An Inventory of Paleontological Resources from Glacier Bay National Park and Preserve, Alaska

Robert B. Blodgett, Geological Consultant, 2821 Kingfisher Drive, Anchorage, AK 99502; robertbblodgett@yahoo.com

Vincent L. Santucci, Senior Geologist, Geologic Resources Division, National Park Service, 1201 Eye Street, NW (Room 1146), Washington, DC 20005; vincent_santucci@nps.gov

Lewis Sharman, Ecologist, Division of Resources Management and Research, Glacier Bay National Park and Preserve, PO Box 140, Gustavus, AK 99826-0140; lewis_sharman@nps.gov

Introduction

Glacier Bay National Park and Preserve (GBNPP), at the northern end of Southeast Alaska, constitutes a spectacular array of mountains, tidewater glaciers, and fjords. The complex geologic story of the Glacier Bay area is dominated by accretionary terranes (fragments of crustal blocks which have been tectonically transported significant distances, hundreds to thousands of km from their origin source area), and more recently by the action of glaciers and coastal processes. The first report of fossils from Alaska, as well as the first documented fossils from western North America, are tied to a discovery of fossil bivalves (pectinids) in 1797 by French explorer La Perouse near Lituya Bay (La Pérouse 1797). U.S. Geological Survey (USGS) cartographers have mapped hundreds of fossil localities, and made large collections of fossils from within the areas now administered by GBNPP. Santucci and Kenworthy (2008) compiled some initial baseline paleontological resource data for GBNPP. Despite the rich fossil record preserved at GBNPP, the park had not been the focus of rigorous paleontological research.

Paleozoic paleontology of Glacier Bay

The Glacier Bay area is primarily composed of an extraordinary thick sequence of Paleozoic rocks associated with the Alexander terrane, an accreted terrane which comprises much of southeastern Alaska. These rocks represent rifted continental rocks of Siberian origin (Blodgett, Rohr, and Boucot 2002; Blodgett et al. 2010). Five Paleozoic formations mapped and described by Rossman (1963) are exposed in GBNPP: Willoughby Limestone (late Silurian); Tidal Formation (late Silurian); Pyramid Peak Limestone; Rendu Formation; and, Black Cap Limestone (Early and Middle Devonian). An unnamed Permian limestone unit has been identified within GBNPP by Dave A. Brew and others in subsequent geologic mapping.

The Willoughby Limestone is a massive Late Silurian limestone unit which measures more than 5,000 feet thick in GBNPP (Rossman 1963). The type section (a type section is designated by the author of a new formation as being its most typical representative outcropping) for the Willoughby Limestone occurs on Willoughby Island within GBNPP (Figure 1). This formation

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represents a thick accumulation of warm, shallow-water calcareous sediments with substantial invertebrate megafauna. Fossils discovered in this formation are extremely large (some bivalves approach 0.2 meters in length) suggesting their existence during a period of extremely high bio-productivity in a shallow-water, high energy reef environment. The largest known Paleozoic bivalve, *Pycinodesma giganteum* (Figure 2), was collected by USGS paleontologist Edwin Kirk in 1917 from a small island situated about 150 m northeast of Willoughby Island (Kirk 1927). The Willoughby Limestone also preserves a number of brachiopods, gastropods, sphinctozoan sponges, as well as large thumbnail-sized ostracodes. Kirk's original collections from Willoughby Island have yielded a number of additional type specimens, including the gastropods *Bathmopterus* Kirk, 1928 (Figure 3), *Kirkospira* Rohr and Blodgett, 2003, named in honor of Edwin Kirk, and a new species of gastropod *Coelocaulus karlae* Rohr, Blodgett, and Frýda 2003. Similar fauna are documented on Drake Island and Gloomy Knob to the north within Glacier Bay; however, these fossils are slightly more altered or metamorphosed.

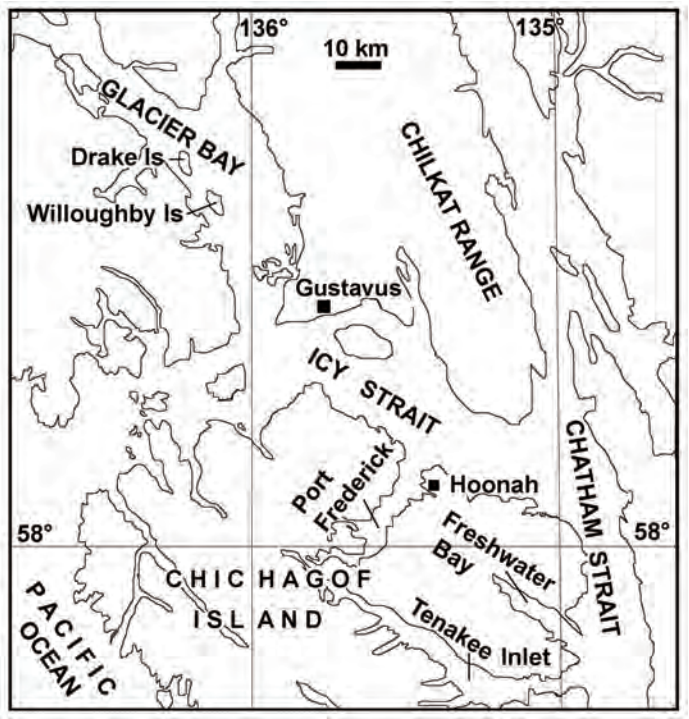

Figure 1. Index map showing Glacier Bay and immediately surrounding area in Southeast Alaska.

Figure 2. Various views of the upper Silurian bivalve *Pycinodesma giganteum* (Kirk).

The Tidal Formation is a very thick Late Silurian unit consisting of thin-bedded argillite (mudstone), calcareous greywacke (sandstone), and limestone. This unit contains dipping sedimentary structures which indicate a turbidite-fan complex, and may represent a deep water environment. The Tidal Formation is exposed in the Tidal Inlet region of GBNPP, where the section measures over 10,000 feet in thickness (Rossman 1963). Although the unit is largely lacking in fossils, tabulate corals (*Favosites* sp. and *Striatopora*? sp.) were reported by Edwin Kirk from the Sandy Cove area.

Both the Pyramid Peak and Rendu formations are reported as being largely unfossiliferous, Late Silurian through Early Devonian, carbonate units. These formations may be in part deep-water, laterally equivalent lithologic units of the shallow-water Willoughby Limestone. The Rendu Formation contains some fossils, including conodonts and rugose corals. Colonial rugose corals were documented at a locality in the Rendu/Queen Inlet area of GBNPP (Santucci and Kenworthy 2008).

Collectively, the Willoughby Limestone, Tidal Formation, and basal portions of the Rendu and Pyramid Peak formations may represent the thickest known sequence of Silurian rocks in North America, perhaps the world.

The Early and Middle Devonian Black Cap Limestone is a massive, dark gray, fine-grained carbonate limestone which is widely exposed on the east side of Glacier Bay. This formation is interpreted as a shallow-

water carbonate shelf environment, and is represented today by approximately 4,500 feet of thickness in southeast Alaska (Rossman 1963). The Black Cap Limestone is quite fossiliferous, and extensive collections were obtained between 1966 and 1972, including rugose corals, brachiopods (see Figure 4 for photographs of a new rotund atrypid brachiopod species found in the summer of 2010 in Adams Inlet by a NPS field party), gastropods, ostracods, and the calcareous green alga *Coelotrochium* (Blodgett, Rohr, and Boucot 2002). The brachiopod taxa included at least two species of "*Atrypa*" and the genus *Warrenella*.

Figure 3. Various views of the upper Silurian gastropod *Bathmopterus liratus* (Kirk).

In 1966, E.M. MacKevett Jr. made a collection of fossils from the Black Cap Limestone, at a locality on the west side of Red Mountain, east of Muir Inlet. Stromatoporoids, tabulate corals, and some undetermined rugose corals, were obtained from the locality. The stromatoporoids were identified as *Amphipora* sp., and the tabulate corals include *Alveolites* sp., *Aulocystis* sp., *Favosites* sp., and *Thamnopora?* sp.

Conodonts were collected from the Black Cap Limestone, at Tidal Inlet south of Black Cap Mountain. The locality is described as a recrystallized algal-crinoid-gastropod bank with minor corals. The conodont collection included *Belodella resima, Panderodus* sp., paltodontiform elements, a neoprioniodiniform element, a plectospathodan element, and an ozarkodinan element.

An unnamed Permian age limestone unit was reported by retired USGS geologist Dave Brew. The fossil locality occurs on the south side of the entrance to Adams Inlet and is interpreted as Permian, based on the fauna, including brachiopods, bryozoans, and echinoderm debris. These fossils were evaluated by USGS geologist J.T. Dutro who assigned the collection to Permian (most likely late Leonardian). The brachiopod taxa include *Septacamera stupenda, Spiriferella* sp., and *Stenoscisma?* sp., part of a fauna known from Permian Pybus Formation, also occurring in Southeast Alaska.

Figure 4. Six views of a new rotund atrpyid brachiopod species from Middle Devonian strata of the Black Cap Limestone.

Cenozoic paleontology of Glacier Bay

Cenozoic rocks along the outer Pacific Ocean margin in the Lituya Bay

area, which are associated with the Yakutat terrane, have been more intensively studied relative to the stratigraphy and paleontology. Numerous fossil localities are rich in marine bivalves (MacNeil 1961; Marincovich 1980), gastropods (Marincovich 1980), echinoids (Wagner 1974), decapods, and to a lesser degree, land plants (Wolfe 1977). The principle formations containing these fossils include the Yakataga Formation, Topsy Formation, and Cenotaph Volcanics.

Quaternary and Holocene glacial deposits in GBNPP preserve the well-known standing stumps of the fossil forests (Herrick 1892; Wik 1973).

Future paleontological work at Glacier Bay

An in-depth paleontological resource assessment has been completed to document all known fossil localities within Glacier Bay National Park and Preserve. This work included the compilation of a comprehensive bibliography, and compiling all paleontology and stratigraphy studies published on GBNPP, along with a complete PDF library of all known internal USGS fossil reports undertaken by USGS paleontologists. The latter reports are also known as E&R (examination and report) reports, and constitute a tremendous source of unpublished paleontological resource data. Finally, we have compiled an Excel spreadsheet listing all known fossil localities (nearly 600 in number) and their taxonomic content within the park. This effort is intended to provide baseline information for future geologic mapping within the park, and to focus researchers on areas needing additional studies, as well as to document and protect its paleontologic resources.

Future planned studies include field work on the Paleozoic rocks in Glacier Bay proper during the summer of 2011, with the aim of better documenting their fossil content, community paleoecology, and paleogeographic setting. As noted above, this work will also bring about collaboration with various paleontologists to cover as many of the fossil groups as possible, from among those represented at GBNPP. Another probable future study may include a visit to the former USGS Paleozoic fossil collections, now housed in the Smithsonian Institution. This evaluation will enable a better understanding of the scope, significance, and taxonomic content of past fossil collections from GBNPP. Many of these collections were made in 1917 by Edwin Kirk, and later in the 1950s and 1960s by D.L. Rossman, D. Brew, and other USGS geologists. Further inventory should also take into account the vast former USGS fossil collections made in Cenozoic age strata of GBNPP, now housed at the University of California Museum of Paleontology, in Berkeley.

One of the primary objectives for the 2011 summer field season at GBNPP will be to undertake a detailed taxonomic study of all fossil groups represented in various Paleozoic formations (notably the Willoughby, Tidal, Rendu, and Black Cap), and to describe the contained fossil communities and their paleoecological setting. This effort will obviously include the participation of many paleontologists in the complete inventory of the fauna.

References

Blodgett, R.B., A.J. Boucot, D.M. Rohr, and A.E.H. Pedder. 2010. The Alexander terrane—A displaced fragment of northeast Russia? Evidence from Silurian-Middle Devonian megafossils and stratigraphy. *Memoirs of the Association of Australasian Palaeontologists* 39:325-341.

Blodgett, R.B., D.M. Rohr, and A.J. Boucot. 2002. Paleozoic links among some Alaskan accreted terranes and Siberia based on megafossils. In *Tectonic Evolution of the Bering Shelf-Chukchi Sea-Arctic Margin and Adjacent Landmasses*, ed. E.L. Miller, A. Grantz, and S.L. Klemperer, 273– 291. Geological Society of America Special Paper 360. Boulder, CO.

Herrick, F.H. 1892. Supplement III. Microscopical examination of wood from the buried forest, Muir Inlet, Alaska. *National Geographic Magazine* 4:75–78.

Kirk, Edwin. 1927. *Pycnodesma*, a new molluscan genus from the Silurian of Alaska. Proceedings of the United States National Museum 71, article 20.

Kirk, Edwin. 1928. *Bathmopterus*, a new fossil gastropod genus from the Silurian of Alaska. *Proceedings of the United States National Museum* 74, article 18, 1–4.

La Pérouse, J.F. de G. 1797. *Voyage de La Pérouse autour du monde, publié confornément au décret du 22 avril 1791,* v. 2. Rédigé par M.L.A. Miet-Mureau. Paris: Imprimerie de la République.

MacNeil, F.S. 1961. *Lituyapecten* (new subgenus of *Patinopecten*) from Alaska and California. U.S. Geological Survey Professional Paper 354-J:225-239, pls. 35–36.

Marincovich, Louie, Jr. 1980. Miocene mollusks of the Topsy Formation, Lituya District, Gulf of Alaska Tertiary province, Alaska. U.S. Geological Survey Professional Paper 1125-C:C1–C14.

Rohr, D.M., and Blodgett, R.B. 2003. *Kirkospira*, a new Silurian gastropod from Glacier Bay, southeast Alaska. In *Studies in Alaska by the U.S. Geological Survey, 2001*, ed. J.P. Galloway. U.S. Geological Survey Professional Paper 1678:117–125.

Rohr, D.M., R.B. Blodgett, and J. Frída. 2003. New Silurian murchisoniid gastropods from Alaska and a review of the genus *Coelocaulus*. In *Short Notes on Alaska Geology 2003*, ed. K.H. Clautice and P.K. Davis, 87–93. Alaska Division of Geological and Geophysical Surveys Professional Report 120.

Rossman, D.L. 1963. Geology of the eastern part of the Mount Fairweather quadrangle, Glacier Bay, AK. U.S. Geological Survey Bulletin 1121-K.

Santucci, V.L., and J.P. Kenworthy. 2008. Paleontological resource inventory and monitoring: Southeast Alaska Network. Natural Resource Technical Report NPS/NRPC/NRTR-2008/108. National Park Service, Fort Collins, CO.

Wagner, C.D. 1974. Fossil and recent sand dollar echinoids of Alaska. *Journal of Paleontology* 48:105–123.

Wik, Ole. 1973. Fossil forests of Glacier Bay. *National Parks Conservation Magazine* 47:7, 12–13.

Wolfe, J.A. 1977. Paleogene floras from the Gulf of Alaska region: U.S. Geological Survey Professional Paper 997.