Project Birdseye Aerial Photograph Collection: Digital and Analog Materials, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

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National Snow and Ice Data Center

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1 OVERVIEW AND HISTORY

The US Navy's Project Birdseye spanned approximately 1962 to the mid-1980s. Over more than 20 years, the project generated numerous reports as well as visible band photographs and other data. The aerial photographs reside in 99 film canisters, each approximately a foot tall and six inches in diameter containing roughly 400 photographic negatives in a long film roll. Photographs from seven of the canisters have been digitized, resulting in 1752 image files. These are available via HTTPS: https://noaadata.apps.nsidc.org/NOAA/G02188/ along with project reports and documents on the history of Project Birdseye. In addition to the film canisters, two boxes of flight data logs and maps are currently held by NSIDC.

Project Birdseye, sometimes referred to as BirdsEye or BIRDSEYE, was initiated in 1962 by Walter I. Wittmann, the director of the U.S. Naval Oceanographic Office (NAVOCEANO) Polar Oceanography Division at the time (Newton 1992). The primary concern of the project was to improve the Navy's ability to operate in the Arctic Ocean, and that meant monitoring ice conditions while acquiring a comprehensive understanding of the physical characteristics of sea ice in order to better predict ice conditions. The project was designed to improve techniques for ice observation, refine forecasting techniques, collect data for military Arctic operations, and support U. S. Navy submarines during under-ice operations. On average, there were about nine missions a year, each composed of several flights; usually, these were classified missions. Flight tracks varied by mission and covered predetermined areas; and altitude depended on the mission and cloud cover. On some missions, repeated observations were made in an area at the start and end of a selected time interval to determine changes in the ice during that interval and then empirically relate those to local wind and pressure patterns.

Figure 1. Project Birdseye Patch for the VXN-8 squadron with the skating arctic fox mascot. Credit: U.S. Navy.

Until about 1976, missions were defined in Naval Oceanographic Research and Development Activity (NORDA) “quick look” reports. They were basic surveys of surface ice conditions as well as under-ice conditions, presumably in concert with a submarine acquiring topsounder data under the flight path.

The program depended primarily on visual observations, both through photographs from a vertically mounted aerial camera and, on at least some missions, by a Navy Aerographers Mate. Almost from the beginning, the project sought to overcome the limitations of visual observations in the Arctic (for example: bad weather and polar night) by conducting experiments to test the usefulness of remote sensing systems including laser profilers; side-looking radar; and infrared, radar, and microwave imagers (Ketchum 1971). Data were used to determine ice surface roughness, types of ice features, and ice-type distribution. However, the photographs are the only comprehensive surviving data as the other forms were either destroyed or lost.

Many of the canisters of photographs had labels that included mention of a sea ice experiment, such as AIDJEX, or notable feature, such as ice island T-3, that will be familiar to sea ice researchers today. With some exceptions, the Birdseye flights were not directly related to projects like AIDJEX; it was coincidental that they were taking place when Birdseye missions were scheduled. At least one mission was referred to as a “top side/bottom side” mission, designed to measure the ice surface with a laser profiler as well as aerial photographs, in conjunction with bottom-side submarine activities to profile the ice (L.D. Farmer, personal communication, 04 Nov. 2010). The track for this mission was between Pt. Barrow, AK, and the North Pole. Sea Ice was the

focus of Birdseye, but glaciers, land, snow cover, and coastlines were photographed as well. About 10 major west coast Greenland glacier fronts were photographed in 1984 as part of Birdseye.

When Project Birdseye began in 1962, the U.S. Navy's Airborne Early Warning Squadron Thirteen (VW-13) was assigned to fly its missions using EC-121K/P aircraft. In 1967, the Air Development Squadron Eight (VX-8) was established and took over flying for Project Birdseye, mostly using NC-121K and C-121J aircraft. VX-8 was designated the Oceanographic Development Squadron Eight (VXN-8) at the beginning of 1969, and the Birdseye aircraft were switched to the RP-3A Orion (Burgess 2006).

These squadrons were based at the Naval Air Station, Patuxent River, Maryland. For some of its missions, Project Birdseye had staging areas at Thule, Greenland, and Eielson AFB, Alaska. The VXN-8 aircraft were painted white with orange trim and a cartoon character mascot to distinguish them as non-weapon carrying aircraft. The cartoon character for Birdseye aircraft was an ice-skating arctic fox. See Figure 2.

Figure 2. RP-3A Orion "Birdseye Arctic Fox" flown by VXN-8. Note the skating fox at the front of the plane and the characteristic white with orange trim color. This photo was taken at the Moffett Field Naval Air Station in December 1975. Credit: Michael Grove and the San Diego Air and Space Museum Archives.

Figure 3. A picture of a Birdseye squadron from 1962. Credit: U.S. Navy

For more information on the history of the squadrons that flew for Project Birdseye, see these resources:

- Evans, J. L. 1987. VXN-8: The World is Their Backyard. *Naval Aviation News* 69(5): 8-9.
- U.S. Navy Patrol Squadron history web sites for VXN-8, VX-8, and VW-13.

When Project Birdseye ended, the remaining data, largely comprised of the 99 canisters of photographs, were transferred to the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL). There, two of the Navy laboratory researchers who had long been associated with Birdseye sought to keep the photographs linked to the other airborne data that were acquired at the same time, such as laser profiling date and passive microwave date. One outcome of this was “Ocean Ice Data: A Relatable Index of Aerial Photography”, covering photographs acquired between 1970 and 1984. It was compiled by L. Dennis Farmer and Duane T. Eppler, and written in a now defunct database code by Thomas J. Blair. We refer to it in this documentation as the FoxPro database.

The NSIDC acquired the photographs from CRREL in 1996. In 2010, NOAA@NSIDC and the National Geophysical Data Center (NGDC) secured a NOAA Climate Database Modernization Program (CDMP) grant to digitize the photographs. The intention was to scan all analog material,

however the CDMP program ended abruptly and only seven canisters of film were digitized resulting in 1752 image files. The canisters as well as several boxes of hand-written logbooks currently reside at NSIDC.

From the arrival of film canisters at NSIDC in 1996 to the publication of this data set in 2014, the principals involved were Florence Fetterer, project lead; Allaina Wallace, archivist and CDMP digitization lead; and Brian Zelip, MLS graduate student who researched Project Birdseye so that documentation could be made more complete than it would have been otherwise. Many others contributed, as noted in the Acknowledgments section of this document.

2 DETAILED DATA DESCRIPTION

This data set is comprised of a number of different items:

1. Digitized Aerial Photographs.
    a. 1752 digitized aerial images from seven film canisters from 1971, 1973, and 1975.
    b. 73 additional digitized photographs that also include photos of the aircraft and crew, like Figure 3, from 1962 and 1967.
2. 74 Birdseye reports from the U.S. Navy describing the first 74 campaigns from 1962 to 1971.
3. 99 canisters of aerial photographs with approximately 400 photos per canister from 1970 to 1984.
4. Two boxes of flight data logs and maps from 1970 to 1984.

2.1 Digitized Aerial Photographs and Related Files

2.1.1 Photographs

Photographs were acquired with vertically mounted cameras, described as “vertically mounted CA-8 aerial camera” (Ketchum 1971, p. 42) and “CA-14 (gyro-mounted) Cartographic Camera System" (NAVOCEANO 1974, p. 5). Table 1 contains information about the photos taken from the exterior of the seven canisters of photos scanned through the CDMP program and taken from the spreadsheet Project-Birdseye-Canister-Metadata.xls in the aerial photos folder of the HTTPS site. This file includes similar metadata for all 99 canisters, as described in the Analog Photographs and Flight Data Logs section.

As the images were scanned, they were assigned a sequential number. This number was incorporated in the digitized image file name. This approach was taken after the scanning contractor, HOV Services, found that the descriptive information found on each 10 by 10-inch image negative/frame is inconsistent from roll to roll. On some frames, a sequential number was handwritten on each frame; on others, only every 10th frame was identified this way (10,20, etc). Sometimes, no number was written on the frame at all, but the counter changed. In other

instances, there was also no frame number and the counter appeared stuck at “0000;" and sometimes the counter changed from frame to frame but in an odd way (for example 3,5,7...).

With no key to what these identifiers mean, we have no way to identify the geographical location of the photographed ice other than generally through the region number on the canister that contained the photograph. A key to those numbers is shown in Table 2 and Figure 7.

In addition to the canister images, two collections of photographs that appear to have been taken by handheld camera are available. These were found in a search of the Matthew Fontaine Maury Oceanographic Library catalog. Brian Zelip acquired them through interlibrary loan and scanned them while at the University of Illinois. Their names, 5-62 and 8-67, are from the month and year that the photos were acquired.

Table 1. Description of Digitized Photos

Canister/ Collection No.	Date	Location	Mission No.	No. of Images	HTTPS URL	Notes on Canister
59	24 March 1973	Bering Sea Ice Pack (Figures 6a - 6d)	MAR-73	332	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0059/	Bering Sea Ice Pack, No Log, 24 March 1973, SUBICEX 1-73, SEADRAGON
64	22-27 August 1971	Unknown	BE 8-71	129	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0064/	6-71-5, 17 Aug. 1971, Roll 5, Thule Star # 1 [NSIDC Note: The date on this canister is incorrect. Use the date in Column 2.]
65	01 May 1975	Arctic Ocean (Figure 4)	OS-17-75	402	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0065/	OS 17-75, Roll # 1, 1 May, 1975, Frame 974
66	02 May 1975	Nares Strait	OS-17-75	403	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0066/	OS 17-75, 21 May 1975, Roll # 3, Runs 1-6 [NSIDC Note: The date on this canister is incorrect. Use the date in Column 2.]
67	05 May 1975	Unknown	OS-17-75	360	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0067/	OS 17-75, Roll 6, 5 May 75, 2 of 3, Runs 1-4

Canister/ Collection No.	Date	Location	Mission No.	No. of Images	HTTPS URL	Notes on Canister
84	20 May 1973	Heimaey Volcano, Iceland	BE 5-73	72	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0084/	BE 5-73, Heimaey Volcano Iceland
87	23 March 1971	Beaufort Sea and AIDJEX Camp 200 (Figure 5) (See the flight line in NAVOCEANO_BIRDS_EYE_03-71.pdf, page 19, Track 11)	BE 3-71	54	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/0087/	AIDJEX Camp, Beaufort Sea, DN Roll # 30
5-62	May - June 1962	Arctic Ocean	unknown	36	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/5-62/	N/A
8-67	21-23 August 1967	Fletcher's Ice Island (T3)	unknown	37	https://noaadata.apps.nsidc.org/NOAA/G02188/aerial-photos/8-67/	N/A

Example images are shown below.

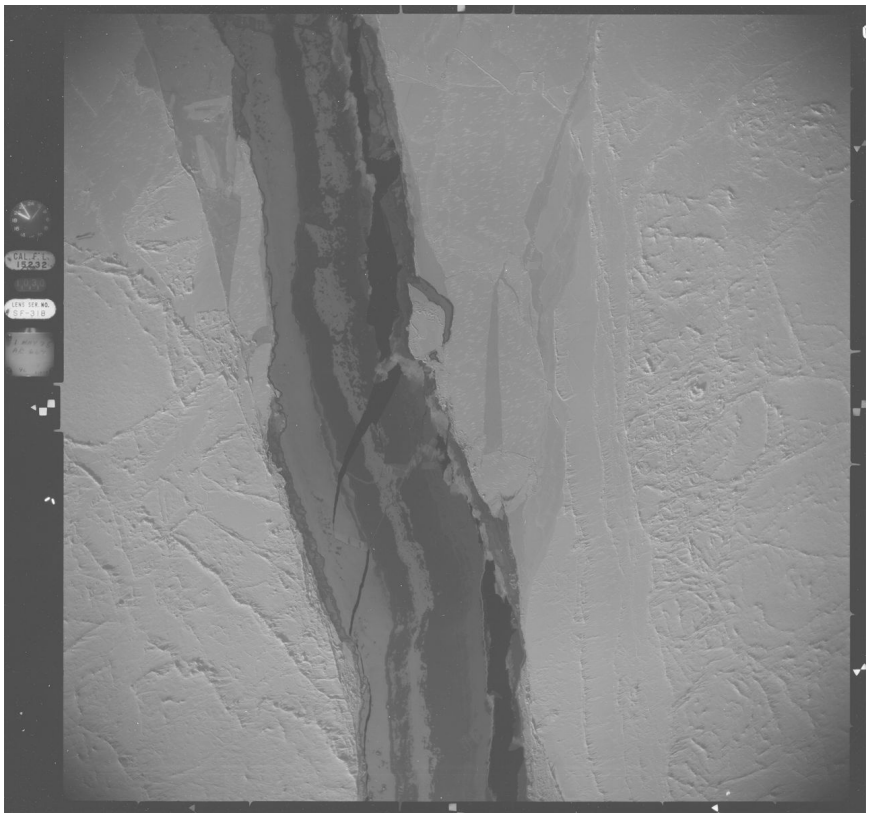

Figure 4. Photograph from canister 65 frame 402 showing a lead in the sea ice.

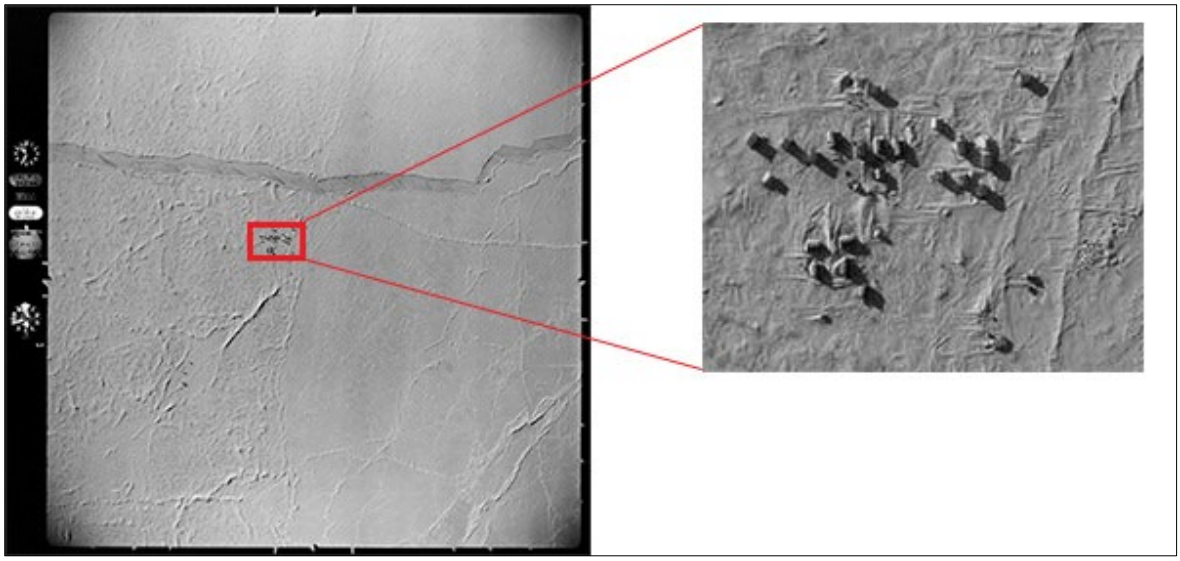

Figure 5. Photograph from canister 87 frame 27 showing AIDJEX Camp 200 on 23 March 1971.

Figures 6a through 6d show a sequential sample from the reel in canister 59. Many of the images look similar to Figure 6d, with a mostly white view.

Figure 6a. Photograph from canister 59 frame 1.

Figure 6b. Photograph from canister 59 frame 3.

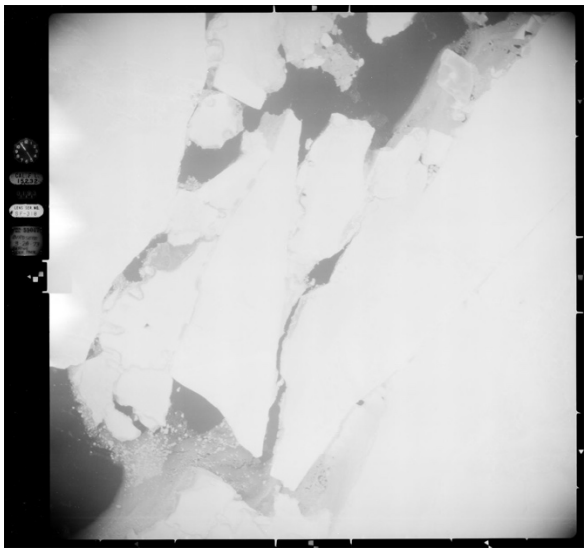

Figure 6c. Photograph from canister 59 frame 5.

Figure 6d. Photograph from canister 59 frame 6.

2.1.2 FoxPro Database

As noted in Section 1, the canisters were accompanied by a database in FoxPro, a now defunct format. We were not entirely successful in reading and understanding this database, but through efforts at NSIDC, some of the data for the seven canisters that were digitized were extracted from this legacy database and entered in Excel spreadsheets. The data that was extracted is quite minimal; but for the sake of completeness, it is provided in the Excel file, extracted-legacy-db-data-for-7-digitized-canisters.xlsx, on the HTTPS site. This Excel file contains seven sheets, one per digitized canister.

It is unfortunate that we cannot, at this time, decipher the entire database. The legacy-db-README.txt file on the HTTPS site that accompanied the FoxPro database indicates that it includes information on what region of the arctic was covered along with aircraft altitude, camera lens focal length, scale of photography, and some indication of quality of each frame, usually related to exposure or the presence of clouds or haze.

2.1.3 Data Logs

In addition, several of the analog flight data logs for 01 May 1975 were scanned at NSIDC. These files provide ancillary data for the photos from canister 65 and can be found on the HTTPS site:

- PhotographicLog-May1.pdf: Three page scanned photographic log for 1 May 1975. Contains columns such as frame #, time, altitude, ground speed, and heading.
- WeatherChart1May1975.pdf: Three page scanned weather chart for 1 May 1975 in a polar oriented view from ~60° N to 90° N lat and ~110° W to ~20° E.

- NavFltRecMay1.pdf: Five page scanned "Navigator's Flight Record" for 1 May 1975 19:24 to 2 May 1975 01:11. Contains columns for time, position (lat/lon), wind direction and velocity, ground speed, and remarks.
- WeatherLogGreenland.pdf: Eight page scanned weather log for Greenland from 29 Apr to 16 May 1975. Specific sites are NE Ellesmere Island, Thule, and Ellesmere Island.

The full set of these data logs is described in the next section.

2.2 Analog Photographs and Flight Data Logs

The analog collection consists of 99 canisters (Figure 7) of aerial photographs with approximately 400 photos per canister along with two boxes of analog flight data logs and maps from 1970 to 1984. Each canister contains a roll of 10" x 10" photographic negatives that were taken automatically using a vertically mounted aerial camera. As of 2014, NSIDC holds these, along with other analog material, in an archive that is not fully supported by agency or university funds. We hope to move the material to a more secure archive in the near future.

A complete list of the canisters is provided in Project-Birdseye-Canister-Metadata.xls on the HTTPS site. When the NOAA CDMP project was approved, prior to shipping cannisters to the contractor for scanning, the archivist at NSIDC, Allaina Wallace, composed this spreadsheet containing information taken from labels affixed to each canister. These were not all of the same format, nor did they all have all categories of information. The columns in the spreadsheet are given in Table 2.

Figure 7. The canisters stored in NSIDC's analog archive room.

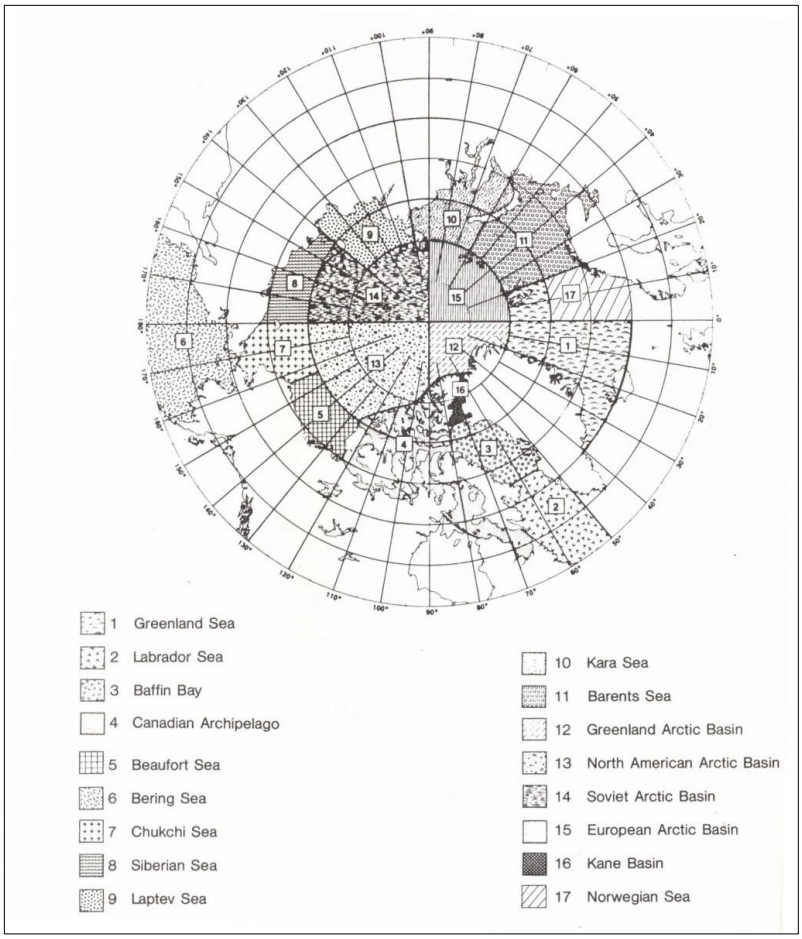

Figure 8. This figure is from Welsh et al. (1986, p. 2) and shows the regions and their numbers used by the Navy.

Table 2. Column Description for Canister Metadata

<table>
<tr><th>Column</th><th>Description</th></tr>
<tr><td>Canister #</td><td>An assigned number, generally but not always sequential according to flight date.</td></tr>
<tr><td>Region</td><td>These range from 1 to 16 and correspond to the regions shown in the table below. Figure 8 shows an image of the regions.
<table>
<tr><td>1</td><td>Greenland</td><td>10</td><td>Kara Sea</td></tr>
<tr><td>2</td><td>Labrador Sea</td><td>11</td><td>Barents Sea</td></tr>
<tr><td>3</td><td>Baffin Bay</td><td>12</td><td>Greenland Arctic Basin</td></tr>
<tr><td>4</td><td>Canadian Archipelago</td><td>13</td><td>North American Arctic Basin</td></tr>
<tr><td>5</td><td>Beaufort Sea</td><td>14</td><td>Soviet Arctic Basin</td></tr>
<tr><td>6</td><td>Bering Sea</td><td>15</td><td>European Arctic Basin</td></tr>
<tr><td>7</td><td>Chukchi Sea</td><td>16</td><td>Kane Basin</td></tr>
<tr><td>8</td><td>Siberian Sea</td><td>17</td><td>Norwegian Sea</td></tr>
<tr><td>9</td><td>Laptev sea</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Year</td><td>Year as noted somewhere on the canister label.</td></tr>
<tr><td>Month</td><td>Month as noted somewhere on the canister label.</td></tr>
<tr><td>Day (range)</td><td>Day or range of days as noted somewhere on the canister label. Note: Some of the dates from the canisters appear to be incorrect. For the seven digitized canisters, the dates in Table 1 Column 2 are the correct dates.</td></tr>
<tr><td>Notes</td><td>Often includes a mission designation and some other identifying information such as the name of a project or ice camp that was coincident with Birdseye image acquisition, such as AIDJEX, APLIS, or ARLIS.</td></tr>
</table>

2.3 U.S. Naval Oceanographic Office (NAVOCEANO) Reports

Seventy-four NAVOCEANO reports describe the first 74 Birdseye campaigns from 1962 to 1971. These were found in a search of the Matthew Fontaine Maury Oceanographic Library, at the Naval Oceanographic Office at Stennis Space Center, Mississippi. Brian Zelip acquired them through interlibrary loan and scanned them while at the University of Illinois. Along with a description of the missions, the reports also contain information about the observed sea ice, including estimated concentration, type, condition, age, topography, and number and height of topographic features. In addition, pressure ridge and water opening counts and weather observations are included. Water opening data include the number, width, and orientation of water openings or leads.

After March 1971, the publication of the NAVOCEANO reports ended and future Birdseye data and descriptions were condensed and added to the annual Report of the Arctic Ice Observing and Forecasting Program Special Publication Number 70 (SP-70) by the U. S. Naval Oceanographic Office (NAVOCEANO 1971).

A complete list of the reports with their HTTPS locations is provided in two formats on the HTTPS site: an Excel spreadsheet (NAVOCEANO_Birdseye_reports_index.xlsx) and a comma separated value file (NAVOCEANO_Birdseye_reports_index.csv).

2.4 Format

2.4.1 Digitized Aerial Photographs

The photographs from the canisters were digitized into TIFF and JPEG formats at three different resolutions: master (high resolution), reference, and thumbnail. The images digitized from the collections found at the Maury Library were digitized into TIFF format at one high resolution. Table 3 describes the photo sizes and formats by canister or collection.

Table 3. Resolution, Size, and Format of the Digitized Images

Photo Origination	Resolution Type	Dimensions (width x height, pixels)	Resolution (pixels/inch)	Size/File	Format
Canisters	Master (high resolution)	10500 x 9832	1058	~100 MB	TIFF
	Reference	640 x 599	600	~100 KB	JPEG
	Thumbnail	150 x 140	600	~10 KB	JPEG
Collection 8-67	High resolution	5904 x 4849	600	~20 MB	TIFF
Collection 5-62	High resolution	~6100 x 4800	600	~20 MB	TIFF

2.4.2 NAVOCEANO Reports

The 74 NAVOCEANO Reports are provided in PDF format. Note that optical character recognition (OCR) has not been performed on these files, so they are not currently searchable using a PDF reader. The reports range in size from 23 MB to 460 MB.

2.5 File and Directory Structure

Digitized data are available on the HTTPS site in the https://noaadata.apps.nsidc.org/NOAA/G02188/ directory. Table 4 describes the subdirectories under G02188 and Figure 9 shows a pictorial representation of the directory structure.

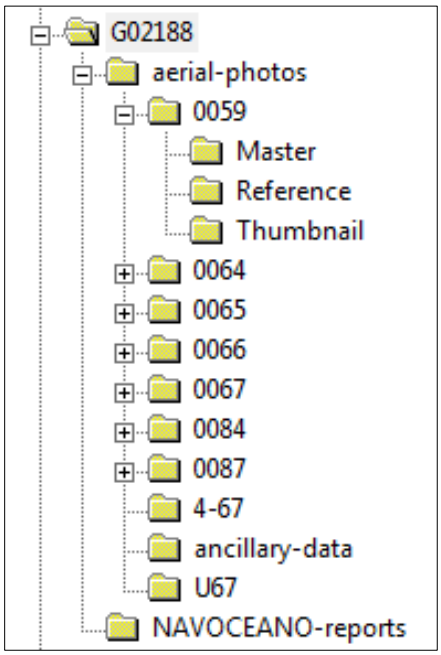

Figure 9. HTTPS Directory Structure

Table 4. Canister File Naming Convention

Directory	Description
aerial-photos	This directory contains the digitized aerial photographs within nine sub-directories plus one directory for ancillary data labeled ancillary-data. Seven of the sub-directories are numbered by canister with two leading zeros (0059, 0064, etc.) and two of them are numbered by collection (8-67 and 5-62). The canister directories each contain three sub-directories for the three different resolutions (Master, Reference, and Thumbnail).
NAVOCEANO-reports	Contains the 74 NAVOCEANO reports and an excel file with and index of the reports.

2.6 File Naming Convention

2.6.1 Digitized Aerial Photographs

2.6.1.1 Photos from the Canisters

The files digitized from the canisters are named according to the following convention described in Table 5. Note: All three resolutions of these images have the same naming convention. They are differentiated by the directory that they are in as described in Table 4.

```
BE_00CC_YYYYMM_XXXX.ext
```

Table 5. Canister File Naming Convention

Variable	Description
BE	Identifies this file as being part of Project Birdseye
00CC	Canister number (0059, 0064, 0065, 0066, 0067, 0084, and 0087)
YYYY	4-digit year that the photograph was taken
MM	2-digit month that the photograph was taken
XXXX	Digitization counter
.ext	File extension: .TIF and .jpg

2.6.1.2 Photos from Collection 8-67

The photos digitized from Collection 8-67 are named according to the following convention described in Table 6.

```
Birdseye-8-67-photos-frame-XX[-meta].tif
```

Table 6. Collection 8-67 File Naming Convention

Variable	Description
Birdseye-8-67-photos	Identifies this file as being part of the Birdseye collection 8-67
frame-XX	Frame number
[-meta]	If this is part of the file name, it identifies this as a metadata image for the associated collection 8-67 photograph. The metadata image contains a scan of the back of the photographic print which contains some handwritten notes about the photo.
.tif	Identifies this as a TIFF image file

There is an index in Excel format of these images that includes a description of the images along with their date, flight altitude, and position: Birdseye-8-67-photos-index.xlsx on the HTTPS site.

2.6.1.3 Photos from Collection 5-62

The photos digitized from Collection 5-62 are named according to the following convention described in Table 7.

```
Birdseye-5-62-photos-XX[-meta].tif
```

Table 7. Collection 8-67 File Naming Convention

Variable	Description
Birdseye-5-62-photos	Identifies this file as being part of the Birdseye collection 5-62
XX	Frame number
[-meta]	If this is part of the file name, it identifies this as a metadata image for the associated collection 8-67 photograph. The metadata image contains a scan of the back of the photographic print which contains some handwritten notes about the photo. Not all 5-62 photos have an associated metadata image.
.tif	Identifies this as a TIFF image file

2.6.2 NAVOCEANO Reports

The NAVOCEANO reports are named according to the following convention:

```
NAVOCEANO_BIRDS_EYE_XX_YY.pdf
```

Table 8. NAVOCEANO Reports File Naming Convention

Variable	Description
NAVOCEANO_BIRDS_EYE	Identifies this file as being a NAVOCEANO report
XX	2-digit mission number for that year
YY	2-digit year
.pdf	Identifies this as a PDF file

3 REFERENCES AND RELATED PUBLICATIONS

The following is a list of several papers and technical reports that contain research carried out as part of Project Birdseye or that mention its research. Note that this list is not exhaustive.

Barry, R. 2013. Data on the Geographical Distribution of Sea Ice. *NSIDC Special Report 15*. Boulder, Colorado USA: National Snow and Ice Data Center.

Bilello, M. A. and R. E. Bates. 1971. Ice Thickness Observations, North American Arctic and Subarctic 1966-67, 1967-68. SR43, Pt. V. U.S. Army Corps of Engineers, CRREL.

Burgess, R. 2006. Lest We Forget, Note on VX-8. *Proceedings Magazine* 132/3/1,237. U. S. Naval Institute: Annapolis.

Evans, J. L. 1987. VXN-8: The World is Their Backyard. *Naval Aviation News* 69(5): 8-9.

Gow, A. J., W. B. Tucker III, and W. F. Weeks. 1987. Physical Properties of Summer Sea Ice in the Fram Strait, June-July 1984. *CRREL Report* 87-16.

Ketchum, R. D. Jr. 1971. Airborne Laser Profiling of the Arctic Pack Ice. *Remote Sensing of the Environment* 2: 41-52.[1]

Mock, S. J., V. LaGarde, and W. B. Tucker. 1974. Arctic Terrain Characteristics Data Bank. *CRREL Technical Report* 247.

NAVOCEANO. 1974. Technical Specification for Airborne Laser Profiling Data Acquisition Standardization Techniques of Sea Ice in Arctic Regions: Birdseye 8-74. Naval Oceanographic Office: Washington D.C.[2]

NAVOCEANO. 1971. BIRDS EYE 3-71, 2-25 March 1971. *Navy Informal Report* 71-10. Naval Oceanographic Office: Washington D.C.

Newton, G. B. 1992. Walter I. Wittmann (1918-1992). *Arctic* 45(3): 325. doi:10.2307/40511476.

Nutt, D. C. 1966. The Drift of Ice Island WH-5. *Arctic* 19(3): 244-262.

O'Lenic, E. A. 1978. U.S. Navy Global Ice Analysis and Forecasting. *Glaciological Data* GD-2: 43-46.

Sterrett, K. F. 1976. The Arctic Environment and the Arctic Surface Effect Vehicle. *CRREL Report* 76-1.

Welsh, J. P., R. D. Ketchum, A. W. Lohanick, L. D. Farmer, D. T. Eppler, R. E. Burge, and C. J. Radl. 1986. A Compendium of Arctic Environmental Information. Naval Ocean Research and Development Activity Technical Report 138.

Westhall, V. H. 1973. An Analysis of Selected Airborne Sea Ice Observation: Project Birdseye (1968-1971). *NAVOCEANO Technical Note* 6140-1-74.[3]

Westhall, V. H. 1975. An Arctic Sea Ice Data Bank from Airborne Observations. *Technical Note* 6140-2-75. Naval Oceanographic Office: Wasington.[4]

Wittman, W. I. and J. J. Shule, Jr. 1967. *Proceeding of the Symposium on the Arctic heat Budget and Atmospheric Circulation*. Edited by J. O. Fletcher, RAND Corp. Mem. RM-5233-NSF.

[1]Ketchum (1971) describes how Birdseye visual observations assisted in the interpretation of the validity of laser profiler estimates of ice thickness and other ice characteristics. It is interesting to note that useful estimates of sea ice thickness measurements were not possible because of the many sources of error and uncertainty. Today, the IceBridge program provides just such estimates.

[2]The NAVOCEANO (1974) document details the procedures and instruments used for ice observations on one mission consisting of six flights.

[3]Westhall (1973) describes how approximately 12,000 visual observations from 1968-1971 were used to construct a statistical summary of ice concentration, stage of development, ridge height, stage of melting, and more. This information was displayed as a map of the probability of occurrence of various features, though Westhall notes that “the data were too sparse over the whole arctic region to develop any definitive prediction scheme” (p. 1). The observations he used were recorded on forms every five minutes by an ice observer following World Meteorological Organization (WMO) sea ice terminology. The analog data were transferred to magnetic tape via computer punch cards.

[4]Westhall (1975) provides visual observations from the Birdseye ice reconnaissance flight and other missions in the Arctic during 1964-1972 that have been coded and filed in sectors 2° latitude by 10° longitude. The files include location, time, ice, concentration, the primary ice form (floe size), stage of development and fractional concentration, topography, extent of ridging, opening, and number of bergs in three size categories (Barry 2013).

3.1 Related Data Collections

The Arctic Ice Dynamics Joint Experiment (AIDJEX)

4 CONTACTS AND ACKNOWLEDGMENTS

Acknowledgments:

NSIDC would like to acknowledge the contributions of L. Dennis Farmer, Duane T. Eppler, and R. Ketchum for their work in compiling, preserving, and documenting this collection. R. Ketchum was responsible for work done in 1976 to organize and recover elements of the collection (L.D. Farmer, personal communication, 04 Nov. 2010). L. Dennis Farmer worked for NORDA, an activity later absorbed by the Naval Research Laboratory (NRL) and flew Birdseye missions from 1977 until the end of the program. With Duane T. Eppler, also of NORDA, he formed Bronson Hill Associates and continued working to preserve these and other valuable data acquired for defense research but of value to the wider research community.

The NOAA CDMP grant made it possible to publish some of these analog images in digital form. We thank those who administered the program as well as our NOAA NGDC partners for the project, along with HOV Services, the CDMP contractor.

Jana Kopp, a library science masters student, assisted Allaina Wallace in initial curation work on this collection. NSIDC's Ruth Duerr, an adjunct professor at the Graduate School of Library and Information Science, University of Illinois-Urbana/Champaign, arranged Brian Zelip's participation.

This data collection is maintained and made available online through funding to NOAA@NSIDC from the NGDC.

5 DOCUMENT INFORMATION

5.1 Document Authors

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