Division of Geological & Geophysical Surveys

MISCELLANEOUS PUBLICATION 147G

ANNOTATED BIBLIOGRAPHY SERIES IN SUPPORT OF COASTAL COMMUNITY HAZARD PLANNING—NORTHWEST ALASKA

KAKTOVIK, ALASKA

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November 2011

This annotated bibliography is part of a series created to facilitate access to documents useful for coastal geohazard evaluation and community planning in Northwest Alaska. Below is a comprehensive list of community-specific information sources, each with full bibliographic information and an informative-style annotation that highlights content pertaining to the community of Kaktovik, Alaska. For a detailed description of the preparation and scope of this resource, please refer to this bibliography series' foreword. Any notable errors and/or omissions may be reported to the Coastal Hazards Program manager at the Alaska Division of Geological & Geophysical Surveys (DGGS).

Alaska Department of Commerce, Community & Economic Development (DCCED), accessed 2011, Division of Community & Regional Affairs (DCRA) Community Profiles [website]: State of Alaska Department of Commerce, Community & Economic Development.

http://www.commerce.state.ak.us/dca/profiles/profile-maps.htm

This website provides access to community profile maps for community-based planning. The maps are available in 24" by 36" and 30" by 42" formats. The Kaktovik map was created in 1978 based on land survey and/or interpretation of aerial imagery. Subsistence hunting grounds, habitat areas, community buildings and public facilities are delineated. Shoreline position and potential erosion zones are included in the map content. All maps have been sponsored by the Alaska Department of Community and Regional Affairs and contracted to local agencies for production.

Alaska Department of Natural Resources Division of Coastal and Ocean Management (DCOM), accessed February 2011, Alaska coastal management program [website]: Alaska Department of Natural Resources Division of Coastal and Ocean Management.

http://alaskacoast.state.ak.us/Explore/Tour.html

This website outlines the Alaska Coastal Management Plans for each coastal district. It provides stewardship plans "to ensure a healthy and vibrant Alaskan coast that efficiently sustains long-term economic and environmental productivity."

Arp, Christopher D., Benjamin J. Jones, Joel A. Schmutz, Frank E. Urban, and M. Torre Jorgenson, 2010, Two mechanisms of aquatic and terrestrial habitat change along an Alaskan Arctic coastline: Polar Biology, vol. 33, p. 1629–1640.

Scientific abstract: "Arctic habitats at the interface between land and sea are particularly vulnerable to climate change. The northern Teshekpuk Lake Special Area (N–TLSA), a coastal plain ecosystem along the Beaufort Sea in northern Alaska, provides habitat for migratory waterbirds, caribou, and, potentially, denning polar bears. The 60 km coastline of N–TLSA is experiencing increasing rates of coastline erosion and storm surge flooding far inland, resulting in lake drainage and conversion of freshwater lakes to estuaries. These physical mechanisms are affecting upland tundra as well. To better understand how these processes are affecting habitat, we analyzed long-term observational records coupled with recent short-term monitoring. Nearly the entire coastline has accelerating rates of erosion ranging from 6 m/year from 1955 to 1979 and most recently peaking at 17 m/year from 2007 to 2009, yet an intensive monitoring site along a higher bluff (3–6 masl) *suggested high interannual variability. The frequency and magnitude of storm events appears to be increasing along this coastline and these patterns correspond to a greater number of lake tapping and flooding events since 2000. For the entire N–TLSA, we estimate that 6% of the landscape consists of salt-burned tundra, while 41% is prone to storm-surge flooding. This offset may indicate the relative frequency of low-magnitude flood events along the coastal fringe. Monitoring of coastline lakes confirms that moderate westerly storms create extensive flooding, while easterly storms have negligible effects on lakes and low-lying tundra. This study of two interacting physical mechanisms, coastal erosion and storm-surge flooding, provides an important example of the complexities and data needs for predicting habitat change and biological responses along Arctic land–ocean interfaces."*

Immediate Action Workgroup (IAWG), Michael Black and Patricia Opheen, eds., March 2009, Recommendations to the Governor's Subcabinet on climate change: Immediate Action Workgroup, 162 p.

The Immediate Action Workgroup was established to address known threats to Alaskan communities caused by coastal erosion, thawing permafrost, flooding and fires. This report is a follow-up to the recommendations made in April 2008, and provides recommendations for actions and policies to be implemented in 2009 and 2010. Kaktovik was recognized as receiving agency action from the Division of Emergency Management. A storm event is reported for Kaktovik during 2008.

Immediate Action Workgroup (IAWG), Black, Michael and Patricia Opheen, eds., 2008, Recommendations report to the Governor's Subcabinet on Climate Change: Immediate Action Workgroup, 86 p.

This report includes the recommendations provided by the Immediate Action Workgroup (IAWG) regarding the actions and policies that should be taken within the next 12–18 months to prevent loss of life and property in Alaska's communities that are most vulnerable to the effects of climate change. Kaktovik was mentioned as one of nine communities under examination of the nature of imminent threats from flooding and erosion.

Jones, Benjamin M., Kenneth M. Hinkel, Christopher D. Arp, and Wendy R. Eisner, 2008, Modern erosion rates and loss of coastal features and sides, Beaufort Sea coastline, Alaska: Arctic, vol. 61, no. 4, p. 361–372.

Scientific abstract: "This study presents modern erosion rate measurements based upon vertical aerial photography captured in 1955, 1979, and 2002 for a 100 km segment of the Beaufort Sea coastline. Annual erosion rates from 1955 to 2002 averaged 5.6 m a-1. However, mean erosion rates increased from 5.0 m a-1 in 1955–79 to 6.2 m a-1 in 1979–2002. Furthermore, from the first period to the second, erosion rates increased at 60% (598) of the 992 sites analyzed, decreased at 31% (307), and changed less than ±30 cm at 9% (87). Historical observations and quantitative studies over the past 175 years allowed us to place our erosion rate measurements into a longer-term context. Several of the coastal features along this stretch of coastline received Western place names during the Dease and Simpson expedition in 1837, and the majority of those features had been lost by the early 1900s as a result of coastline erosion, suggesting that erosion has been active over at least the historical record. Incorporation of historical and modern observations also allowed us to detect the loss of both cultural and historical sites and modern infrastructure. U.S. Geological Survey topographic maps reveal a number of known cultural and historical sites, as well as sites with modern infrastructure constructed as recently as the 1950s, that had disappeared by the early 2000s as a result of coastal erosion. We were also able to identify sites that are currently being threatened by an encroaching coastline. Our modern erosion rate measurements can potentially be used to predict when a historical site or modern infrastructure will be affected if such erosion rates persist."

Jorgenson, M.T., and J. Brown, 2005, Classification of the Alaskan Beaufort Sea coast and estimation of carbon and sediment inputs from coastal erosion: Geo-Marine Letters, vol. 25, no. 2-3, p. 69–80.

Scientific abstract: "A regional classification of shoreline segments along the Alaskan Beaufort Sea Coast was developed as the basis for quantifying coastal morphology, lithology, and carbon and mineral sediment fluxes. We delineated 48 mainland segments totaling 1,957 km, as well as 1,334 km of spits and islands. Mainland coasts were grouped into five broad classes: exposed bluffs (313 km), bays and inlets (235 km), lagoons with barrier islands (546 km), tapped basins (171 km), and deltas (691 km). Sediments are mostly silts and sands, with occasional gravel, and bank heights generally are low (2–4 m), especially for deltas (<1 m). Mean annual erosion rates (MAER) by coastline type vary from 0.7 m/year (maximum 10.4 m/year) for lagoons to 2.4 m/year for exposed bluffs (maximum 16.7 m/year). MAERs are much higher in silty soils (3.2 m/year) than in sandy (1.2 m/ year) to gravelly (0.3 m/year) soils. Soil organic carbon along eroding shorelines (deltas excluded)

range from 12 to 153 kg/m^2 of bank surface down to the water line. We assume carbon flux out from depositional delta sediments is negligible. Across the entire Alaskan Beaufort Sea Coast, estimated annual carbon input from eroding shorelines ranges from -47 to 818 Mg/km/year (Metric tons/km/year) across the 48 segments, average 149 Mg/ km/year (for 34 nondeltaic segments), and total 1.8 to-105 Mg/year. Annual mineral input from eroding shorelines ranges from 1,863 (accreting) to 15,752 Mg/ km/year, average 2,743 Mg/km/year, and totals 3.3-106 Mg/year."

Lantuit, H., and W.H. Pollard, May 2008, Fifty years of coastal erosion and retrogressive thaw slump activity on Herschel Island, southern Beaufort Sea, Yukon Territory, Canada: Geomorphology, vol. 95, p. 84–102.

The aim of this study is to assess patterns and rates of coastal erosion an ice-rich coast over a period of 48 years at Herschel Island, which is southeast of Kaktovik, Alaska. The authors identify thermal-mechanical processes of thawing permafrost, melting ground ice, and wave action as determining factors of erosion rates. Erosion rates were determined using orthorectified airphoto imagery from 1952 and 1970 and Ikonos images from 2000. The total area of retrogressive thaw slumps was found to increase by 125% and 160% for 1952 and 2000.

Mahoney, Andy, Hajo Eicken, Allison Graves, Lew Shapiro, and Patrick Cotter, 2004, Landfast sea ice extent and variability in the Alaskan arctic derived from SAR imagery: IEEE, Fairbanks, Alaska, p. 2146–2149.

This report explains the use and reliability of a new technique using synthetic aperture radar (SAR) to derive seaward landfast ice edge positions as they migrate. The data presented spans the Alaskan Arctic coast, from east of Point Lay to the Mackenzie Delta.

Mars, J.C., and D.W. Houseknecht, July 2007, Quantitative remote sensing study indicates doubling of coastal erosion rate in past 50 yr along a segment of the Arctic coast of Alaska: Geology, vol. 35, no. 7, p. 583–586.

Scientific abstract: "A new quantitative coastal land gained-and-lost method uses image analysis of topographic maps and Landsat thematic mapper short-wave infrared data to document accelerated coastal land loss and thermokarst lake expansion and drainage. The data span 1955–2005 along the Beaufort Sea coast north of Teshekpuk Lake in the National Petroleum Reserve in Alaska. Some areas have undergone as much as 0.9 km of coastal erosion in the past 50 yr. Land loss attributed to coastal erosion more than doubled, from 0.48 km^2/yr during 1955–1985 to 1.08 km^2/yr during 1985–2005. Coastal erosion has breached thermokarst lakes, causing initial draining of the lakes followed by marine flooding. Although inland thermokarst lakes show some uniform expansion, lakes breached by coastal erosion display lake expansion several orders of magnitude greater than inland lakes."

Nielson, Jon M., *of* North Slope Borough Planning Department *for* City of Kaktovik and North Slope Borough Commission on History and Culture, November 1977, Kaktovik, Alaska—An overview of relocations: North Slope Borough Planning Department, 26 p.

Kaktovik has served as a barter station between Barrow and Canadian Eskimos on their way to Neglik on the Colville River, or Nunamiut journeying to Herschel Island. Kaktovik remained un-westernized until Western culture and economics were introduced by military activities.

The first relocation of Kaktovik in 1952 was induced by the building of an Air Force air strip in the village. All structures were hauled 1,650 yards up the beach to the northwest. The new village site was along a slowly-eroding section of beach and in the landing pattern of the airfield. Because of changes in the DEW line, the village was relocated again in 1953. The new village was moved in the same manner as the first relocation, planting the village further to the west and a little further back from the beach. The village remained at this location until 1964, when the village was again moved to accommodate expanding Air Force facilities. Unlike other moves, the village actively participated in this move. The new village site was located on the east shore of the island facing Kaktovik Lagoon, on 280.29 acres. The site is on silty soils with a complete absence of gravel.

This study was an attempt to assess the past and present relationships between the U.S. Navy, the U.S. Air Force and the northern Eskimo village of Kaktovik, Alaska, specifically how land withdrawals were established,the priorities involved, and their impact on this village.

Reimnitz, Erk, and Douglas K. Maurer, 1979, Effects of storm surges on the Beaufort Sea coast, northern Alaska: Arctic, vol. 32, no. 4, p. 329–344.

Scientific abstract: "In 1970, a major storm surge caused by gale-force westerly winds inundated low-lying tundra plains and deltas as far as 5,000 m inland and left a driftwood line as much as 3.4 m above normal sea level along the Beaufort Sea coast of Alaska. The height of the surge followed a predictable pattern and was highest along windward-facing shorelines. Coastal retreat and thermoerosion are greatly accelerated on such west-facing shores with eastward sediment transport opposite to normal littoral drift. Evidence suggests an approximate 100-year recurrence interval for similar surges, with potential for damaging the developing oil fields on the North Slope."

Stankiewicz, Joe, 2005, City of Kaktovik local all hazard mitigation plan: The North Slope Borough Risk Management Division, 26 p.

This plan was meant to fulfill the requirements to make Kaktovik eligible for disaster relief and emergency assistance from FEMA. The plan identifies hazards, establishes community goals/objectives, and outlines mitigation strategies for the natural hazards that could threaten Kaktovik. Seven hazards are identified, including coastal storm surges, erosion, and flooding.

Flooding in Kaktovik occurs from coastal storm surges that develop in the area due to the low lying topography, gradually sloping bathymetry near shore, and a long fetch. A brief storm history is provided in the report. Storm surges also cause dramatic coastal erosion at Kaktovik, but can be hindered by bottomfast ice during the winter. During the 1980s, erosion along the lagoon at Kaktovik forced the North Slope Borough to build a seawall to prevent further damage. The fall storms continue to threaten the airport runway with both flooding and erosion.

Strain, Daniel, July 2011, Collapsing coastlines—How Arctic shores are pulled a-sea: Science News, vol. 180, no. 2, p. 18–21.

This popular press article describes mechanisms of coastal erosion and rates of bluff erosion in the Kaktovik area. The author highlights some of the issues associated with community responses to elevated rates of erosion, including challenges and costs associated with relocation solutions. Shishmaref is also highlighted as a community imperiled by accelerated erosion.

Taylor, Ronald J., *of* Department of Biology, Western Washington University, March 1981, Shoreline vegetation of the arctic Alaska coast: Arctic, vol. 34, no. 1, p. 37–42.

This study was administered by the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The primary objective of this work is to provide descriptions and definitions of vascular beach plants along the arctic coast of Alaska, to better predict the effects of oil spills on the region's ecosystems. Deering was used as a research station representative of a coastal-bluff-dominated habitat. This environment was associated with high rates of coastal erosion, low vegetative cover, and a poorly defined plant community assemblage.

Barter Island, on which Kaktovik is located, was used as a research station representative of the salt marsh habitat. The vegetation of this environment was controlled by mean high water level. Tidal storms were found to influence vegetal growth because of salt burn, represented by varying degrees of necrosis.

U.S. Army Corps of Engineers, accessed 2011, Civil works floodplain management services [website]: U.S. Army Corps of Engineers, Alaska District.

http://www.poa.usace.army.mil/en/cw/fld_haz/floodplain_index.htm

This website provides flood hazard data for communities throughout Alaska. A link is provided to a flood-hazard-specific bibliography, maintained by the U.S. Army Corps of Engineers. The worst flood event on record for Kaktovik was recorded during 1964 from a coastal storm. Recommended building heights as well as comments from the 1964 flood are available at this site.

U.S. Army Corps of Engineers, March 2009, Study findings and technical report—Alaska baseline erosion assessment: Elmendorf Air Force Base, Alaska, U.S. Army Corps of Engineers, Alaska District, 68 p.

http://www.poa.usace.army.mil/AKE/Home.html

This statewide assessment was conducted by the U.S. Army Corps of Engineers to coordinate, plan, and prioritize responses to erosion throughout Alaska. This report has recognized Kaktovik as being subject to erosion issues; Kaktovik was identified as one of 69 communities where the monitoring of erosion conditions is actively ongoing.

U.S. Army Corps of Engineers, Timothy J. Gallagher, ed., April 2006, Alaska village erosion technical assistance program—An examination of erosion issues in the communities of Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet: U.S. Army Corps of Engineers, Alaska District, 44 p.

This report documents an investigation of issues surrounding erosion at several Alaska Native villages. It contains an examination of erosion rates and control, potential relocation sites, and impacts to Alaska Native culture and tradition. Kaktovik is identified as requiring $40 million for future erosion protection, or $20–40 million for relocation. There have been no erosion control measures implemented in Kaktovik, and no funding by state and federal agencies. Minor erosion has been reported in Kaktovik Lagoon, but no threats from coastal storm surge have been identified for this community, with the exception of the airport and cultural resources. Threats to the community are not projected for at least 100 years.

U.S. Government Accountability Office (GAO), June 2009, Report to congressional requestors—Alaska Native villages, limited progress has been made on relocating villages threatened by flooding and erosion: U.S. General Accountability Office Report GAO-040895T, 53 p.

http://www.gao.gov/products/GAO-09-551

This report is a follow-up to the 2003 GAO report on flooding and erosion in Alaska Native villages, and was completed to identify concerns due to climate change that have increased the urgency of federal and state efforts. The GAO developed recommendations for Congress that include:

1. *A flooding assessment to augment the erosion assessment completed by the Army Corps of Engineers.*
2. *An amendment to federal legislation that would allow 64 more villages to be eligible for grants.*
3. *The designation of a federal entity to oversee and coordinate village relocation efforts.*

Kaktovik is recognized as one of 33 communities with a FEMA-approved hazard mitigation plan.

U.S. Government Accounting Office (GAO), 2003 [2004], Alaska Native villages—Most are affected by flooding and erosion, but few qualify for federal assistance: U.S. General Accounting Office Report GAO-04-142, 82 p.

http://www.gao.gov/products/GAO-04-142

This study was conducted to provide recommendations to Congress that would improve how state and federal agencies respond to flooding and erosion in Alaska. This was done by:

1. *Determining the extent to which these villages were affected.*
2. *Identifying federal and state flooding and erosion programs.*
3. *Determining the current status of efforts to respond to flooding and erosion in nine villages.*
4. *Identifying alternatives that Congress may wish to consider when providing assistance for flooding and erosion (see "Highlights" section).*

The recommendations provide alternatives to current actions taken during flooding and erosion responses by including federal agencies and the Denali Commission. The adoption of policies by the Denali Commission would guide investments in infrastructure for Alaska Native villages affected by flooding and erosion. Kaktovik is identified as one of five villages conducting flooding and erosion studies or improving infrastructure, that aren't planning to relocate. The airport runway at Kaktovik, which is located 1–2 feet above MSL, is subject to annual flooding. The FAA has begun preparation for an Airport Master Plan in order to respond to this issue.

Wise, James L., Albert L. Comiskey, and Richard Becker, 1981, Storm surge climatology and forecasting in Alaska: Anchorage, Alaska, Arctic Environmental Information and Data Center, University of Alaska, 26 p.

The objective of this study was to improve the quality of life and the security of property in coastal areas susceptible to flooding by enhancing the decision-making process for human activities and development. This study compiles historical climatological data to develop a surge forecast regression equation. One storm profile specific to Kaktovik, from 1972, was used in this report.

Worth, Jess, July 2009, A slow earthquake: New Internationalist, issue 424, p. 4–7.

http://www.newint.org/features/2009/07/01/keynote-arctic/

This popular-press article discusess political and climate changes occurring in Kaktovik, Alaska, and the Arctic National Wildlife Refuge. Personal stories and perspectives of residents of the village are portrayed in a story of struggle for the community of Kaktovik and the entire Arctic region.