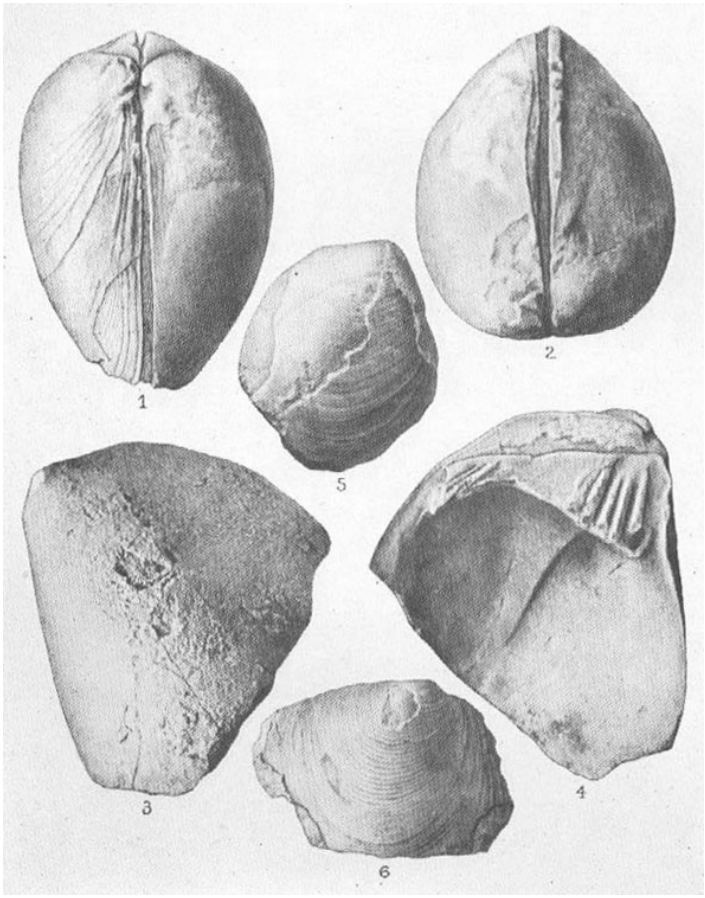
FINAL REPORT ON GLACIER BAY NATIONAL PARK & PRESERVE PALEONTOLOGICAL INVESTIGATIONS OF ROBERT B. BLODGETT

[FORMAL TITLE: PALEONTOLOGICAL INVENTORY AND GEOLOGIC FRAMEWORK OF GLACIER BAY NATIONAL PARK AND PRESERVE]

by

Robert B. Blodgett, Ph.D.
Consulting Geologist
2821 Kingfisher Drive
Anchorage, Alaska 99502



Cover photo: Various views of the bivalve *Pycinodesma giganteum* (Kirk, 1927a), an index fossil to the upper Silurian strata of the Willoughby Limestone from a small unnamed satellite island in Johnson Cove northeast of Willoughby Island. This fossil is typical of the lagoonal facies of the Willoughby and is easily recognized in numerous shoreline exposures on both Willoughby and Drake Islands. It is especially common at our "*Pycinodesma*" Point locality (our 11RB06) (locally referred to by some residents of Gustavus as "Kissing Clams" point), a prominent promontory on the northeast side of Willoughby Island. The genus *Pycinodesma* is endemic, being known only from the Alexander terrane of Southeast Alaska.

INTRODUCTION

This report summarizes the paleontological and stratigraphical findings of the investigator, Robert B. Blodgett, and those of his colleagues (D.M. Rohr, A.J. Boucot, L. Slavik, J. Kříž, and V.V. Baranov) in paleontological studies of Glacier Bay National Park & Preserved (GLBA). Blodgett as a former staff member of the now disbanded Branch of Paleontology & Stratigraphy (commonly referred to as the P&S Branch) of the USGS, has long had an interest in the geology and paleontology of Glacier Bay, having been focused on Alaska paleontological research (he grew up in Alaska) for what is now over 30 years. Before this study he had published several papers which were focused upon (Rohr and Blodgett, 2003, Rohr, Blodgett, and Frýda, 2003) or involved fossils occurring in part in Glacier Bay (Blodgett and others, 2002). Despite the numerous visiting geologists to GLBA since the end of the 19th Century, very few publications existed on the Paleozoic fossils found in Glacier Bay proper [Kirk, 1927a, b; 1928 on fossil mollusks establishing two genera: *Pycinodesma* and *Bathmopterus* (see cover photo and Figs. 1 and 3); and Soja and others, 2000, on a Silurian reef trend on Drake Island (the paper illustrated some of the algae and sponges found in the Willoughby Limestone, unfortunately her illustrations of the fossil gastropods are misidentified!). The situation with the Cenozoic marine invertebrates found along the outer Pacific coastal fringe of GLBA is better, but nonetheless,

Figure 1. Side view of the gastropod *Bathmopterus liratus*, established by Kirk (1928) from upper Silurian strata of the Willoughby Limestone on the northeast end of Willoughy Island. This is type species of the genus, an endemic genus known only from the Alexander terrane of Southeast Alaska. It is closely related to the genus *Euomphalopterus* (photo from Knight, 1941).

much work remains to be done, and I would guess that we still have only a small fraction of the total Cenozoic marine fauna documented. The work with Paleozoic fauna as indicated has been relatively sparse, but our former (Rohr and Blodgett, 2003; Rohr, Blodgett, and Frýda and on-going studies (see publication products list below) are now shedding much additional light on the taxonomic and paleoecologic character of these older faunas. During 2008, an inventory and monitoring network-based paleontological resource inventory was undertaken for the parks of the Southeast Alaska Network. This report (Santucci and Kenworthy, 2008) included a

compilation of paleontological resource data for Glacier Bay National Park and Preserve. This work helped to identify a number of geology and paleontology related questions for GLBA and this resulted in a series of recommendations for future work.

The investigator had the good fortune to be invited by Bruce Heise (NPS Geologic Resources Division) to the 2009 scoping meeting on geological resources of GLBA held in the Bartlett Cove headquarters office. Blodgett presented a powerpoint talk on the paleontological resources based on his 30+ years experience with Alaskan paleontology, but was also greatly aided by his possession of many internal fossil reports and files on Glacier Bay which he acquired during his time with the P&S Branch. It was quite fortunate that he has archived his own set of these records as since the 1995 RIF which destroyed the Branch, many of these resources are now lost or very difficult to find in the USGS archives in Reston, VA. As a result of his participation in this conference he was awarded a NPS grant through the Lewis Sharman (NPS, GLBA) to develop (1) a paleontological database archiving all known fossil data from GLBA, and (2) to conduct field work in order to better refine the stratigraphy, age correlation, and faunal content of Paleozoic rock units exposed along the shoreline of lower Glacier Bay. The fieldwork portion of the study was supported by the use of the Park research vessel, the R/V Capelin, under the able seamanship of Captain Justin Smith. The grant (awarded to the investigator by NPS via Oregon State University (Blodgett is a courtesy faculty member there) was formally entitled "Paleontological Inventory and Geologic Framework of Glacier Bay National Park and Preserve." It has the following Award Number: Task Agreement # J8W07100031 / Coop Agreement # H8W07060001.

The first phase of the study involved the construction of paleontological database for GLBA, involving all known publications on the region, as well as all unpublished internal USGS fossil reports (known as "E&R" reports). For this purpose Blodgett made a complete bibliography of all paleontological and stratigraphical studies within GLBA. He then had these converted to PDF files which he later presented to the Archives office at GLBA in Bartlett Cove. In addition, Blodgett scanned all E&Rs on GLBA and burned to a DVD which was also presented to the Archives office. Finally, an Excel Spreadsheet was constructed all of known fossil citations in the literature and the E&Rs (total locality citations numbering 580 localities). Data entered into the database included complete faunal and floral lists, locality descriptions, interpreted geologic age, as well as latitude/longitude information (based on original determinations or by digitization of these localities on a modern topographic base). This is the first such compilation for any NPS unit in Alaska, and should be an invaluable asset for future workers on paleontological matters in GLBA, as well as an excellent tool for future geological mapping in the region.

The second phase of the study involved a two-week field effort in Glacier Bay during the summer of 2011 in which the investigator and his colleague David M. Rohr (Dept. of Geology, Sul Ross State University, Alpine, Texas) visited a number of shoreline exposures in lower Glacier Bay, including Willoughby Island, Drake Island, North Marble Island, Marble Mountain, numerous small outcroppings in Geikie Inlet, Sandy Cove, and Tidal Inlet. Vincent L. Santucci (NPS Geologic Resources Division) joined us for the last week of field work and ably assisted us in this study. These sites were selected in order to get a better feel for the Paleozoic fauna and stratigraphy of Glacier Bay, and as a result we have somewhat modified the stratigraphic relationships and the paleoenvironmental interpretations of the formations earlier established by

Rossman (1963) and Seitz (1959). Perhaps the most significant result is the recognition that the accepted stratigraphic succession for Glacier Bay given in Rossman (1963) (see Fig. 2 below) needs revision.

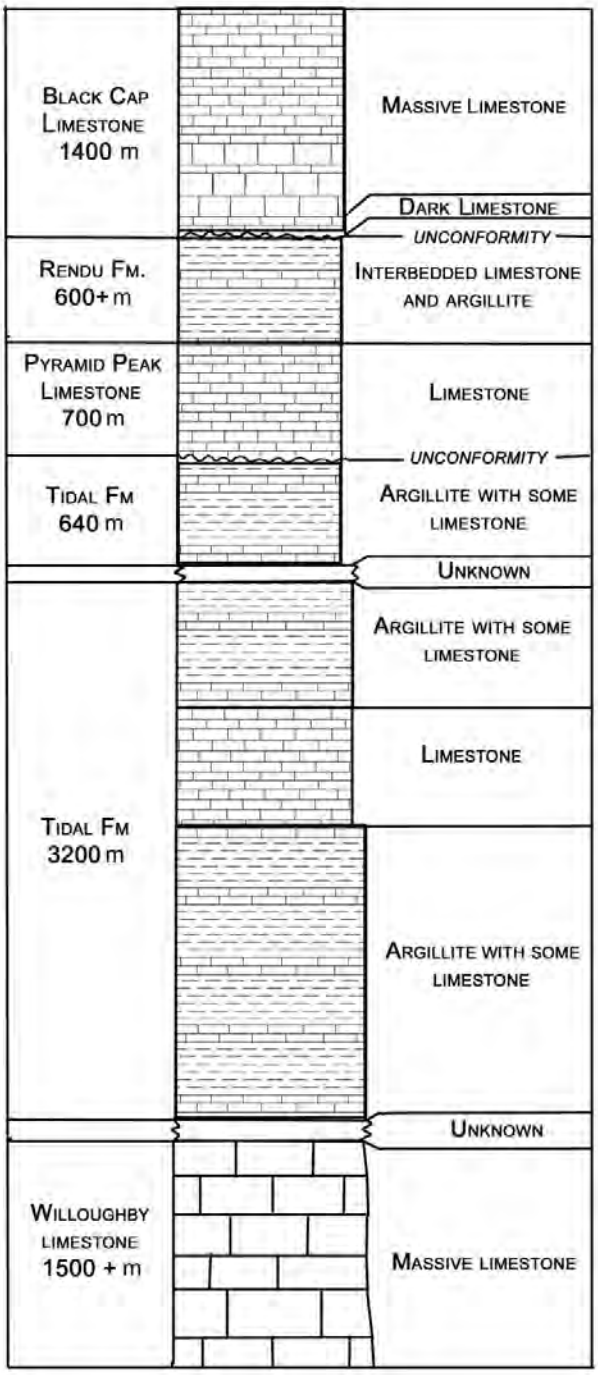


Figure 2. Generalized columnar section of the Paleozoic stratigraphic succession in Glacier Bay shown in Rossman (1963, fig. 2).

Our study indicates that Tidal Formation is not in superpositional relationship to the Willoughby Limestone as indicated by Rossman, but rather that these two formations are contemporaneous, with the Willoughby representing a shallow water platform carbonate succession cropping out primarily on the west side of Glacier Bay, grading laterally to the east into the deeper-water Tidal Formation, whose outcroppings are restricted to the east side of Glacier Bay. The relationships of these two contemporaneous Silurian units are outlined in great detail in Rohr and others (in press, see citation below in Products for this study). We were also able to better clarify the community relationships within the shallow-water platform environments in the Willoughby, recognizing two basic assemblages, the first being a lagoonal assemblage dominated by the large bivalve genus *Pycinodesma* (see cover photo and Fig. 3) and lesser abundant large gastropods, including species *Kirkospira glacialis* (established by Rohr and Blodgett, 2003; see Fig. 4) and *Coelocaulus karlae* (established by Rohr, Blodgett, and Frýda, 2003; see Fig. 5). A number of several kilogram-size samples of limestone were dissolved in acetic acid for recovery of conodonts from both the Willoughby Limestone and Tidal Formation. The residues were sent to Ladislav Slavík (Praha, Czech Republic) for study, but these samples all proved to be barren.

Figure 3. Abundant shell bank accumulations of the bivalve *Pycinodesma giganteum* (Kirk, 1927) in lagoonal facies of the Willoughby Limestone at our "*Pycinodesma* Point" locality (Blodgett field location 11RB06) on a prominent promontory on the northeast side of Willoughby Island (NE ¼ SE ¼ Sec. 2, T. 38 S., R. 56 E.). Most of the specimens are still articulated, although isolated detached valves also are present. Large scale bar denotes inches, smaller scale bar denotes centimeters.

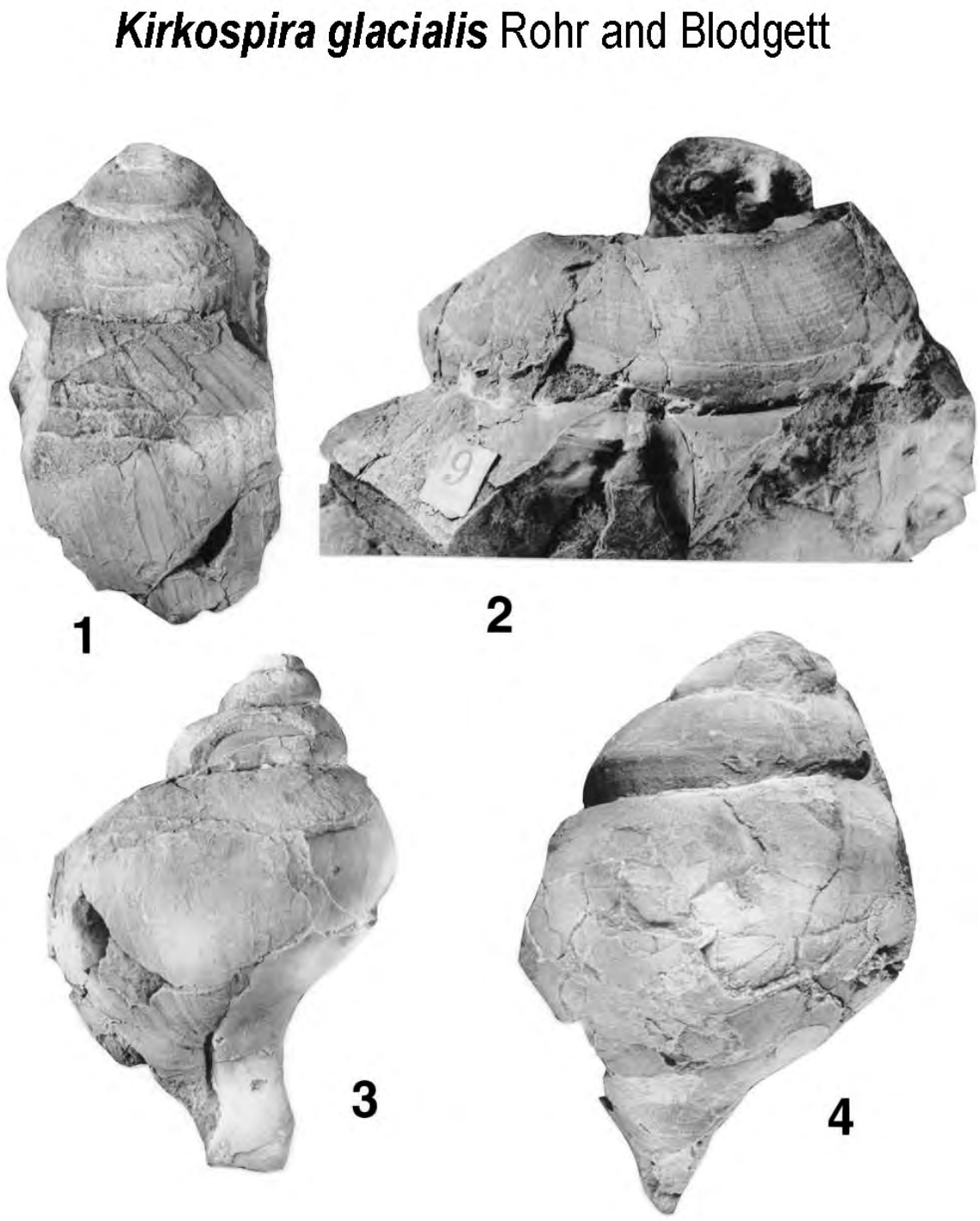
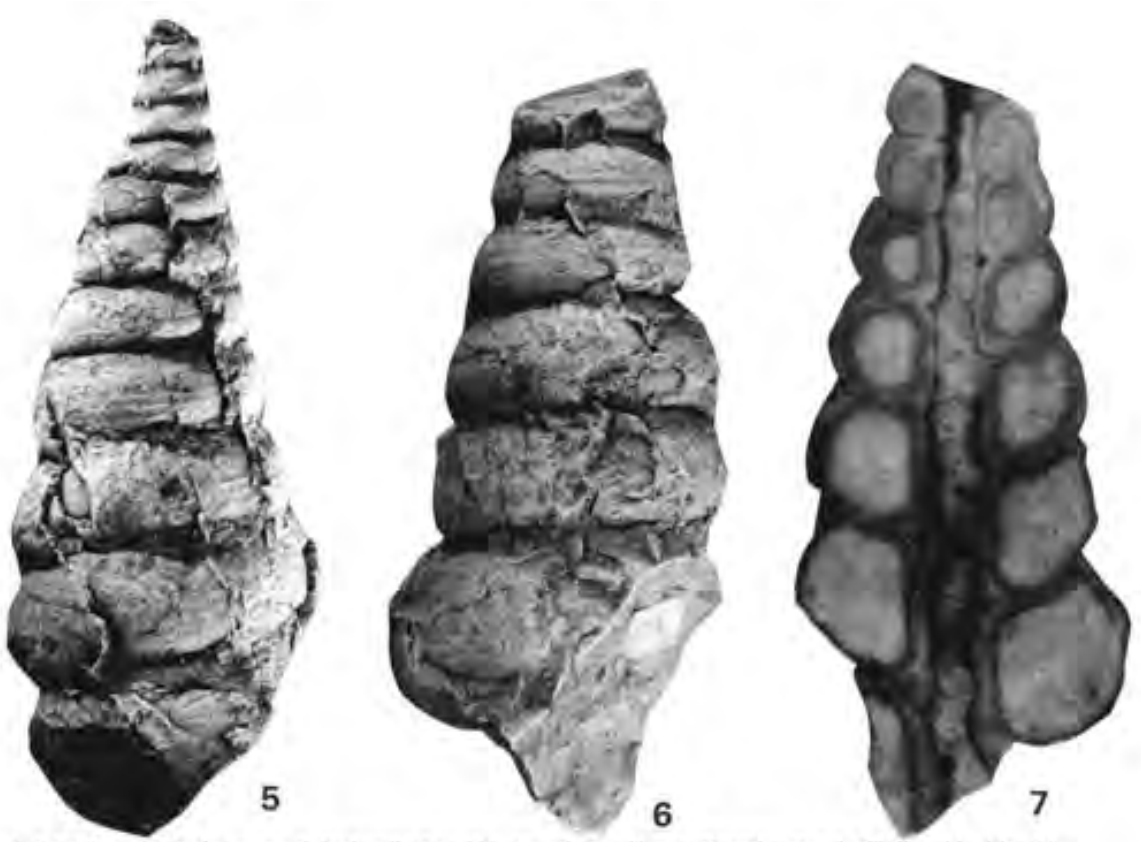


Figure 4. Various views of the gastropod *Kirkospira glacialis* Rohr and Blodgett, 2003, from exposures of the Willoughby Limestone on a small satellite island on east end of Johnson Cove, northeast end of Willoughby Island (from Rohr and Blodgett, 2003)



4–7. **Coelocaulus karlae** *n. sp., E. Kirk collection 993, "small island lying off northeast end of Willoughby Island," Glacier Bay, southeastern Alaska. 4, side view highlighting selenizone and growth lines, x2; and 5, side view of entire shell, x1, USNM 511815. 6, 7, exterior and interior showing deep umbilicus, x1.5, USNM 511816.*

Figure 5. The gastropod *Coelocaulus karlae* Rohr, Blodgett, and Frýda 2003 from the Willoughby Limestone. Specimens collected by USGS paleontologist Edwin Kirk in 1917 from a small island lying off the northeast end of Willoughby Island. (illustration from Rohr, Blodgett, and Frýda, 2003).

The second assemblage consists of algal reefal buildups, presumed to lie seaward of the lagoonal facies, we visited and sampled one prominent section of this assemblage exposed along the southwest shoreline of Drake Island (locality 11RB16). Detailed discussion of this exposure can be found in Rohr and others (in press) and Soja and others (2000). Megafossil shelly fauna are not common in this assemblage, but we did find one small pocket-sized shell accumulated that formed within the reef core and we made a good collection of the fauna present. A new brachiopod genus and species, *Sapelnikoviella santuccii* (see Fig. 6), is present here and will shortly be formally established in print (Blodgett and others, 2012, in press). The article naming this new taxon will be in a forthcoming issue of the Memoirs of the Association of Australasian Palaeontologists, slated to appear before the end of the year 2012.

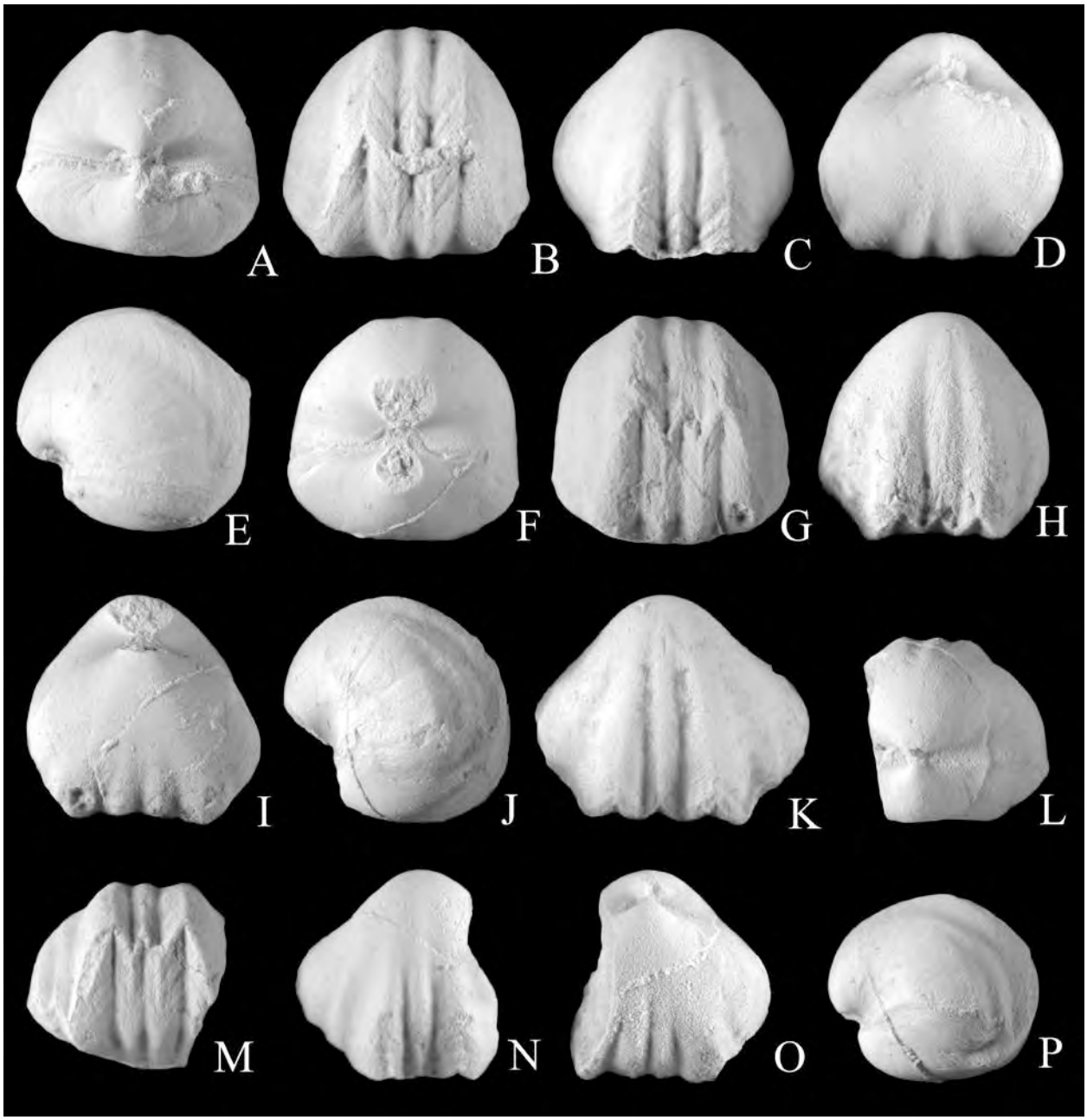


Figure 6. Specimens of the new brachiopod genus and species *Sapelnikoviella santuccii* Blodgett, Boucot, Baranov and Rohr (2012, in press), from locality 11RB16 in algal buildups exposed along the southeast shoreline of Drake Island. This brachiopod occurs in a small shell-rich cavity within the reef complex which includes other brachiopods (*Septatrypa* sp.) and several high-spired coelocaulid gastropods. The article naming this new taxon will be in a forthcoming issue of the Memoirs of the Association of Australasian Palaeontologists, slated to appear before the end of the year 2012.

As noted above, we now recognize the deep-water Silurian age Tidal Formation to be contemporaneous in age with the shallow-water Willoughby Limestone, these two units being laterally equivalents of one another. Fossil fauna is markedly rare in the Tidal Formation though we were able to found some brachiopods in a deep-water siliciclastic section (our locality 11RB11) with debris flows exposed at Sandy Cove (see Fig. 7). The fauna from locality 11RB11 is thought by one of our collaborators (A.J. Boucot, internationally recognized expert on Silurian brachiopods) to be most likely late Silurian age, but he could not definitively rule out an earliest Devonian age. Silurian age graptolites had been earlier collected from the Tidal Formation by USGS workers in the 1960's, unfortunately these collections were subsequently lost and never had a formal report issued upon them.

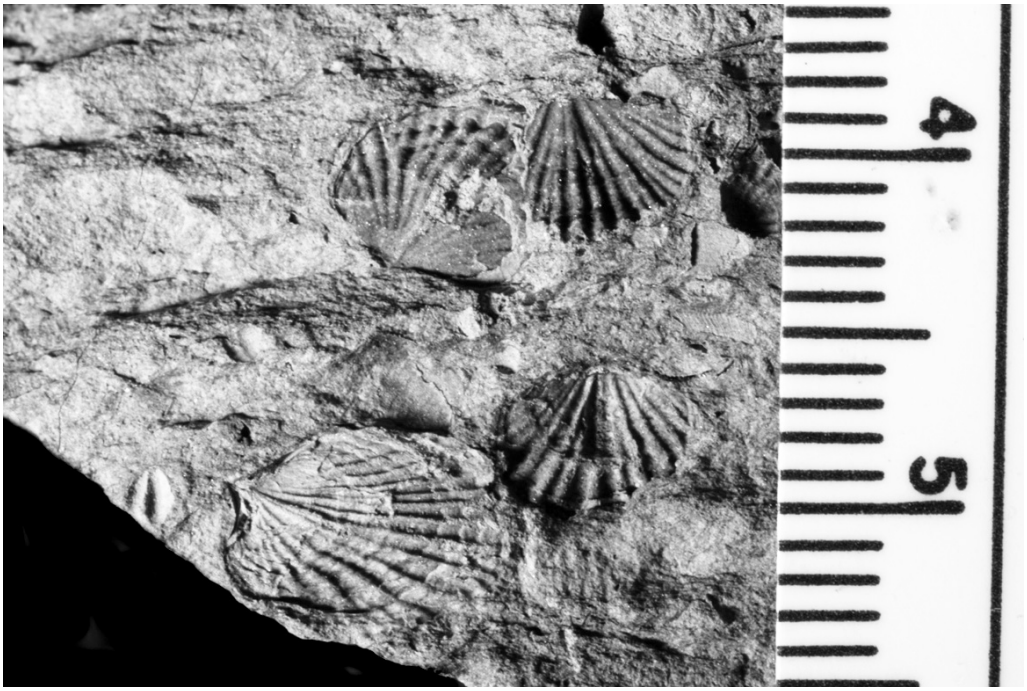


Figure 7. Bedding plane showing crowded remains of atrypid brachiopods in the Silurian age Tidal Formation at Sandy Cove. The fauna was studied by A.J. Boucot, who indicates on a late Silurian to Early Devonian age (he favors a late Silurian age), however, he suggests that a future revisit to the site might be useful in getting a larger sample to better date this locality.

One locality we would have liked to visit was that of Adams Cove, where Devonian age limestones of the Black Cap Limestone are exposed. Unfortunately, we could not visit it as it is a protected Wilderness area and requires non-motorized boat access. Fortunately, however, Greg Streveler and Craig Murdoch, both of the NPS staff at GLBA were able to visit a very productive fossil site in the Black Cap Limestone there, and made collections which I now have under study. The fauna is rich in 4-5 species of brachiopods, mostly atrypids (see Fig. 8), but several other types are present as well. The fauna at hand clearly indicates an Early Middle Devonian (Eifelian) age and is now under study by the investigator and his colleague Valeryi V. Baranov (from Yakutsk, Russia, but who visited me during the summer of 2012). We intend to formally describe and illustrate this material in a future publication.

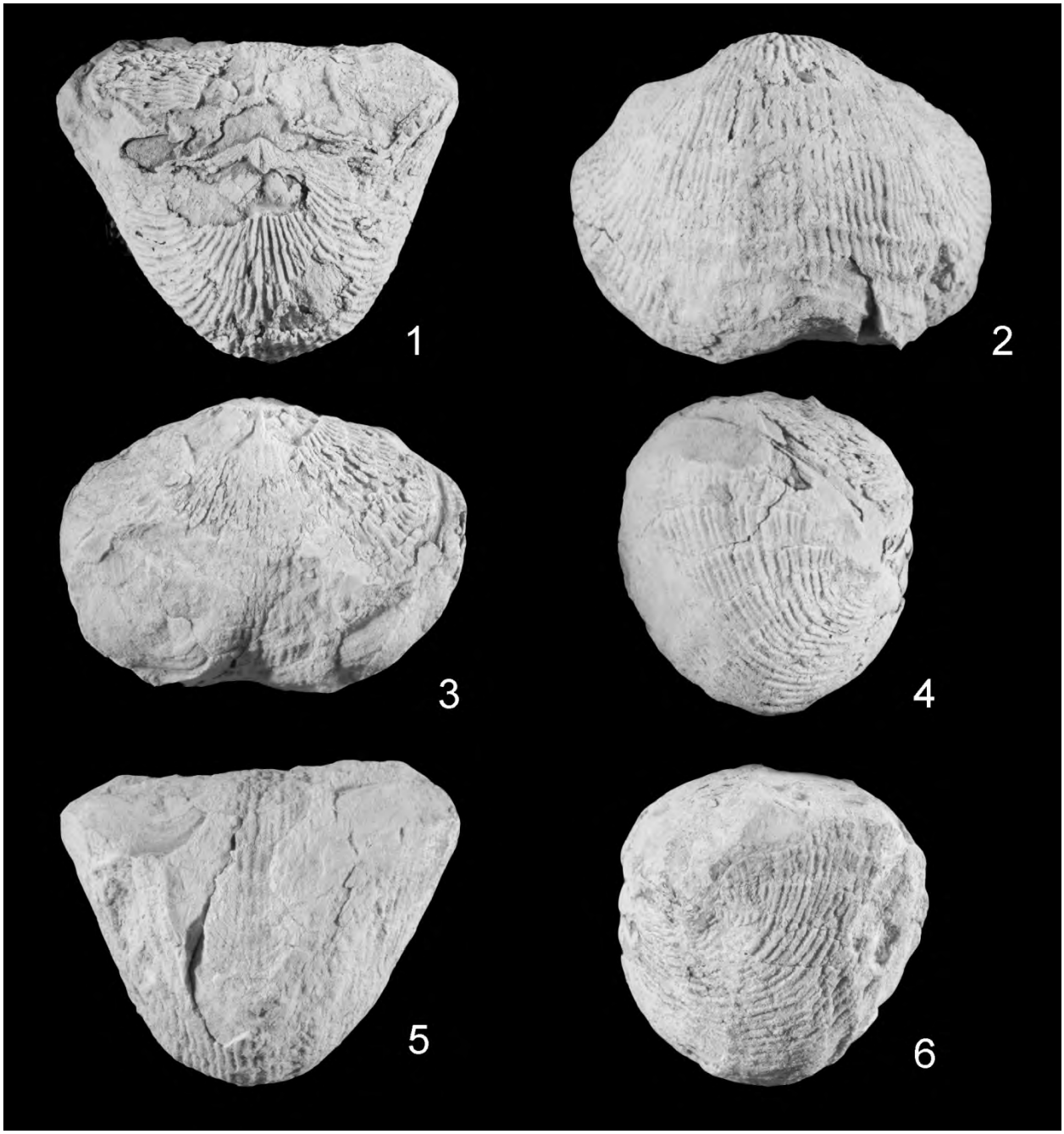


Figure 8. A new species of atrypid brachiopod from Devonian age Black Cap Limestone exposures at Adams Inlet. This species is part of a fauna intended for publication by the investigator and his collaborator Valeryi V. Baranov (Yakutsk, Russia).

One additional result of this study is continued affirmation of the non-North American nature of the fossil Silurian and Devonian fauna of the Alexander terrane of Southeast Alaska. Our continued study of the Glacier Bay materials supports previously published results supporting the view that the Alexander terrane is exotic to North America, and represents an accreted block of

eastern Siberia that was subsequently brought to the shores of North America by rifting and sea-floor spreading (Blodgett and others, 2002, 2012).

The results of our past and on-going study of the fossil fauna and stratigraphy of GLBA are outlined below in the section entitled: PRODUCTS BY INVESTIGATOR ON GLBA PALEONTOLOGY & STRATIGRAPHY.

RECOMMENDATIONS FOR FUTURE STUDY

As a result of this study, I can recognize several subjects that I would like to recommend for future in order to better understand the Paleozoic stratigraphy of Glacier Bay:

1. Further study of the Silurian age Tidal Formation, especially in the area of Sandy, our visit to this area was brief and we found only one fossil-bearing horizon, which turned out to have some long-ranging taxa. Another longer visit to this locality should potentially yield more material which would hopefully narrow the age range of the host strata. This locality was easily accessible by "The Capelin". Another Tidal Formation locality that could be visited is above the town of Gustavus, near a water treatment plant. The locality is outside the boundary of GLBA proper, but can easily be reached by a truck. Several Tidal Formation localities were reported by Dave Brew (oral communication) to have yielded Silurian graptolites. These localities were collected by USGS field geologists in the 1960's, but the collections were subsequently lost in the USGS Menlo Park office, and no official USGS E&R were ever made for them. It would be useful to scan the old field notes to find where these localities were in order to recollect these horizons. Graptolites are extremely useful index fossils (having narrow biostratigraphic ranges).

2. Additional study of the Devonian age Black Cap Limestone would most likely yield extensive faunas, based on the limited material we have now from Adams Inlet. The fauna is richly diverse in brachiopods, rugose and tabulate corals, gastropods, and conodonts (we got the first conodonts ever from GLBA from samples collected by Greg Streveler and Craig Murdoch). Refinement of the total age range of the Black Cap Limestone would be valuable for regional geology, especially in relating it to the limestone member of the Cedar Cove Formation exposed nearby on northeast Chichagof Island.

3. There are some well developed limestone outcrops on the west side of Glacier Bay just west of the head of Geikie Inlet. These were mapped by Seitz (1959) but their exact age remains unknown. Based on my review of the E&R reports released on these 1950's collections, I suspect they will be either of Devonian or Mississippian age (an Iyoukeen equivalent; the Iyoukeen is known from NE Chichagof Island). It would be most useful to get a paleontologist on the ridgeline to collect and inventory these exposures (I would recommend helicopter support if possible).

4. There are several belts of Permian age sedimentary rock units shown on the unpublished geologic map of Dave Brew and George Plafker (in press). Not much is known of these faunas, and it is highly recommended that they be visited and collected in the future by helicopter.

ACKNOWLEDGMENTS

This work would not have been possible without the help and assistance provided by NPS personnel who include, Lewis Sharman, Rusty Yerxa, and Justin Smith (all from GLBA), Vincent L. Santucci, Bruce Heise and Tim Connors (all from NPS Geologic Resources Division). I would also like thank my various paleontological colleagues who have provided expert advice on various aspects of the fossil fauna collected during this study: David M. Rohr (Sul Ross State University, Alpine, TX); Arthur J. Boucot (Oregon State University, Corvallis, OR); Valeryi V. Baranov (Yakutsk, Russia), Jiří Kříž (Prague, Czech Republic) and Ladislav Slavík (Prague, Czech Republic). Two other NPS staff members from GLBA, Greg Streveler (retired) and Craig Murdoch, are also gratefully acknowledged for collecting and providing exciting new faunal material from the Devonian age Black Cap Limestone exposed in Adams Inlet. The latter material is currently under study and a manuscript is planned in the future to document Devonian fossils in detail for the first time from GLBA.

REFERENCES

Blodgett, R. B., Boucot, A. J., Rohr, D. M., and Pedder, A.E.H., 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, v. 39, p. 325-341.

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

Kirk, Edwin, 1927a, *Pycnodesma*, a new molluscan genus from the Silurian of Alaska: Proceedings of the United States National Museum, v. 71, article 20, 9 p.

Kirk, Edwin, 1927b, *Pycinodesma*, a new name for *Pycnodesma* Kirk not Schrammen: Journal of the Washington Academy of Sciences, v. 17, p. 543.

Kirk, Edwin, 1928, *Bathmopterus*, a new fossil gasteropod genus from the Silurian of Alaska: Proceedings of the United States National Museum, v. 74, article 18, p. 1-4.

Knight, J. B., 1941, Paleozoic Gastropod Genotypes: Geological Society of America Special Paper 32, 510 p., Baltimore.

Rossman, D.L., 1963, Geology of the eastern part of the Mount Fairweather quadrangle, Glacier Bay, Alaska: U.S. Geological Survey Bulletin 1121-K, p. K1-K57, 2 sheets, scale 1:63,360.

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. TIC# D-155. National Park Service, Fort Collins, Colorado.

Seitz, J., 1959, Geology of Geikie Inlet area, Glacier Bay, Alaska: U.S. Geological Survey Bulletin 1058-C, C61-C120, 1 map sheet, scale 1:62,500.

Soja, C.M., White, B., Antoshkina, A., Joyce, S., Mayhew, L, Flynn, B., and Gleason, A. 2000. Development and decline of a Silurian stromatolite reef complex, Glacier National Park, Alaska. Palaois, v. 15, 273-292.

PRODUCTS BY INVESTIGATOR ON GLBA PALEONTOLOGY & STRATIGRAPHY

Publications:

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

Rohr, D. M., Blodgett, R. B., and Frýda, J., 2003, New Silurian murchisoniid gastropods from Alaska and a review of the genus *Coelocaulus*, p. 87-93, *in* Clautice, K.H., and Davis, P.K., eds., Short Notes on Alaska Geology 2003: Alaska Division of Geological & Geophysical Surveys Professional Report 120.

Blodgett, R.B., and Boucot, A.J., 2009, The Alexander terrane – A displaced fragment of northeast Siberia? Evidence from Silurian brachiopods and Silurian and Lower Devonian stratigraphy: Geological Society of America Abstracts with Programs, v. 41, no. 7, p. 302

Blodgett, R.B., and Rohr, D.M., 2009, Invertebrate paleontological research in National Parks of Alaska: Geological Society of America Abstracts with Programs, v. 41, no. 7, p. 365.

Blodgett, R. B., Boucot, A. J., Rohr, D. M., and Pedder, A.E.H., 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, v. 39, p. 325-341.

Blodgett, R.B., Rohr, D.M., Santucci, V.L., and Sharman, Lewis, 2010, A paleontologic resource assessment of Glacier Bay National Park and Preserve, Southeast Alaska: Geological Society of America Abstracts with Programs, v. 42, no. 5, p. 564.

Blodgett, R.B., Santucci, V.L., and Sharman, Lewis, 2011, Glacier Bay National Park and Preserve paleontological resource inventory: The George Wright Society Conference on Parks, Protected Areas & Cultural Sites, Abstracts volume, p. 146.

Blodgett, R.B., Santucci, V.L, and Sharman, L., 2012, An inventory of paleontological resources from Glacier Bay National Park and Preserve, Alaska. p. 43-47 *in* Weber, Samantha (ed.), Rethinking protected areas in a changing world: Proceedings of the 2011 George Wright Society Biennial Conference on Parks, Protected Areas, and Cultural Sites. Hancock, Michigan. The George Wright Society.

Blodgett, R.B., Boucot, A.J., Baranov, V.V., and Rohr, D.M., 2012 (in press, to be released before Dec. 31, 2012), *Sapelnikoviella santuccii*, a new gypidulinid brachiopod genus and species from the Upper Silurian of Glacier Bay National Park & Preserve, Southeast Alaska. Memoirs of the Association of Australasian Palaeontologists.

Rohr, D.M., Blodgett, R.B., Santucci, V.L., and Slavík, L., in press, Shallow and deep water origins of Silurian rocks at Glacier Bay, Alaska. Alaska Park Science.

Blodgett, R.B., Baranov, V.V., Streveler, Greg, and Murdoch, Craig., in preparation, Early Middle Devonian (Eifelian) Brachiopoda from the Black Cap Limestone, Adams Inlet area, Glacier Bay National Park & Preserve, Southeast Alaska. [photographs taken; text still needs to be completed; several new species involved, first formal descriptions of Middle Devonian fauna from GLBA][note this product is an "encore" item, not part of the original work plan for the project]

PUBLICATIONS FROM NORTHEAST CHICHAGOF ISLAND WHICH REFER TO CORRELATIVE ROCKS AND FAUNAS IN NEARBY GLACIER BAY [RESEARCH NOT FUNDED THROUGH NPS]

Rohr, D.M., Blodgett, R.B., Boucot, A.J., and Skaflestad, J., 2011, Upper Silurian facies and fauna of northeast Chichagof Island, Southeast Alaska: 2011 Western Region Meeting SPE Pacific Section, AAPG 6-14 May 2011, Program with Abstracts, p. 82.

Kříž, Jiri, Blodgett, R.B., and Rohr, D.M., 2011, Silurian Bivalvia from Chichagof Island, Southeast Alaska (Alexander terrane): Bulletin of Geosciences, v. 86, no. 2, p. 241-258.

Boucot, A.J., Blodgett, R.B., and Rohr, D.M., 2012. *Strophatrypa*, a new genus of Brachiopoda (Atrypidae) from upper Silurian strata of the Alexander terrane, Southeast Alaska. Bulletin of Geosciences, v. 87, no. 2, p. 261-267.

DATABASE ON GLBA PALEONTOLOGY

A complete database of all known paleontological localities, their location, geologic age and taxonomic content was prepared by the investigator in the form of an EXCEL spreadsheet and presented to the GLBA staff. Other products in this database compilation included a complete digital copy of all paleontological publications, internal E&R reports which were likewise presented to the GLBA staff. Photos of the significant faunal elements present in former USGS fossil collections now transferred to the National Museum of Natural History (Smithsonian Institution, Washington, D.C.) have been taken.

ANCILLARY GLBA PRODUCT BY INVESTIGATOR

Geologic Names reviewer for the USGS of:

Brew, D.A., and Plafker, George, in press, Geologic Map of Glacier Bay National Park and Preserve, Southeast Alaska. U.S. Geological Survey publication. [this work done during August 24-31, 2012].