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A Water Bird Survey in Bristol Bay and Proposals for Future Studies

by

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ABSTRACT

This paper reports a preliminary attempt to census fall water bird populations in Bristol Bay within the zone from high tide to the 12-mile off shore limit. Aerial sampling techniques, originally designed for censusing breeding pairs of ducks in marshlands, were modified slightly for this survey. Results of our census provided positive information on these bird populations and indicated that, with further refinements, better information can be collected in the future.

We flew 99, 8-mile-long transects to sample 8,064 square miles of water in early October. Birds were observed on all but three of these transects, with a maximum of 747 birds being seen on any one segment. A total of 9,473 birds was tallied. Sampling error, calculated as for a simple random sample at the 95% confidence level, was 27.5%. The average number of birds observed per square mile was 47.83 $\pm$ 27.5%. This figure translated onto the entire area sampled provides a population estimate of 335,702 $\pm$ 106,001 birds.

Scoters occurred on 67 of the segments and comprised 88% of the waterfowl and 47% of the total birds observed. All three species of scoters were present, but common scoters predominated. Other waterfowl identified included emperor and Canada geese and harlequin and old squaw ducks.

Introduction

The eastern Bering Sea, including Bristol Bay, is one of the greatest congregating areas for water birds in the world. Situated at the top of the huge Pacific basin and just south of the Arctic it is a crossroads for waterbirds that roam one-third of the world in their yearly cycle. Because of the rich and shallow waters of the extensive continental shelf it is a feeding area for hordes of migrant birds bound to and from the vast Arctic nesting areas of Siberia, Alaska and Canada; it is a wintering area for Arctic nesting as well as southern hemisphere nesting birds; and it is a rearing area for millions of colonial and other sea birds.

Little attempt has ever been made to determine the actual numbers of birds that use this area. The time has come that such numbers should be determined for the entire region is underlain with formations that almost certainly contain huge amounts of petroleum. The oil industry is already at work and there is little doubt that big strikes will be made. With oil production comes oil spills, pipeline breaks, wrecked tankers, gushers and other potential disasters for birds. If ever we are to assess the natural abundance of birds in this unique area we must do it now before attrition begins to take its toll.

This paper reports an attempt to census birds in Bristol Bay within the zone from high tide to the 12-mile off shore limit. These would be birds vulnerable to oil spills at sea. The survey area did not include the bays and lagoons inside the barrier beaches which hold several millions of waterfowl, shore birds, and other water birds at this time of year. Surveys farther from shore were deemed inadvisable using a single engine airplane.

Aerial sampling techniques originally designed for breeding pairs of ducks in marshlands were used. These methods have not been successful in other waters because the birds have been clustered in flocks with large stretches of unoccupied water between. Our assumption that Bristol Bay is a unique area proved correct and flocking was not a problem.

We flew 99, 8-mile segments sampling 8,064 square miles of water in early October. Our sample indicated 47.8 birds per square mile within the 12-mile limit with a sampling error of 27.5%. This gives an expanded total of 385,700 birds $\pm$ 27.5% that would be vulnerable to oil spills within the 12-mile limit.

It was concluded that the project was successful in developing positive information and shows promise, with further refinements, of developing better information in the future. Exceptional numbers of birds use Bristol Bay, and survey techniques unusable in other areas are feasible here.

Methods

The survey was planned, executed and the data analyzed in accordance with Standard Procedures for Waterfowl Population and Habitat Surveys (unpublished instruction booklet, BSF&W, M&E Division, Wash., D. C., 1969).

Sixteen-mile transects were laid out on a chart (see Fig. 1) from Cape Newenham to Unimak Pass. Each transect was divided in half and numbered, making 124, 8-mile segments in all. Corrected compass headings for each direction of each segment were marked on the chart. Because of severe winds it was only possible to survey 99 of these segments. A DeHaviland

Beaver on amphibious floats was used. The pilot on one side and an observer on the other recorded birds within one-eighth mile of the airplane so that each segment included an actual count of birds on two square miles. IBM tape recorders were used to record data. Every effort was made to identify birds by either species, genus, family or order. A form was made up to transcribe the data by orders (Exhibit 1).

The plane was piloted by Jim King who observed from the left on all segments. Don McKnight observed on the right for the northern half and Palmer Sekora, Branch of Refuges, observed on the right for the southern half. Don Montgomery of the Bureau of Commercial Fisheries and Ed Bailey, Branch of Refuges, participated in parts of the survey. The plane was flown at 96 mph on a compass heading at 100 feet elevation. Five minutes, corrected for wind speed, were required for each 8-mile segment. Total flight time for the project—from Anchorage and return was 37.3 hours of which 8.25 hours were spent actually counting birds. Surveys were made on October 2, 4, 10, 11 and 13, 1969.

Results

The survey observations, classified to avian orders, are summarized in Table 1. Birds were observed on all but three of the segments with a maximum of 747 birds observed on any one segment. A total of 9,473 birds was tallied.

Sampling error for all birds was calculated as a simple random sample at the 95% confidence level. The average number of birds per square mile was determined to be 47.8 $\pm$ 27.5%. This figure expanded to the 8,064 miles of

habitat within the 12-mile limit gives a population estimate of 385,702 plus or minus 106,001. We can say then that the number of birds sampled lies between 279 and 491 thousand.

Biases occur. These include: 1. Some birds dive or fly away at the approach of the airplane before they can be counted. 2. Visibility varies with position of the sun, cloud cover, size of the ripples on the water and size and color of the birds being observed. Experience with ducks has shown that even under ideal conditions some birds are missed in aerial counts of this type. 3. The width of segment counted is not positive but relies on the ability of the observers to estimate the one-eighth mile swath. 4. The segment length is not constant over water because this depends on the pilot's ability to estimate the effect of winds on the speed and direction of the plane. 5. Practical considerations dictated that a sampling pattern be used starting ~~at~~ randomly selected points. The sample thus does not comply to the letter with the definition of a random sample. We can be certain that items one and two above reduce the number of birds observed below the true figure. Items three and four rely on training and experience of the crew and all we can hope is that errors in one direction are cancelled by errors in the opposite direction. Item five bothers statiticians. We feel that a true random sample would undoubtedly produce very similar results at the expense of considerably more flight time. Clearly the 385 thousand total birds for the survey area is a minimum figure. We feel relatively certain that more than half the true total was observed.

Bird Species

The observers were inexperienced at sea bird surveys. Bird identification

from the air improved as the work progressed. The best breakdown obviously was by orders but some information on the species composition and identification was possible.

Loons - At a distance or in poor visibility loons might be confused with murres. It may not be possible to identify loons to species. Only six were identified.

Grebes - Not enough were seen to draw any conclusions.

Tube-nosed Swimmers - Most of these occurred on the southwestern one-third of the segments. One albatross was observed and seven petrels, the rest were shearwaters and fulmars in about equal numbers. These birds can be identified fairly well when they are flying. On the water the petrels could be confused with several dark alcids and the others might be confused with large gulls.

Cormorants - these occur close to shore generally and probably cannot be identified at the species level.

Waterfowl - Scoters occurred on 67 of the segments and made up 88% of the waterfowl and 47% of the total birds observed. All three species of scoters were present but three-fourths of them were common scoters. Other waterfowl included emperor and Canada geese, harlequin and old squaw ducks in small numbers.

Shore Birds - Tight flocks of shore birds were expected but not encountered. Unidentified shore birds were observed dispersed over mud flats at the head of the bay. Most of the shore birds were seen below Port Moller, dispersed

over the water in flocks from 5 to 200 in number. We assume that these were phalaropes. They were well spaced and easy to count if the water was flat and nearly impossible to see if there were any white caps.

Gulls - Gulls had the most even distribution of all birds, occurring on 87% of the segments. Glaucous-winged gulls made up about 75% of the total with the rest being kittiwakes and sabine's gulls.

Alcids - Members of the Auk family were noteable by their scarcity considering the large number that nest along the north shore of the bay. More than half of those seen were murres, the rest guillemots and murrelets.

Sea Otter

Sea otter were observed on 30 of the 41 segments below Port Moller with 16 being the most that was observed on any one segment. The mean was 1.463 otter per square mile with a sampling error at the 95% confidence level of 41.5%. There are 2,040 square miles of habitat sampled below Port Moller thus we expect a population of 2,984 $\pm$ 1,238 or between 1,746 and 4,222 otters. One additional sea otter was seen off Ugashik Bay. Possiblities for sea otter sampling are indicated, however clustering would be a problem at some times and places.

Sampling Error

The sampling error is rather large in our analysis of bird and sea otter populations and our results would not be acceptable for precise management. Our estimates may be close enough to describe the extent of the resources possibly threatened by oil pollution.

The precision of these population estimates can easily be improved. A sampling error within 20% for the birds could probably be attained by simply adding an additional 90 segments. With knowledge gained on this initial survey it would be possible to stratify the area and greatly improve precision without increasing the sample size. For instance more than half the segments begin on the beach and the rest begin about six miles off shore and continue to about the 12-mile limit. About 80% of the birds were seen on the inside segments. Stratification could separate the area from 1-6 miles and from 6-12 miles off shore. Other natural divisions would be the north side of the Bay, the north half of the Alaska Peninsula and the south half of the Peninsula. Precision can be improved slightly by simply lumping the inside and outside segments and calculating sampling error on the basis of 46, 16-mile segments.

Discussion

This survey produced only minimal population data. The most important result was the demonstration of a usable technique. To get a meaningful picture of the bird situation in Bristol Bay it will be necessary to sample the entire Bay at least once in each of the four seasons and possibly as often as once a month for an entire year. In addition some boat surveys should be done in conjunction with aerial surveys to see if an air visibility factor could be developed and to get a better idea of species composition.

A single engine airplane is not the proper piece of equipment for doing over-water surveys even within the 12-mile limit and no more are contemplated. Further surveys should await the completion of the turbo-Grumman Goose now being rebuilt in Anchorage by the BSF&W. With this airplane survey transects could be run clear across Bristol Bay from Cape Newenham

to False Pass.

We found that surveys should not be attempted when the wind is blowing hard enough to make white caps; i.e., in excess of about 10 mph. Large swells with light winds did not seem to limit visibility.

We found that surveying one segment after another without a break becomes very fatiguing. After two or three hours the observers become too mesmerized to do a good job. When and if extended surveys with the Grumman are done survey segments should be laid out to include not more than 50 minutes observation in every hour even if the plane has to circle while the observers stretch.

There is no doubt that if sampling continues in this area there will be times when large flocks, extra large flocks and huge flocks are encountered.

We were in fact surprised at the very even distribution of birds we encountered on this trip. Our plan, if we met with flocks we couldn't count, was to record them merely as flocks and thus plot their occurrence. A code for flock density, extent, etc. may need to be developed.

There are times of year when bird numbers probably far exceed the 48 per square mile we found in October. Russian scientists aboard fisheries vessels have estimated 75 birds per square mile in mid winter in the eastern Bering Sea. In late April, 1968, King estimated 96 birds per square mile by making random, timed counts while flying 10 miles off shore between Cold Bay and King Salmon. High densities of birds can be expected on the north side of the Bay in summer while the great rookeries are occupied. Enormous

flocks of shearwaters will be found at sea in mid summer. Bird densities at sea may increase considerably in mid winter as ice crowds birds out of the estuaries and down from the north.

If meaningful surveys are to be developed the services of a biometrician will be needed to help lay out surveys and analyze data. Fully acceptable sampling procedures that are practical to fly must be developed. It will doubtless be necessary to run and evaluate several more experimental surveys before an operational survey can be developed. These will be necessary to stratify the areas, develop forms and procedures for the handling of the different types of data and to train the crews.

It would probably take at least 24 hours of flight time to make a survey of all of Bristol Bay. At least one survey would be needed in each of the four seasons. If the turbo Grumman is available at $150.00 per hour, then a minimum of $15,000.00 for flight time would be necessary. A week would probably be needed in each of the seasons thus the services of a pilot, co-pilot and two observers for a total of four weeks would be required. In addition a biometrician would be needed for at least a month. We are talking then of a project that would cost in the neighborhood of $30,000.00 for four surveys a year.

Conclusions

Bristol Bay is a huge area with an immense population of birds that varies from month to month throughout the year. In spite of the magnitude of the job it is becoming clear that we could learn a great deal about these birds with the application and perfection of existing techniques. An expanded

aerial survey, as herein described, could provide a wealth of information.

In addition to aerial surveys, advantage should be taken of oceanographic and other government vessels operating in Bering Sea and Bristol Bay by placing ornithologists aboard during different periods of the year. Such observers could develop visibility factors, species composition data and other useful information that would correlate with air data. Estimates for birds per square mile can be derived from ships at sea by using segmented transects similar to those used in aerial surveys.

Bird migration and activities should be monitored from several points along the shores of Bristol Bay and in the large coastal lagoons in spring and fall. Very useful information can be gathered by observers counting birds in passage for short periods systematically spaced throughout the day during peak migration periods.

Attempts to sample or otherwise census cliff nesting sea birds have not been highly successful although this is worth some more effort. It would be highly rewarding and not too expensive to blanket photograph the huge bird colonies on the north side of Bristol Bay one or more times during the summer. Some experimentation is needed here to determine whether color, black and white or infrared film produces the best results. If these colonies can be photographed now even without censusing them there would be a true and permanent record for the future.

This four phase project could be implemented for about one hundred thousand dollars. Such a record produced before the arrival of the oil industry and before the great fish stocks are depleted would be invaluable to biologists

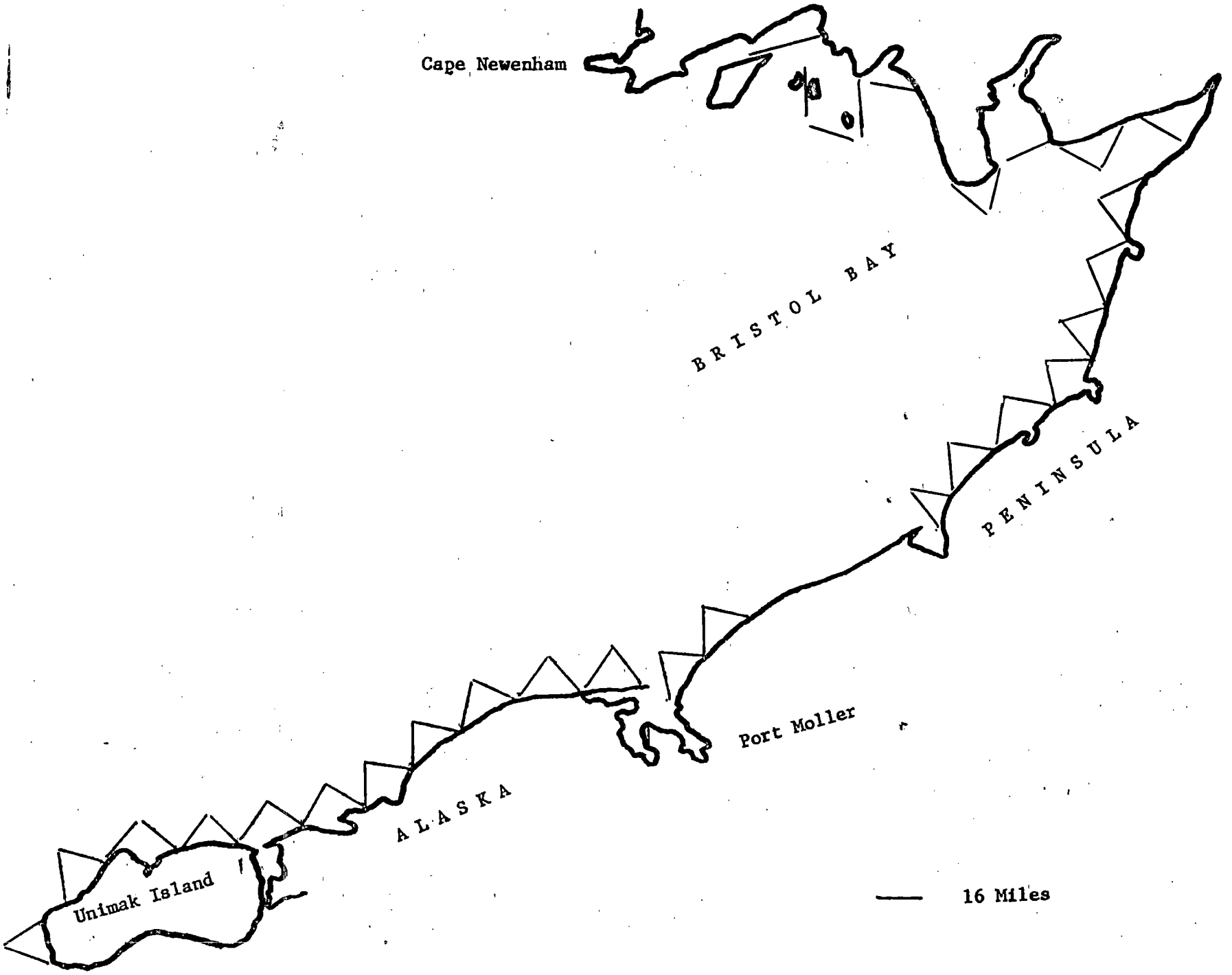
of the future who will unquestionably, as they always have in the past, wish to assess mans impact on the environment. The price is not great for developing a record that would increase in value with each passing year.

Table 1 Bristol Bay Waterbird Survey - October 1969
99, 8-Mile Segments

	Range	Average Number	Frequency	% of Frequency	Total Birds	% of Total Birds	Birds per Sq. Mi.	Expanded Population
Loons	0-2	1.5	4	4%	6	.06	.03	242
Grebes	0-2	1.5	4	4%	6	.06	.03	242
Tube-Nosed Swimmers	0-9	2.7	34	34%	93	.98	.47	3,790
Cormorants	0-6	2.1	16	16%	33	.35	.17	1,371
Waterfowl	0-738	74.1	68	69%	5,036	53.14	25.43	205,068
Shorebirds	0-549	53.8	36	36%	1,937	20.45	9.78	78,866
Gulls	0-196	20.5	86	87%	1,759	18.57	8.88	71,608
Alcids	0-88	9.2	62	63%	573	6.05	2.89	23,305
Unidentified	0-6				30	.32	.15	1,210
Total	0-747	75.4	96	97%	9,473	99.98	47.83	385,702

Range = Least and greatest number seen on any one segment
Average number = Average number of sightings on segments where sightings occurred
Frequency = Number of segments in which sightings occurred
% of frequency = % of total segments where sightings occurred
Total birds = Total all segments
% of total birds = Composition of each order in total bird count
Birds per sq. mi. = 9,473 birds seen divided by 198 square miles in the sample
Expanded population = Birds per square miles multiplied by 8,064 sq. mi. in area

Figure 1


Cape Newenham
BRISTOL BAY
PENINSULA
Port Moller
ALASKA
Unimak Island
16 Miles

Location _____ Date _____ Wind Speed _____ Direction _____

Observers L. _____ R. _____ Temp. _____ Sea _____ Sky Cover _____

Segment No.	Time	Note		Loons	Grebes	Tube-nose	Cormorants	Waterfowl	Shorebirds	Jaegers	Gulls	Auks			Unidentified
			S												
			Flk												
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Exhibit 1

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