on June 23 in 1961 and on June 30 in 1962. Predation and desertion to our nest samples were negligible and amounted to less than 5 per cent.

Following a complete nest search of the study area, two other jobs were accomplished: one was the testing of various sized nest sampling plots to determine which most accurately sampled brant nesting densities. Plots of one-quarter acre, 1 acre, and 5 acres were laid out systematically from a random start. Nine line transects one-half mile in length and 6 feet on a side were also walked parallel to the shoreline. Results of a statistical comparison of these plots suggested that the least error in estimation could be accomplished with the one-acre plots. These were rectangular plots 2 chains by 5 chains and usually surveyed perpendicular to the beach or shoreline, thus extending generally from the dense to less dense nesting.

The second job was that of making an evaluation of the nesting habitat, its vegetative composition, physical arrangement, and the relation of brant nesting to these features. Briefly, one can describe the brant nesting habitat as that portion of the tidal flats which lies below the storm tide level, but slightly above the mean high tide mark, and which is usually broken by numerous shallow pools or sloughs, which may or may not contain water. Nesting is confined to a cover dominated by a single species of sedge, often accompanied by subordinate cover of beach rye in small amounts. Nest sites almost always occur within 5 feet of water (or temporary pools of water) on small islands, points, or among scattered small ponds and sloughs. However, the most important fact to keep in mind is the location of the nests in relation to the mean high tide level. Nowhere did we find a nest that was over one foot above the mean high tide mark. In fact, brant nests seldom occur more than 6 inches above this mark.

One-hundred forty 1-acre nest sampling plots were surveyed on various other nesting areas as a means of determining breeding population densities of brant on the Delta (Table 2). These were systematically placed from a random start with five one-acre plots to a one-half mile base line.

Table 2. Brant nests per acre.

	1961	1962
Study area	1.12	1.44
Plots	1.12*	1.45*

* Sampling error 17 per cent.

Applying these densities to data gathered on the distribution surveys, we arrived at some interesting figures. All told, the area used for nesting by nearly 90 per cent of the Pacific Coast Brant population probably does not exceed 50 square miles. In fact, most of the nesting occurs on a few densely populated flats at the mouths of a few large rivers, such as the Kashunuk River. Nest densities on some of these areas exceeded 1,000 nests per square mile. Theoretically, then, and assuming that there is approximately one nest per acre over the major nesting habitat, an annual breeding population of 40,000 pairs of brant probably nests on these flats. (Population estimates based on winter and molting flock composition agree closely to this figure). Considering that an entire breeding population of one species is confined almost entirely to a small, isolated habitat, which is highly subject to the same population depressants, one can easily imagine the possibility of catastrophic production losses. I will discuss this point, presently.

Methods of Production Estimation

I have already discussed the fact that breeding pair surveys of brant are not reliable and that ground nesting surveys were the most satisfactory methods for delineating annual breeding populations. However, another feature of the annual breeding cycle which is important in determing annual production is the average brood size and number of broods produced.

Brood counts of geese and brant have always been difficult to make, let alone use as an absolute production figure from year to year. This is due to the innate habit of geese of banding into flocks a few days after hatching, thus obscuring the true brood size. In ducks, which do not band together for many weeks, it is easier to estimate mortality by comparing brood size at hatching and later as the ducklings near flight age. During the three years of the brant study, we made many aerial and ground brood counts. Results of these are as follows:

Table 3. Average brant brood sizes.

	1961	1962	1963
Ground	3.3	3.5	2.9
Air	2.8	2.9	2.1

These counts were made approximately one week after the peak of hatching each year. At first, it is obvious that there is only a significant difference between the years of 1962 and 1963. However, a vast difference in total production occurred between 1961 and 1962, but why is it not reflected in the brood counts?

To clarify this situation, we must consider the weather conditions during the nesting and brood periods of these years. We must also consider the size of the breeding population during these years, but this is relatively unimportant in comparison to the climatic effects. In 1961 nesting was delayed some by a late spring, but not excessively so. Weather during the nesting season was fair, and the hatch came off with good success. About one week after the peak of hatch a severe storm struck the Delta, causing extreme tides and extensive flooding. Few nests were lost, but the young brant were scattered all over the flats and thereby subjected to exposure and predation. The effects of this storm were not reflected in subsequent brood counts, but became obvious when the results of the banding surveys were examined. In 1962 the brant were delayed in their nesting nearly one week beyond the 1961 dates; however, the spring of 1962 was followed by unusually excellent weather which continued on until late July. A high breeding population was present, hatching success was good, and brood survival appeared excellent.

One feature of the molting and brood period of the brant is the segregation of adult and subadult molters from the flocks of adults and broods. These brood flocks consist largely of adult males and successful adult females with a few non-breeders. In examining the banding records for both years I noticed (Table 4) that the number of adult males and adult females (with brood patches) was quite similar.

Table. 4. Brood flock composition, 1961 and 1962.

	1961	1962
Adult males	51	345
Adult females (with brood patches)	54	341
Adult females (without brood patches)	7	15
Total young	114	1,019
Number young hatched	3.3	3.5
Young per adult female	$\frac{114}{54} = 2.1$	$\frac{1,019}{341} = 2.9$

These flocks were captured intact and without the loss of many birds, so that the possibility of distorting the adult female:young ratio was very slight. Admittedly, the sample for 1961 is small, but it still gives us some reason to believe there was better brood survival in 1962. Furthermore, in 1962 we determined that 15 per cent of the molting adults were yearling birds; whereas this past summer we found over 39 per cent yearlings in the molting flocks.

Let us return to the 1963 nesting population; this population was slightly smaller than in 1962 but appeared to nest earlier, and up until late incubation nesting had progressed well. Unfortunately, a storm struck during the time when most of the nests were hatching or about to hatch. This storm inundated the entire Delta brant nesting habitat and losses to this storm were terrific. Aerial brood counts over previously established transects indicated a 76 per cent decrease in the number of broods from the 1962 survey.

I would like to again point out the essential factors involved in the nesting ecology of the Black Brant which make its very existence a precarious one, and perhaps one which is only by chance one jump ahead of disaster. You will remember I mentioned a figure of 40,000 pairs of brant nesting annually on an area not exceeding 50 square miles--an area which barely rises 6 inches above the mean high tide level. Any storm, and not necessarily a severe storm, at any time during the late incubation and early brood periods, can potentially wipe out the entire annual production of the brant. Storms of severe nature closely following the peak of hatch can put the population of young brant in absolute jeopardy and subject them to scattering, which in turn can cause excessive losses to exposure and predation.

This study has also indicated that the Black Brant is somewhat inflexible in its habitat requirements, and at present it appears that no new nesting habitat is being formed, but is rather being destroyed by the mechanical forces of the sea. Sometime early in the 1950's, a large island situated at Hazen Bay and reputed to support many thousands of nesting brant, was completely destroyed. Following this disaster the Pacific Coast brant population showed a considerable drop in size.

Barry (1962) working on Brant (Branta bernicla hrota) in Arctic Canada, has demonstrated that populations of these brant may suffer extreme reproductive failures due to late springs; that is, the brant arrive on the far northern breeding grounds physiologically ready to nest but find conditions unsuitable for nesting and are unable to nest or do not lay as many eggs when suitable conditions develop. I do not believe this type of phenomenon is manifest in the Black Brant, but would rather suggest that the main factor governing production on the Yukon-Kuskokwim Delta is weather and its direct or indirect effect on nesting brant or the very young. Marking studies of brant have indicated that some brant nest at 2 years, but most will nest at 3 years; thus, a loss of one year's cohort in the population will possibly be influential in the nesting effort and subsequent population level some years after the actual loss. Although I do not believe the loss of one year's production would endanger the Pacific Black Brant population, its effects may be noticed during the year that this group would have reached its maturity. Undoubtedly the loss of two or more years of production would have a detrimental effect on the population, but the chances for this type of occurrence appear very remote. Whether or not this factor is influential in the periodic fluctuations of Black Brant, I do not know, but suggest that further study of this feature is advisable.

During three banding seasons the State has banded 8,149 Black Brant. Direct returns from this banding have yet to exceed 2.5 per cent--a low rate of return. However, bag checks on one of the major hunting areas (Humboldt Bay, California) in 1962 and 1963 indicated a kill in the excess of 5,000 birds. Assuming the kill on the remainder of the Pacific Flyway is proportional to Humboldt, an estimated 25,000 birds were probably taken this past year. This is still not an excessively high kill if crippling losses were low, but some biologists (Hansen and Nelson, 1957) suggest that one brant is lost for each one retrived. If this is true, the present brant population would have some difficulty maintaining itself. A close check on harvest regulations seems a necessity in the light of recent findings which suggest that catastrophic reproductive failures are a constant possibility.

Management of the Pacific Coast Black Brant seems a distinct possibility within the next few years if certain problems can be resolved. The problem of band loss and deterioration has been settled and more reliable mortality data may be gained from future band returns. In addition we are now able to determine age ratios in Black Brant well enough to gain firsthand knowledge of the age structure of the population. The use of incubation patch data has been valuable in determining nesting success and the age of first breeding. However, there are some areas of research which still need our immediate attention. Studies of the harvest and crippling losses of brant have received little or no attention and investigation of these little known facets of the Black Brants' ecology are important if intelligent management of this species is contemplated in the future.

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