

SANDIA REPORT

SAND2020-6958

Unlimited Release

Printed July 2020



Sandia
National
Laboratories

X-Ray CT Scans - Set 1

John Korbin

Anna Bancroft

Jonathan Dunnum

Senior Collection Manager, Division of Mammals, Museum of Southwestern Biology

Joseph Cook

Curator of Mammals, Museum of Southwestern Biology

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185
and Livermore, California 94550

Issued by Sandia National Laboratories, operated for the United States Department of Energy by National Technology and Engineering Solutions of Sandia, LLC.

NOTICE: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof, or any of their contractors or subcontractors. The views and opinions expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof, or any of their contractors.

Printed in the United States of America. This report has been reproduced directly from the best available copy.



Abstract

A collection of x-ray computed tomography scans of specimens from the Museum of Southwestern Biology.

Contents

Mustelidae 6

<i>Gulo</i>	6
MSB 227356: <i>Gulo gulo</i>	6
<i>Lontra</i>	9
MSB 92668: <i>Lontra canadensis</i>	9
<i>Martes</i>	12
MSB 214688: <i>Martes americana</i>	12
MSB 216253: <i>Martes caurina</i>	15
<i>Mustela</i>	18
MSB 143502: <i>Mustela erminea</i>	18
MSB 101203: <i>Mustela frenata nevadensis</i>	19
MSB 113497: <i>Mustela nigripes</i>	22
MSB 104648: <i>Mustela nivalis rixosa</i>	25
<i>Neovison</i>	29
MSB 143835: <i>Neovison vison</i>	29
<i>Taxidea</i>	32
MSB 214951: <i>Taxidea taxus</i>	32

Ursidae 35

<i>Helarctos</i>	35
MSB 58965: <i>Helarctos malayanus</i>	35

Choloepodidae 38

<i>Choloepus</i>	38
MSB 29177: <i>Choloepus hoffmanni</i>	38

Atelidae 42

<i>Alouatta</i>	42
MSB 34967: <i>Alouatta palliata palliata</i>	42

Cercopithecidae 45

<i>Macaca</i>	45
MSB 11088: <i>Macaca mulatta</i>	45

Hominidae 48

<i>Pan</i>	48
MSB 30673: <i>Pan troglodytes</i>	48

Hylobatidae 51

<i>Hylobates</i>	51
MSB 23437: <i>Hylobates iar</i>	51

Lemuridae 54

<i>Lemur</i>	54
MSB 142900: <i>Lemur mococo</i>	54

Caviidae 57

<i>Hydrochoerus</i>	57
MSB 56081: <i>Hydrochoerus hydrochaeris</i>	57

Ctenomyidae 60

<i>Ctenomys</i>	60
MSB 56088: <i>Ctenomys conoveri</i>	60
MSB 63381: <i>Ctenomys erikacuellarae</i>	63
MSB 57192: <i>Ctenomys leucodon</i>	66
MSB 57186: <i>Ctenomys lewisi</i>	67

MSB 55360: <i>Ctenomys nattereri</i>	68
MSB 55373: <i>Ctenomys opimus opimus</i>	71
MSB 55376: <i>Ctenomys opimus opimus</i>	73
MSB 87078: <i>Ctenomys sp</i>	76
MSB 55368: <i>Ctenomys steinbachi</i>	77

Cuniculidae 80

<i>Cuniculus</i>	80
MSB 56084: <i>Cuniculus paca</i>	80

Echimyidae 83

<i>Dactylomys</i>	83
MSB 85627: <i>Dactylomys boliviensis</i>	83

Geomyidae 85

<i>Geomys</i>	85
MSB 32600: <i>Geomys arenarius</i>	85
MSB 271072: <i>Geomys bursarius</i>	86
MSB 270888: <i>Geomys knoxjonesi</i>	87
MSB 57470: <i>Geomys personatus</i>	88
MSB 55630: <i>Orthogeomys grandis</i>	91
MSB 106753: <i>Thomomys talpoides retrorsus</i>	94

Hystriidae 97

<i>Hystrix</i>	97
MSB 43032: <i>Hystrix africae-australis</i>	97

Spalacidae 100

<i>Myospalax</i>	100
MSB 94336: <i>Myospalax aspalax</i>	100

Tupaiaidae 103

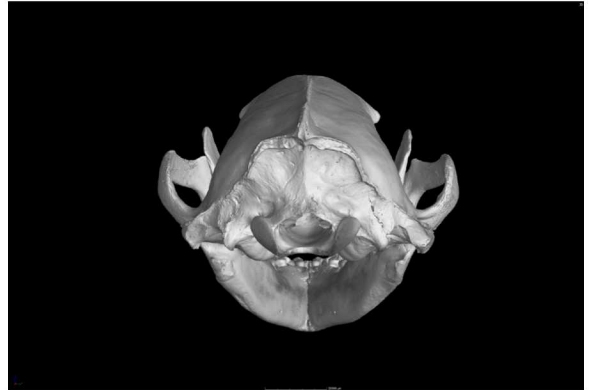
<i>Tupaia</i>	103
MSB 141251: <i>Tupaia belangeri</i>	103

Numerical Index

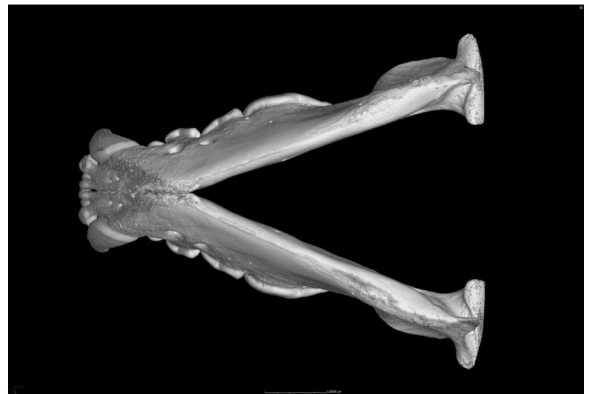
MSB 227356: <i>Gulo gulo</i>	6
MSB 92668: <i>Lontra canadensis</i>	9
MSB 214688: <i>Martes americana</i>	12
MSB 216253: <i>Martes caurina</i>	15
MSB 143502: <i>Mustela erminea</i>	18
MSB 101203: <i>Mustela frenata nevadensis</i>	19
MSB 113497: <i>Mustela nigripes</i>	22
MSB 104648: <i>Mustela nivalis rixosa</i>	25
MSB 143835: <i>Neovison vison</i>	29
MSB 214951: <i>Taxidea taxus</i>	32
MSB 58965: <i>Helarctos malayanus</i>	35
MSB 29177: <i>Choloepus hoffmanni</i>	38
MSB 34967: <i>Alouatta palliata palliata</i>	42
MSB 11088: <i>Macaca mulatta</i>	45
MSB 30673: <i>Pan troglodytes</i>	48
MSB 23437: <i>Hylobates iar</i>	51
MSB 142900: <i>Lemur mococo</i>	54
MSB 56081: <i>Hydrochoerus hydrochaeris</i>	57
MSB 56088: <i>Ctenomys conoveri</i>	60
MSB 63381: <i>Ctenomys erikacuellarae</i>	63
MSB 57192: <i>Ctenomys leucodon</i>	66
MSB 57186: <i>Ctenomys lewisi</i>	67
MSB 55360: <i>Ctenomys nattereri</i>	68
MSB 55373: <i>Ctenomys opimus opimus</i>	71
MSB 55376: <i>Ctenomys opimus opimus</i>	73
MSB 87078: <i>Ctenomys sp</i>	76
MSB 55368: <i>Ctenomys steinbachi</i>	77
MSB 56084: <i>Cuniculus paca</i>	80
MSB 85627: <i>Dactylomys boliviensis</i>	83
MSB 32600: <i>Geomys arenarius</i>	85
MSB 271072: <i>Geomys bursarius</i>	86
MSB 270888: <i>Geomys knoxjonesi</i>	87
MSB 57470: <i>Geomys personatus</i>	88
MSB 55630: <i>Orthogeomys grandis</i>	91
MSB 106753: <i>Thomomys talpoides retrorsus</i>	94
MSB 43032: <i>Hystrix africae-australis</i>	97
MSB 94336: <i>Myospalax aspalax</i>	100
MSB 141251: <i>Tupaia belangeri</i>	103

MSB 227356: *Gulo gulo*

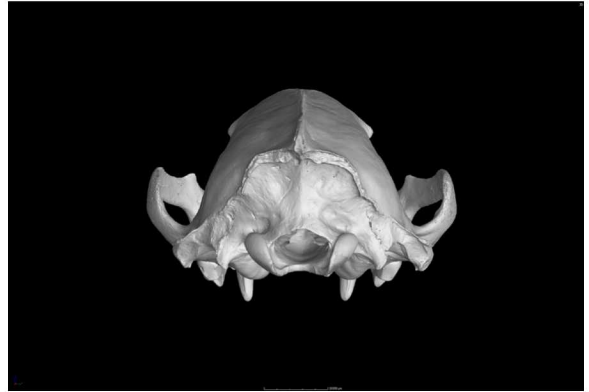
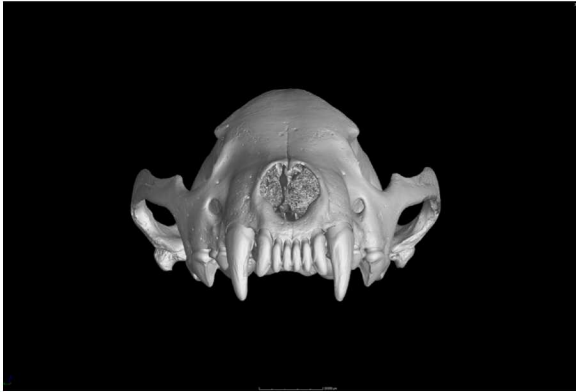
Full: 90 μ m resolution



Skull: 90 μ m resolution



Jaw: 90 μ m resolution

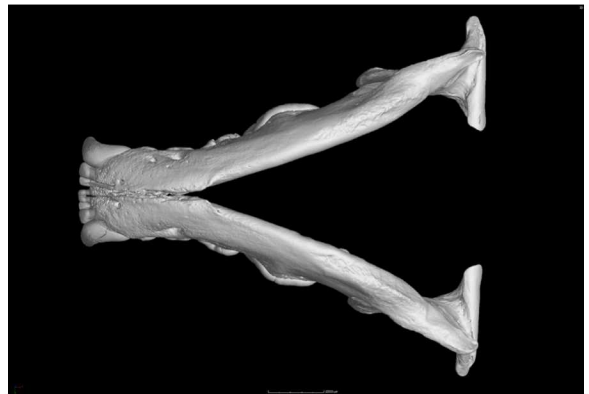
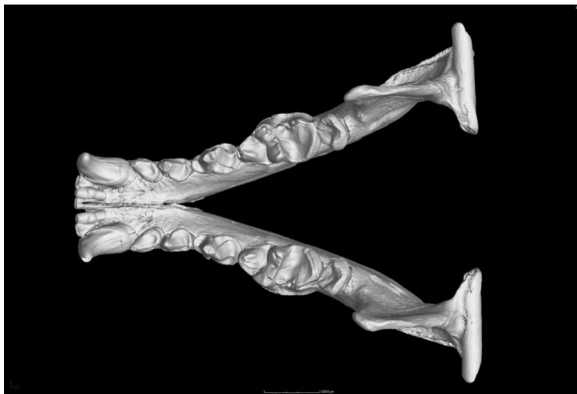
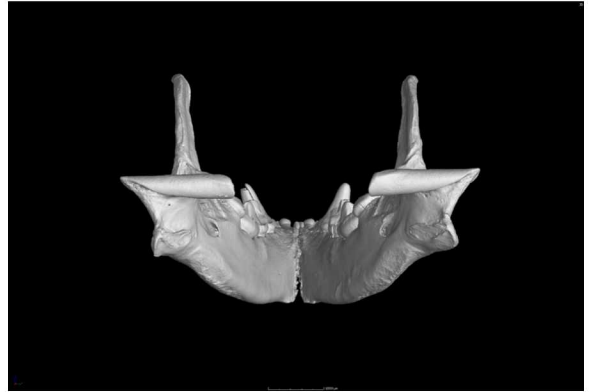
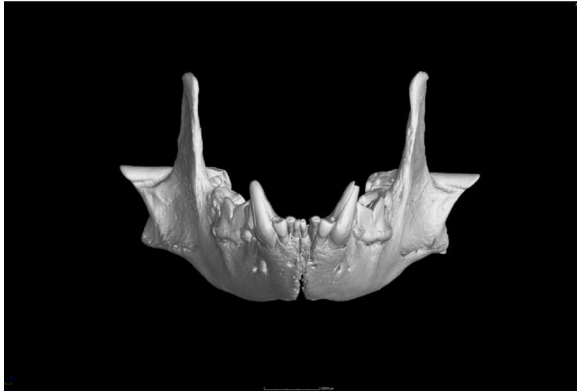


MSB 92668: *Lontra canadensis*

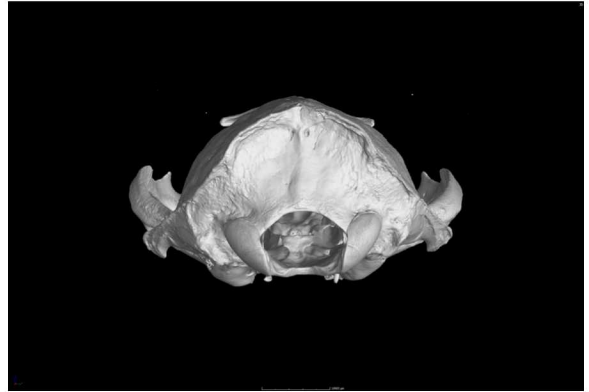
Full: 80 μ m resolution



Skull: 80 μ m resolution

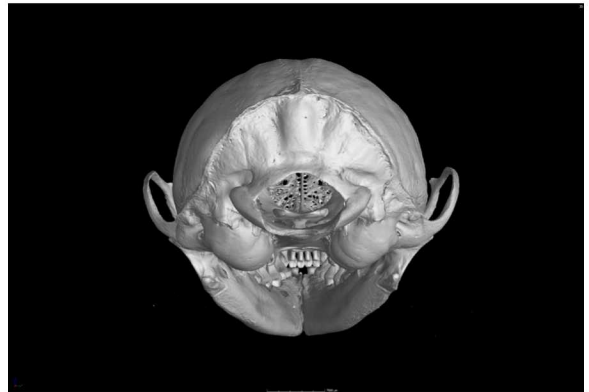


Jaw: 70 μ m resolution

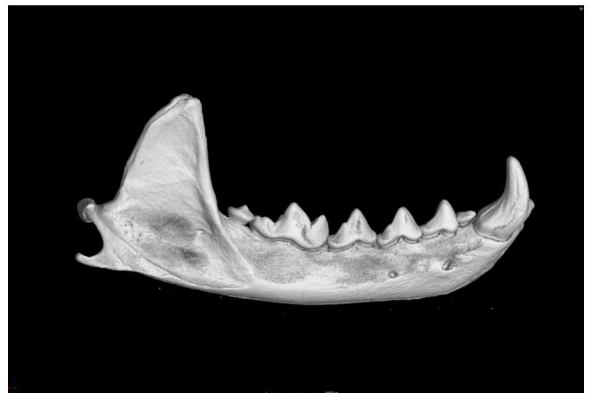
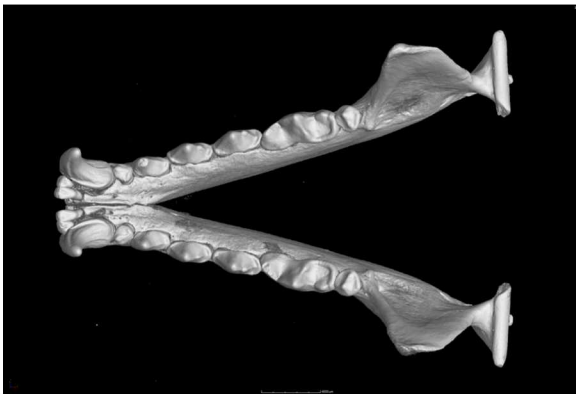
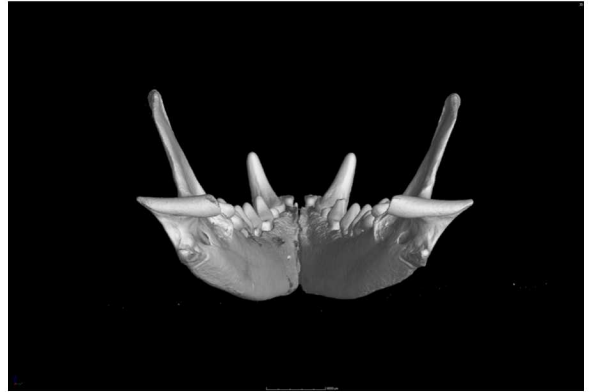
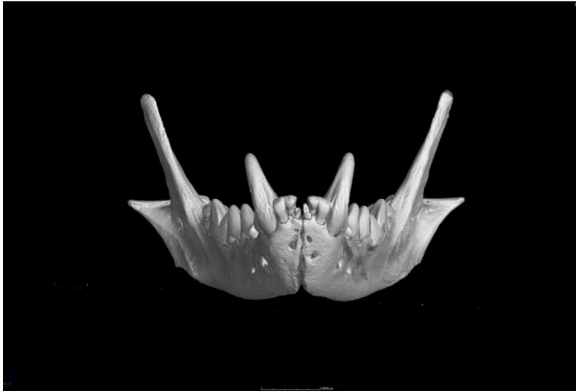


MSB 214688: *Martes americana*

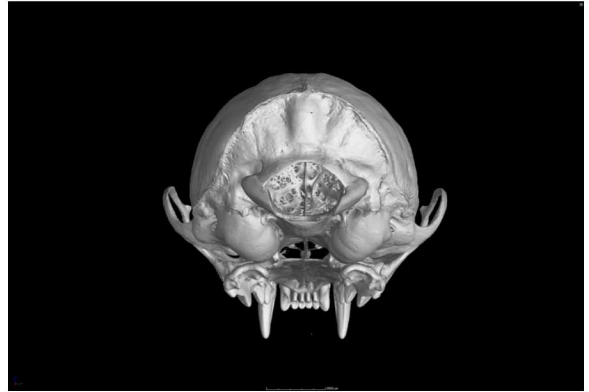
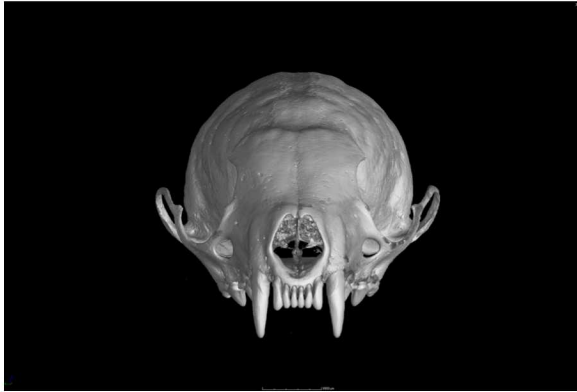
Full: 40 μ m resolution



Skull: 40 μ m resolution

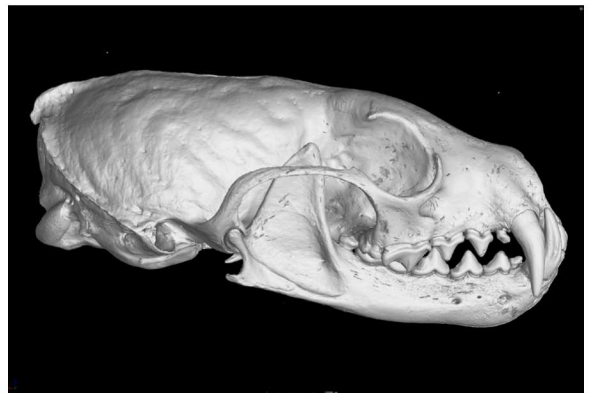
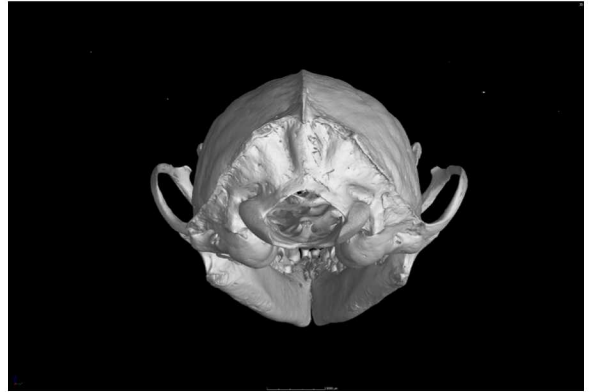
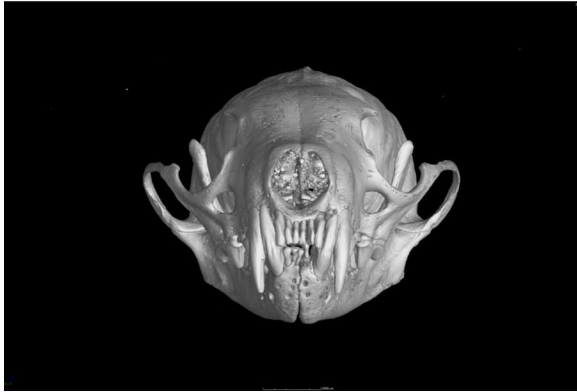


Jaw: 40 μ m resolution

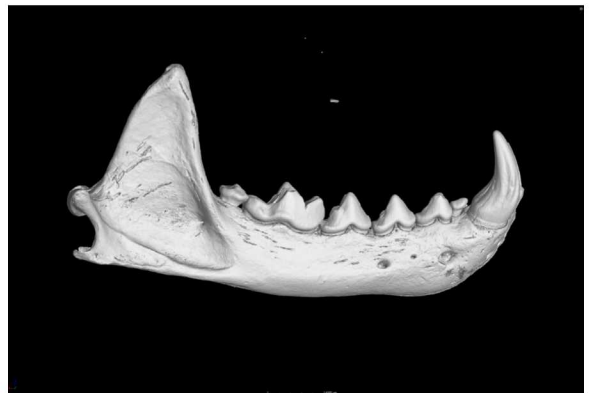
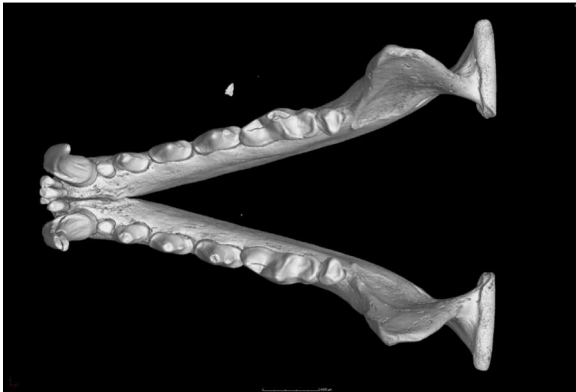


MSB 216253: *Martes caurina*

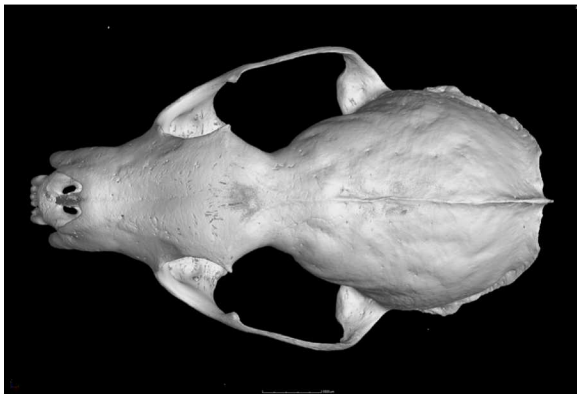
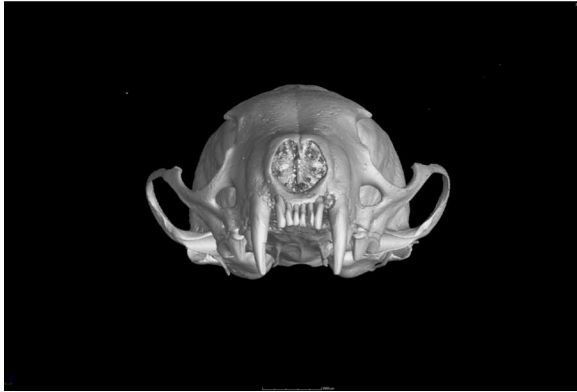
Full: 55 μ m resolution



Skull: 55 μ m resolution

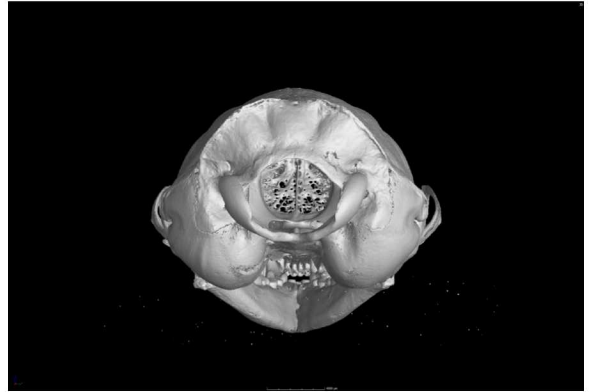
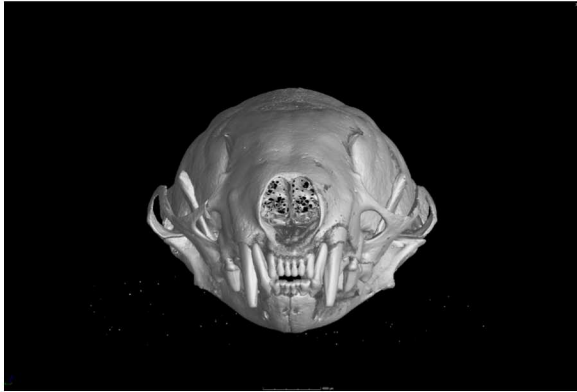


Jaw: 55 μ m resolution



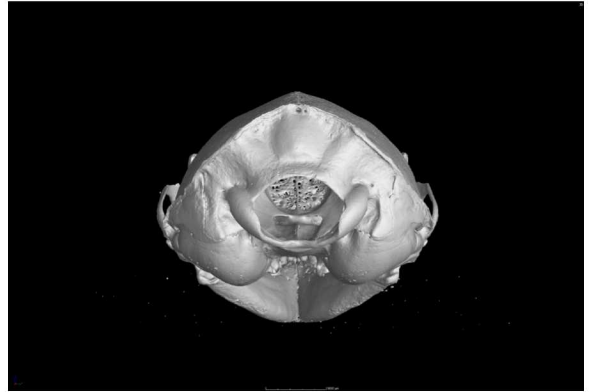
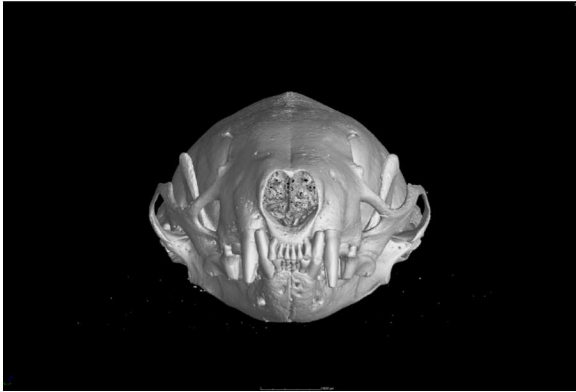
MSB 143502: *Mustela erminea*

Full: 26 μ m resolution

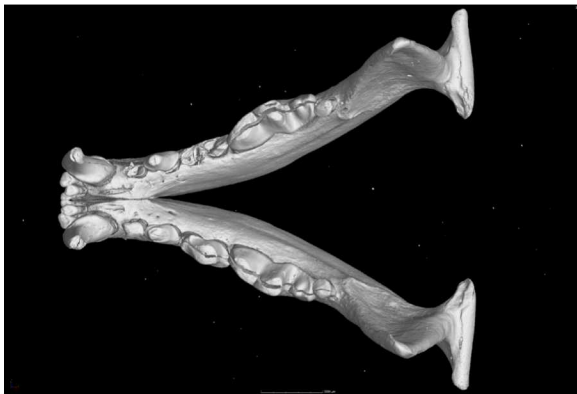
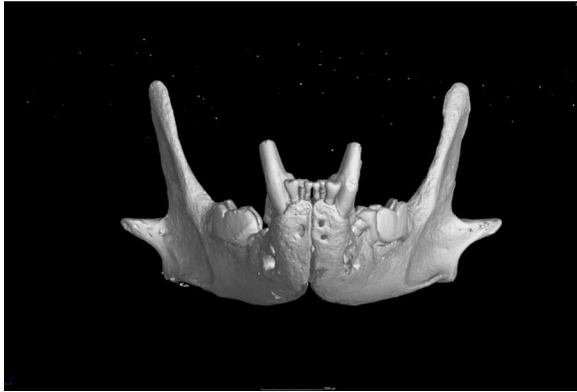


MSB 101203: *Mustela frenata nevadensis*

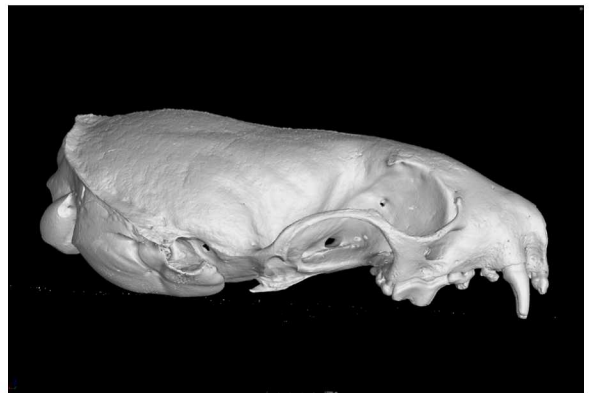
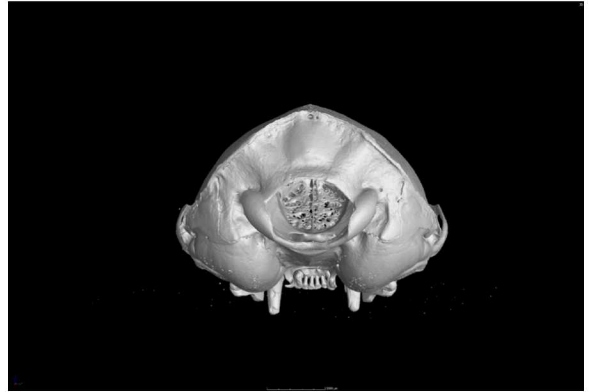
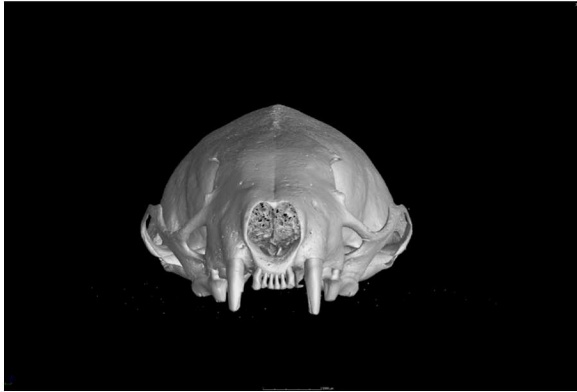
Full: 26 μ m resolution



Skull: 26 μ m resolution

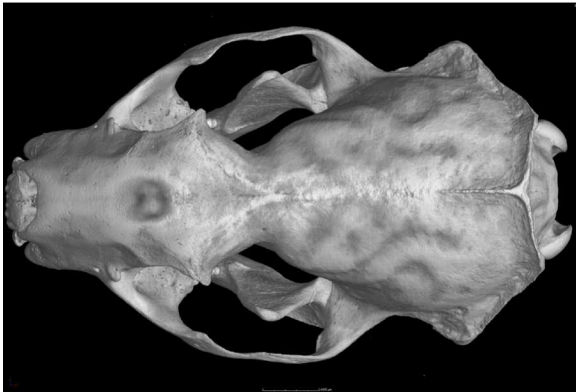
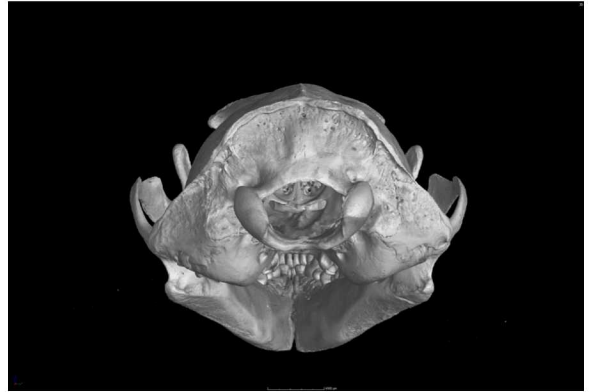
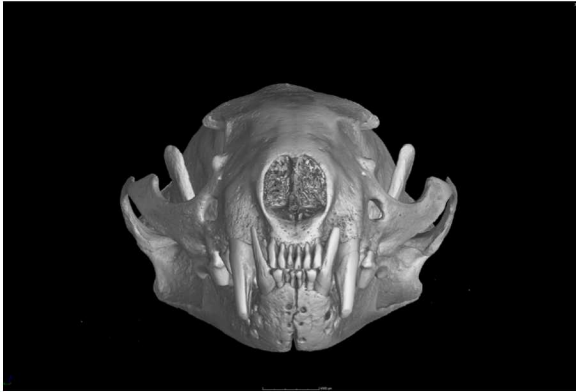


Jaw: 26 μ m resolution

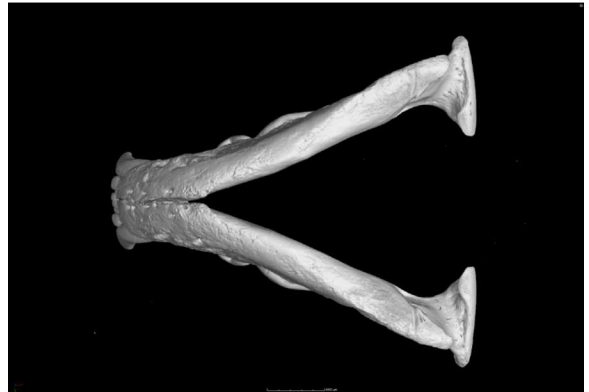
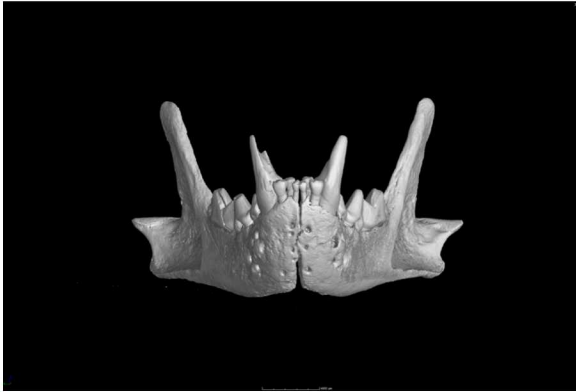


MSB 113497: *Mustela nigripes*

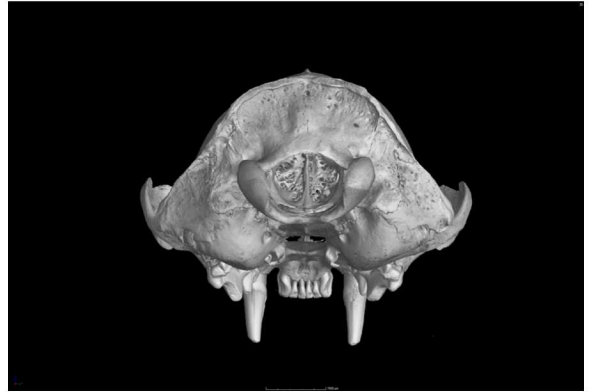
Full: 40 μ m resolution



Skull: 40 μ m resolution

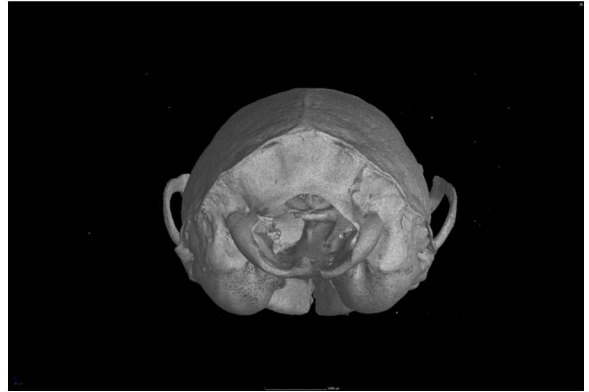
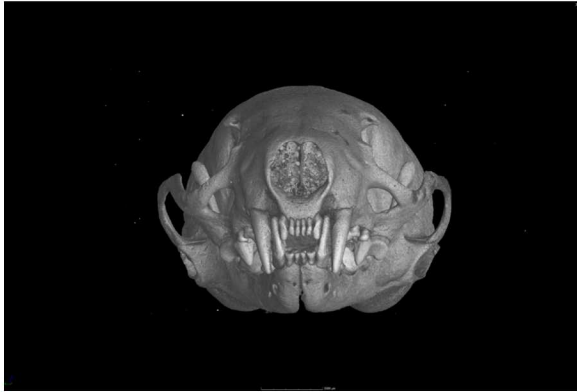


Jaw: 40 μ m resolution



MSB 104648: *Mustela nivalis rixosa*

Full: 20 μ m resolution



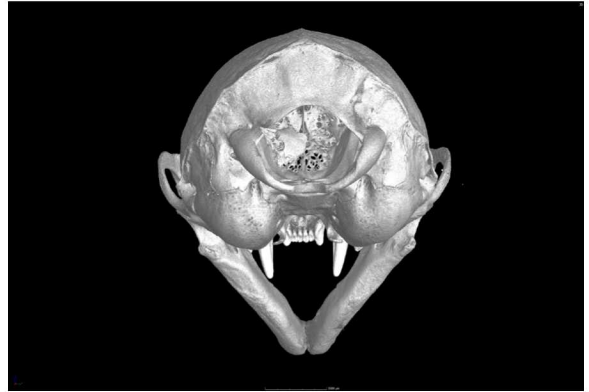
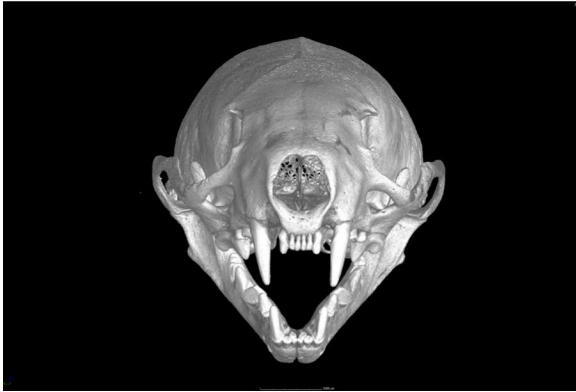
Skull: 20 μ m resolution



Jaw: 20 μ m resolution

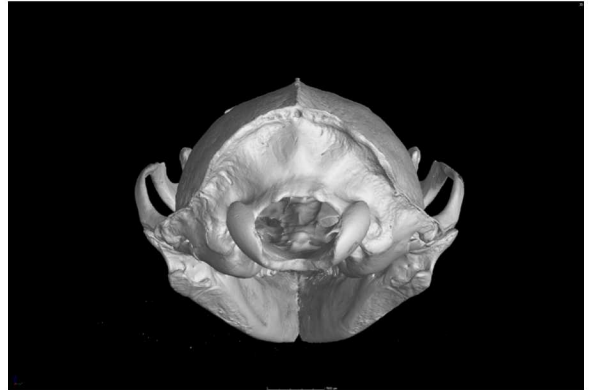


Full Open: 20 μ m resolution

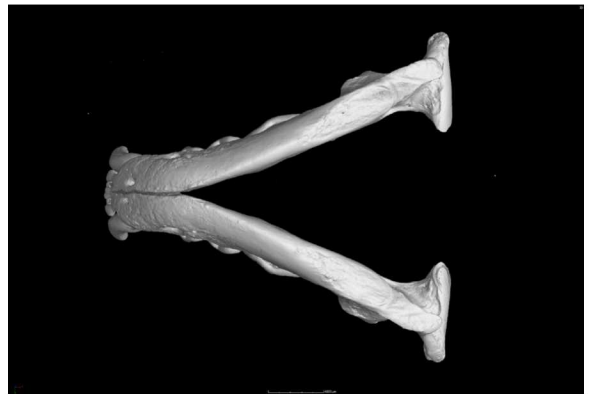
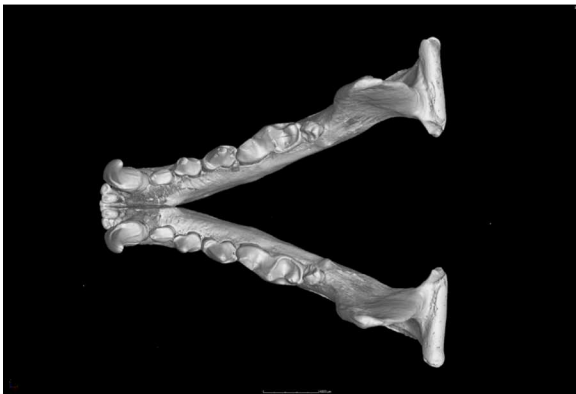
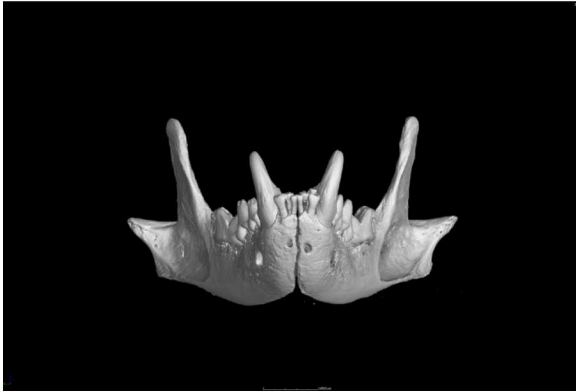


MSB 143835: *Neovison vison*

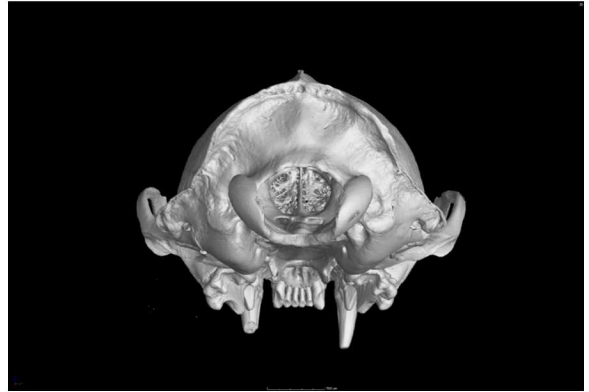
Full: 40 μ m resolution



Skull: 40 μ m resolution

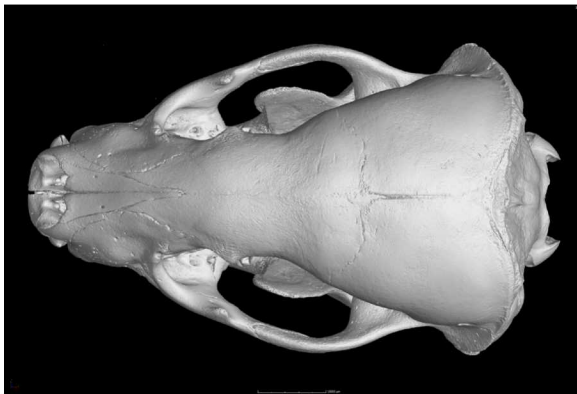
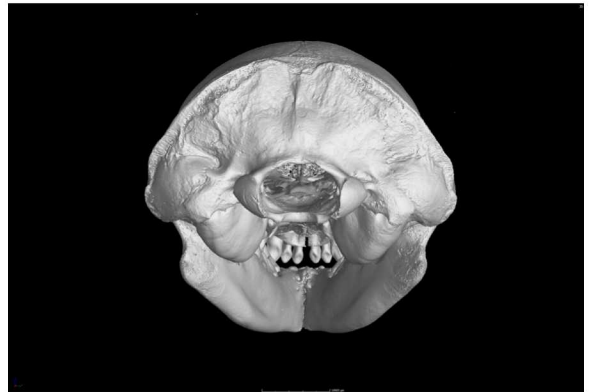


Jaw: 40 μ m resolution

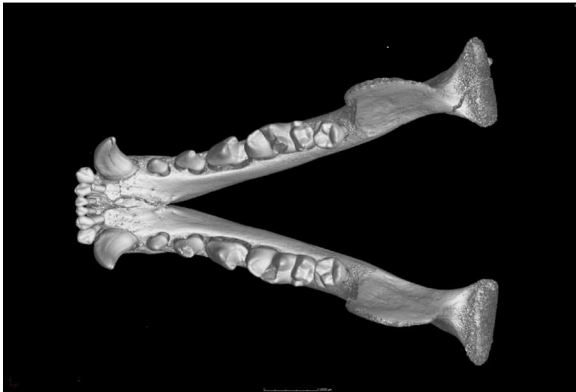
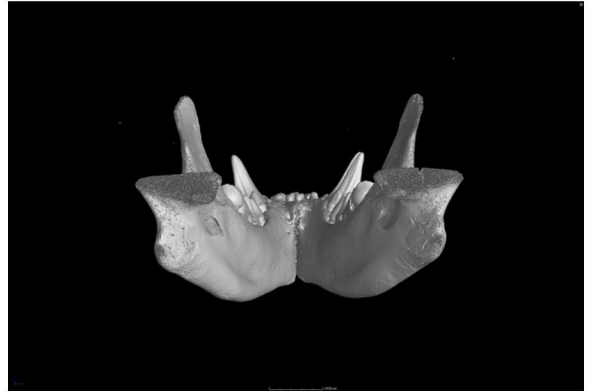
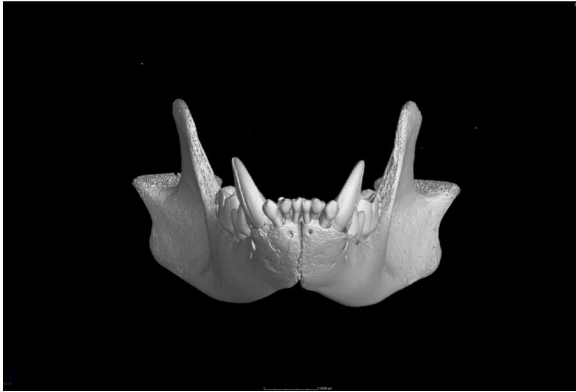


MSB 214951: *Taxidea taxus*

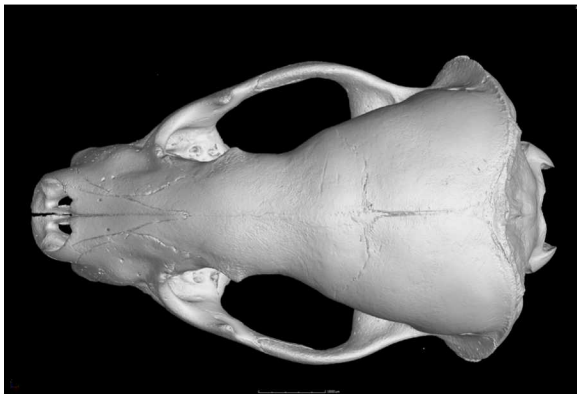
Full: 70 μ m resolution



Skull: 70 μ m resolution

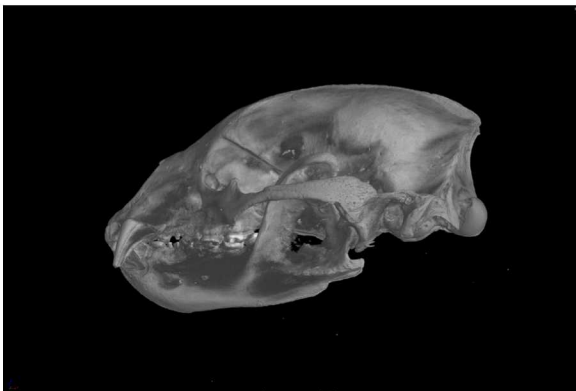
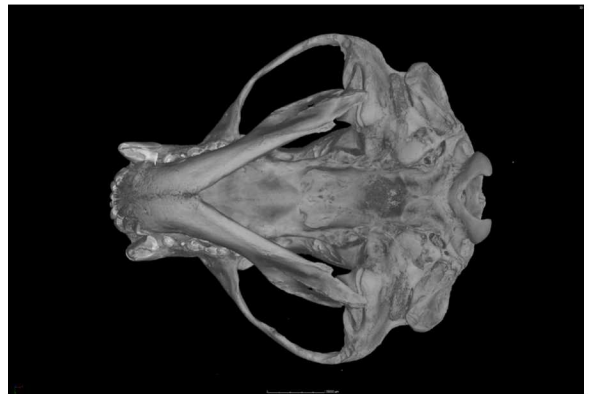
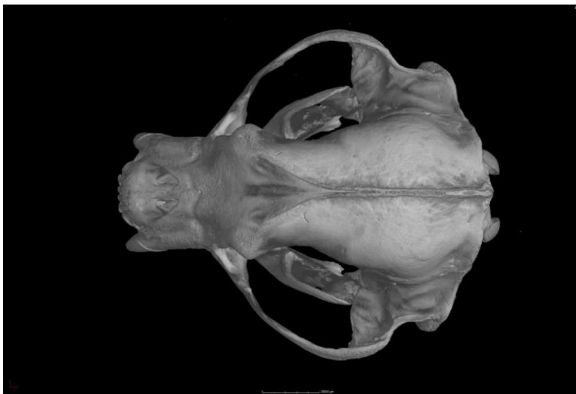


Jaw: 70 μ m resolution

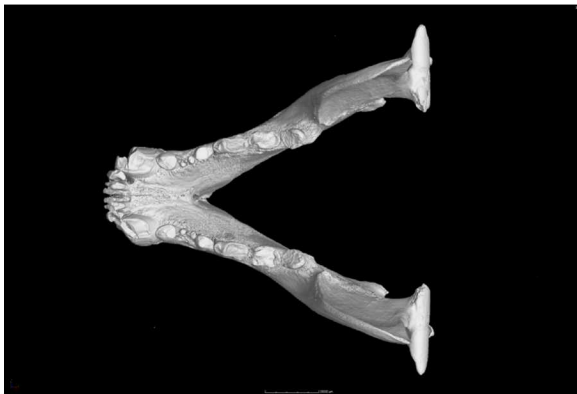
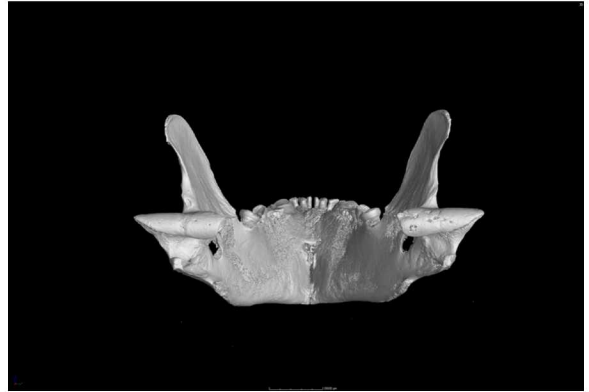


MSB 58965: *Helarctos malayanus*

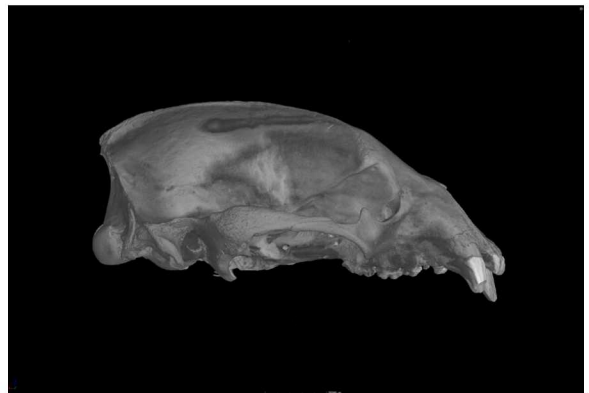
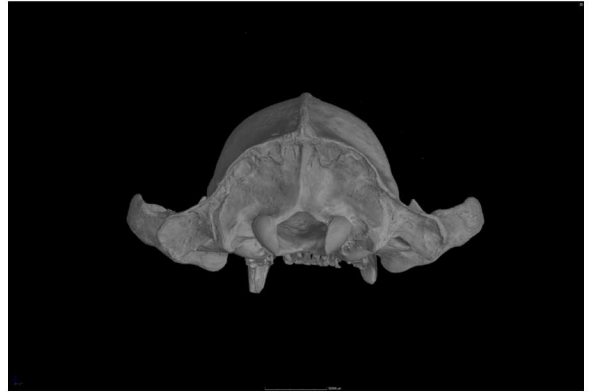
Full: 140 μ m resolution



Skull: 130 μ m resolution

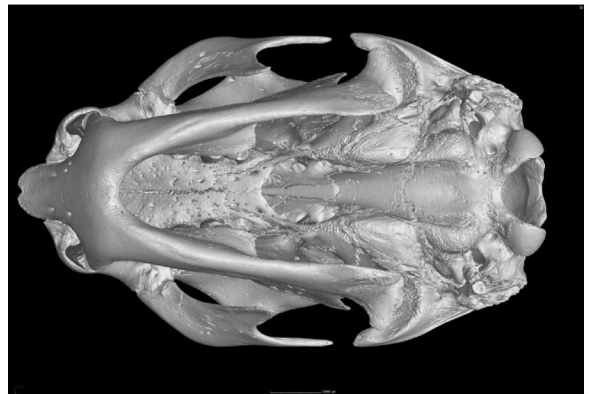
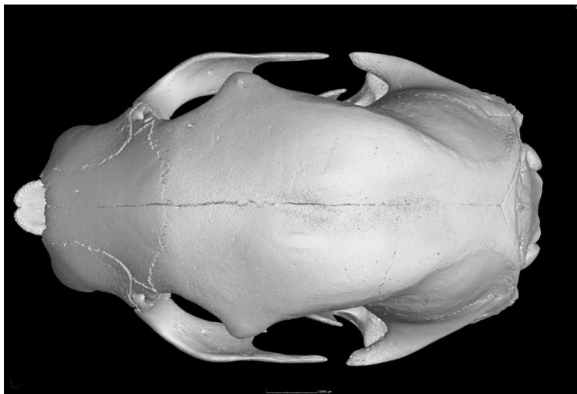
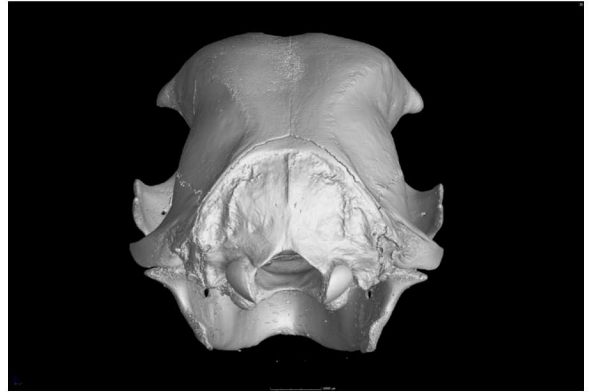
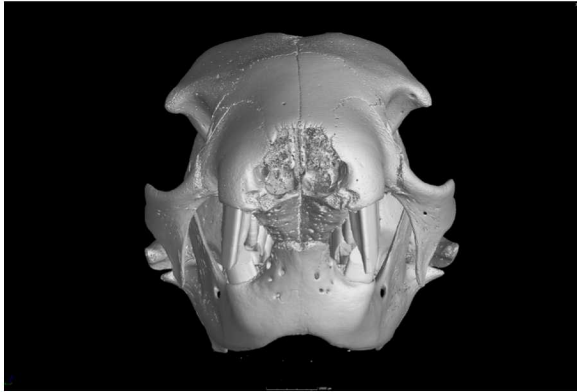


Jaw: 130 μ m resolution

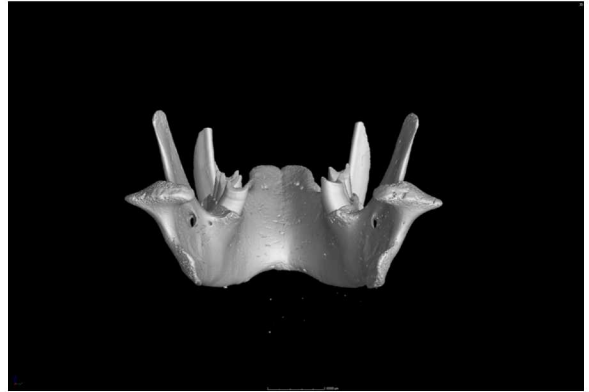
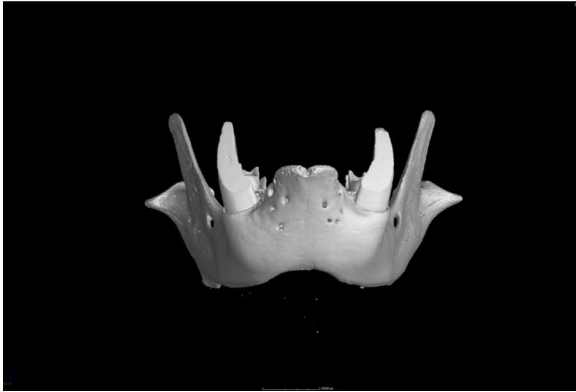


MSB 29177: *Choloepus hoffmanni*

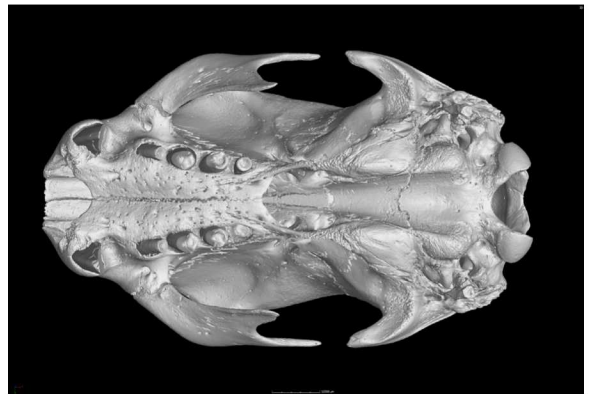
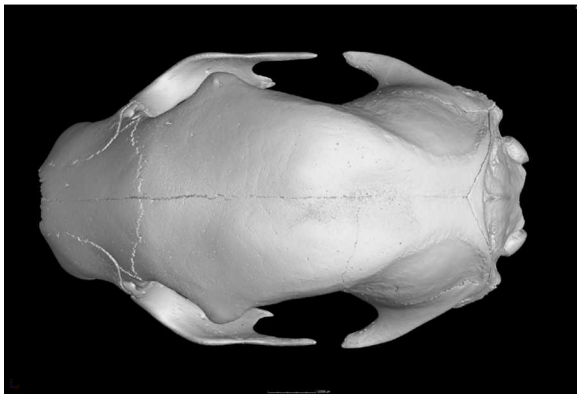
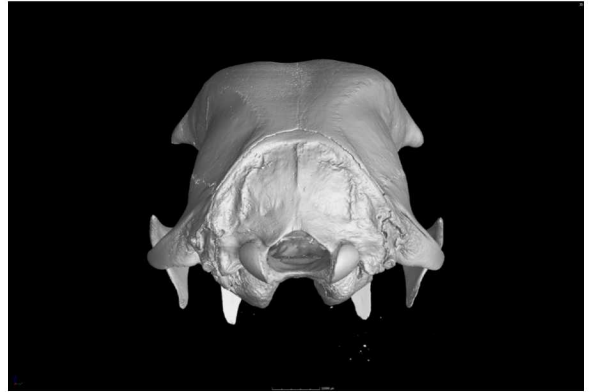
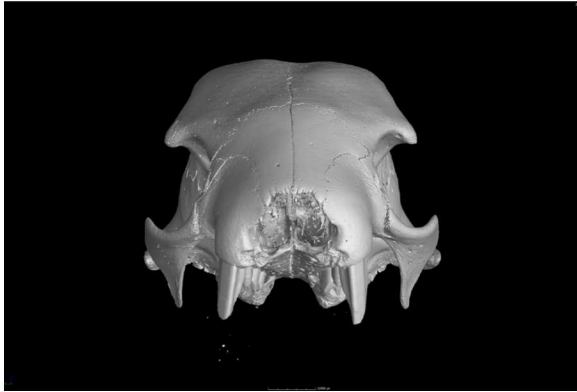
Full: 60 μ m resolution



Skull: 60 μ m resolution



Jaw: 60 μ m resolution

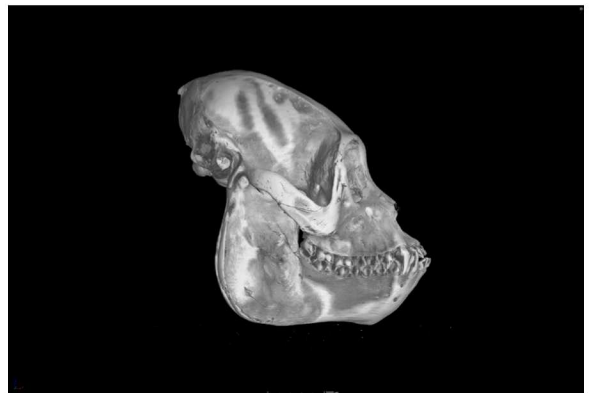
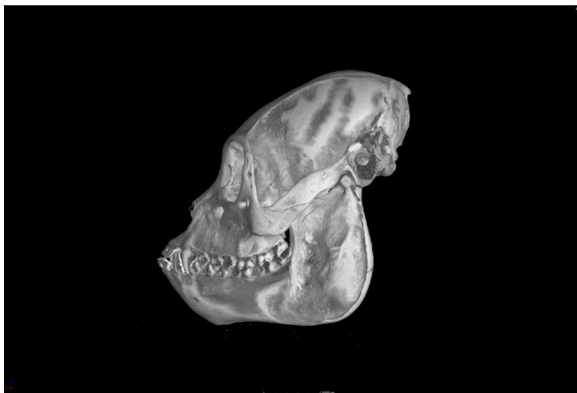
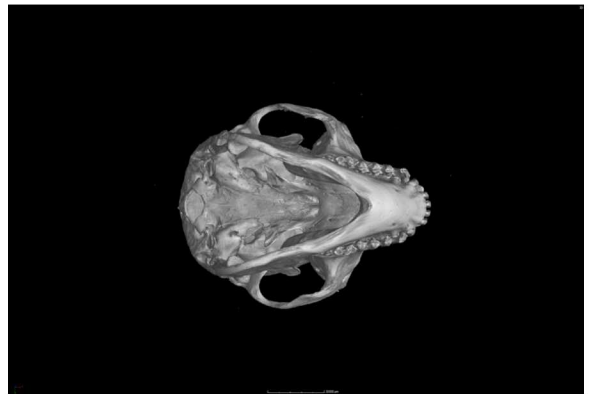
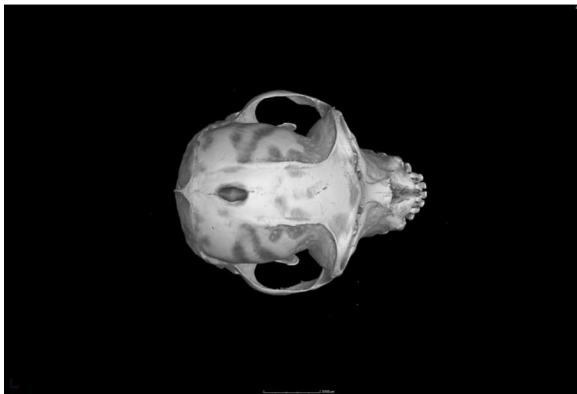
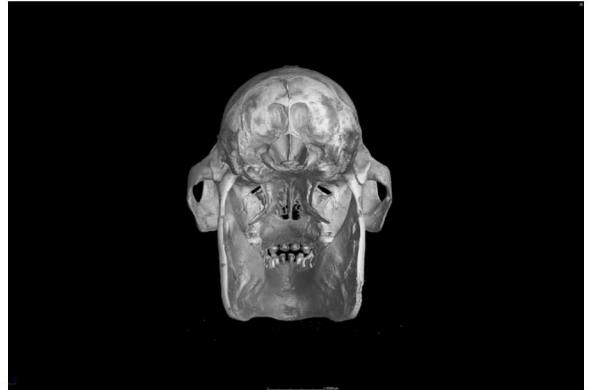


Claw: 30 μ m resolution

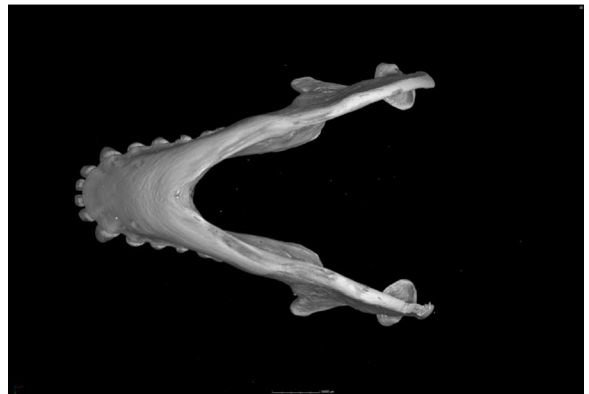
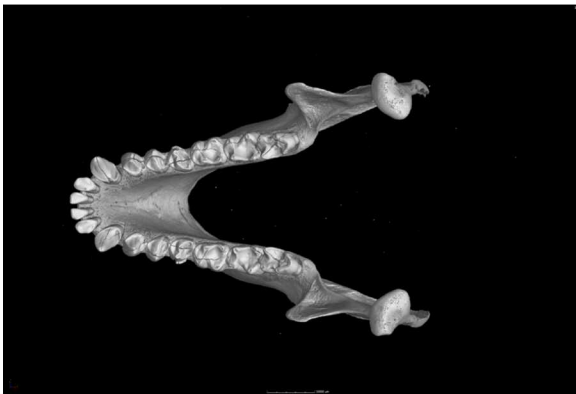


MSB 34967: *Alouatta palliata palliata*

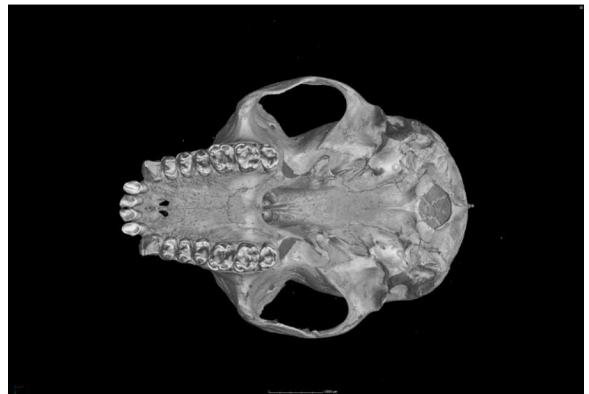
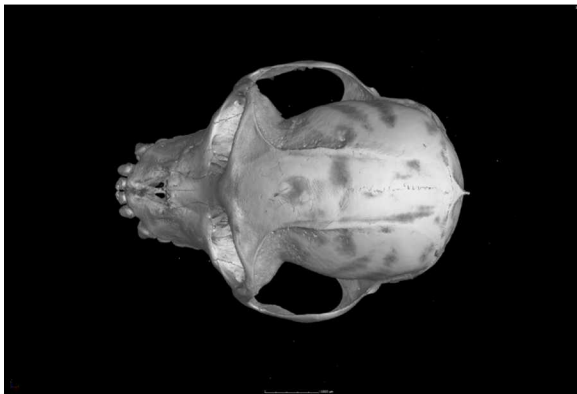
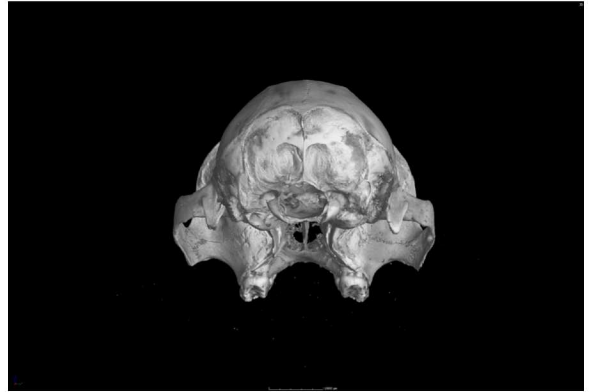
Full: 60 μ m resolution



Skull: 60 μ m resolution



Jaw: 60 μ m resolution

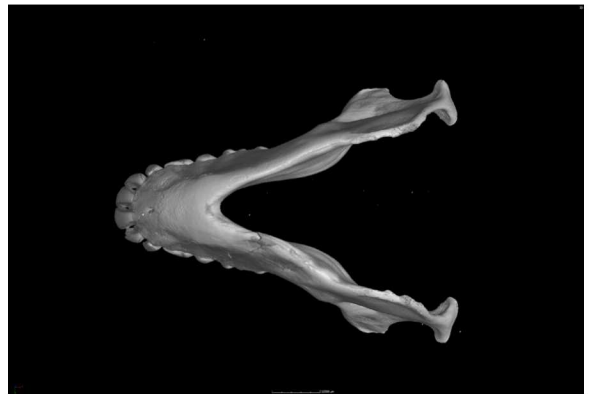
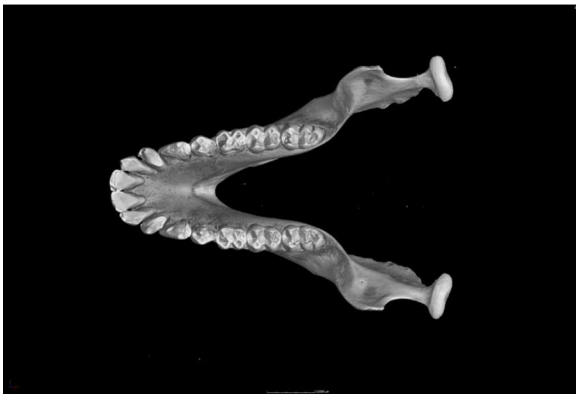
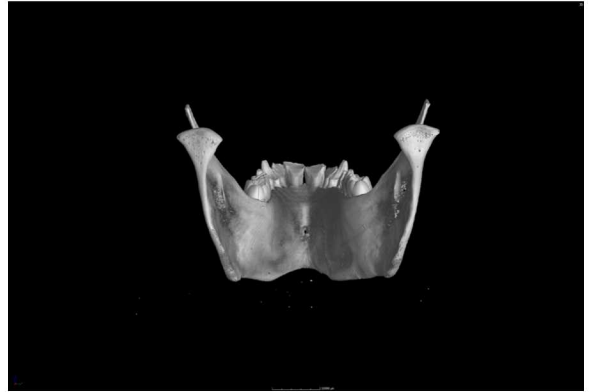
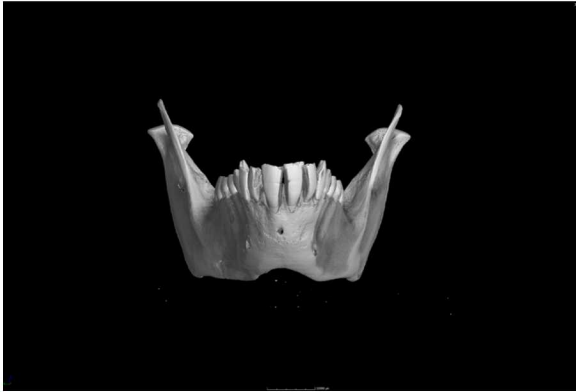


MSB 11088: *Macaca mulatta*

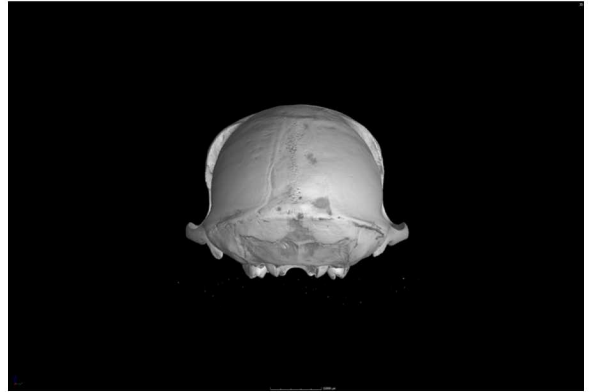
Full: 60 μ m resolution



Skull: 60 μ m resolution

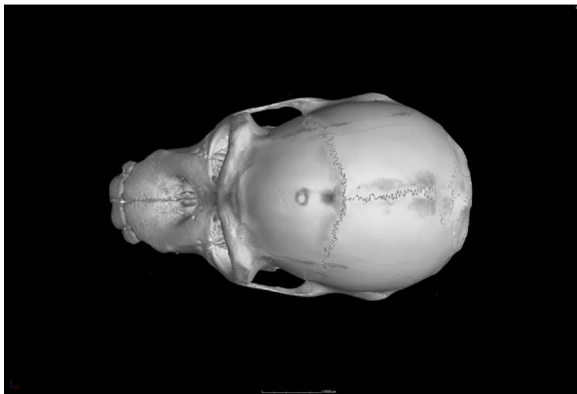
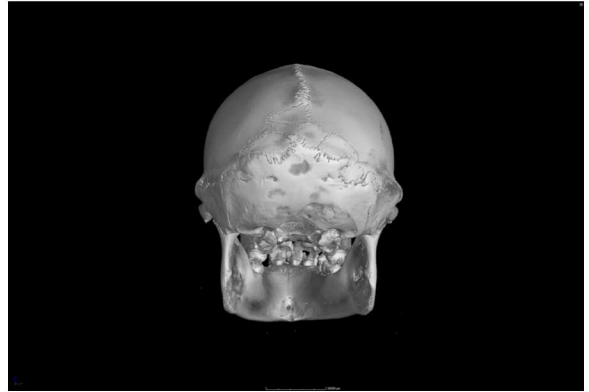


Jaw: 60 μ m resolution

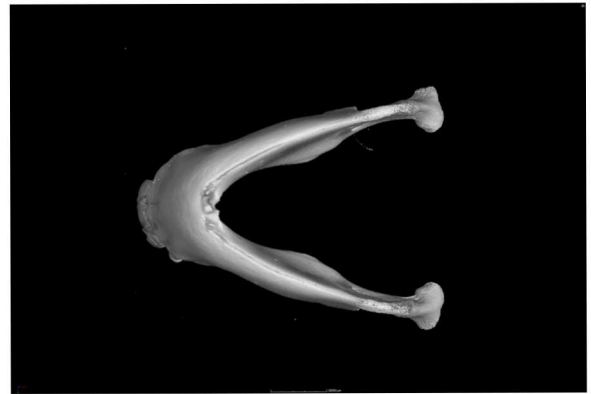
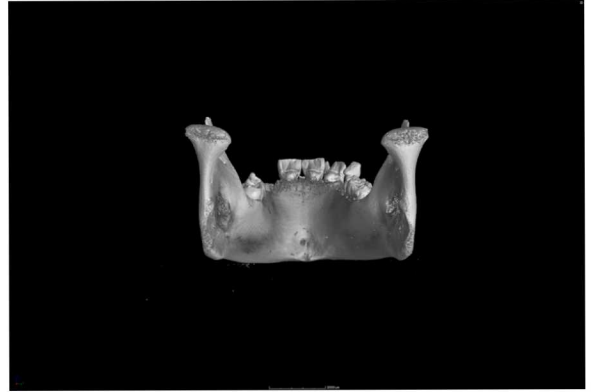
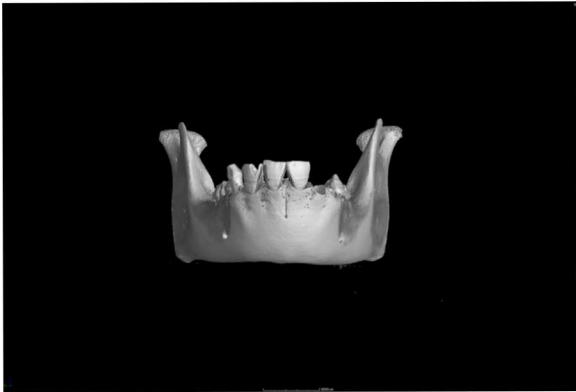


MSB 30673: *Pan troglodytes*

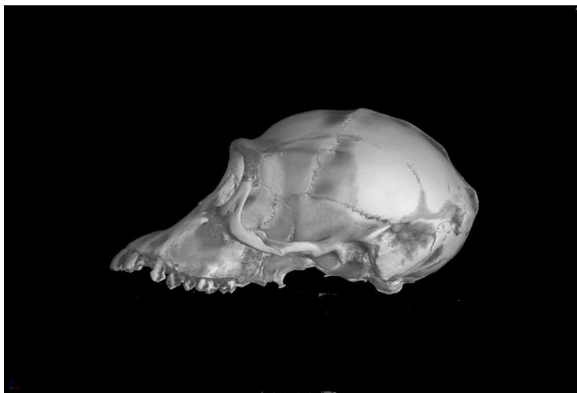
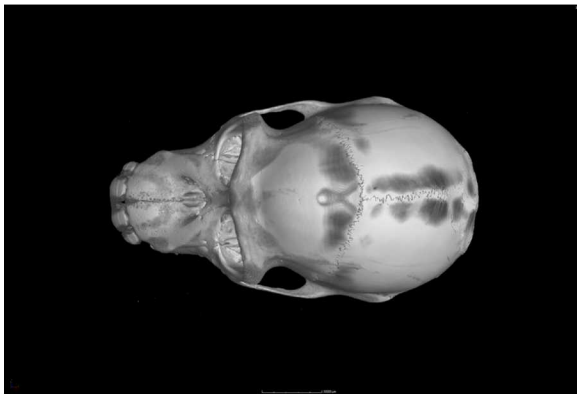
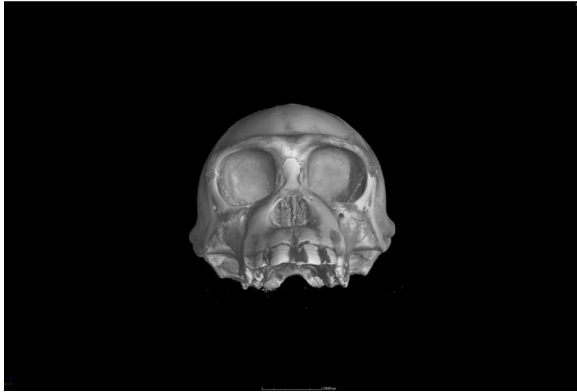
Full: 105.61 μm resolution



Skull: 105.61 μm resolution

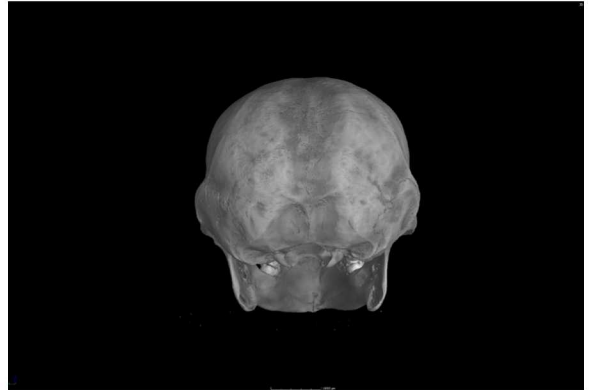


Jaw: 105.61 μm resolution

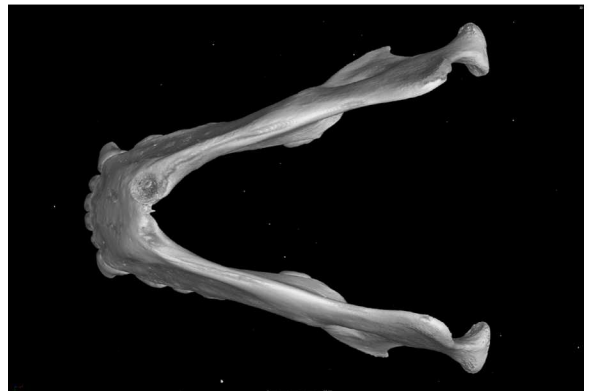
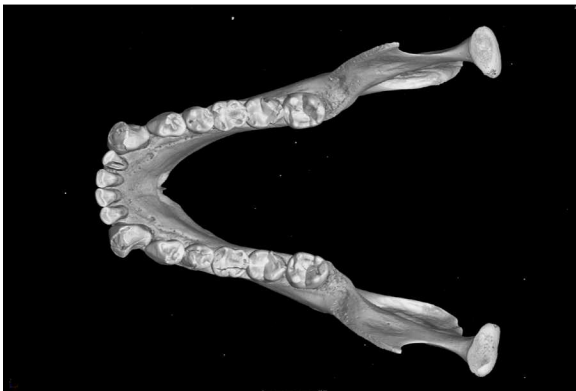
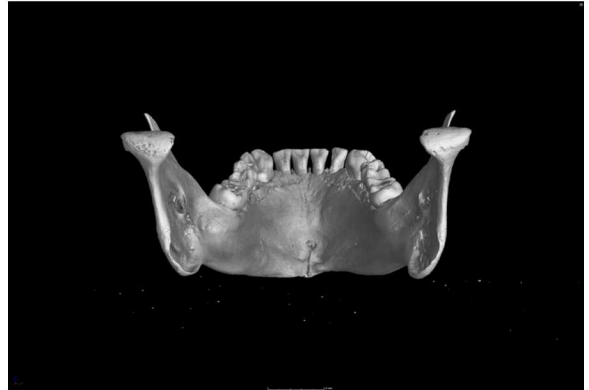


MSB 23437: *Hylobates iar*

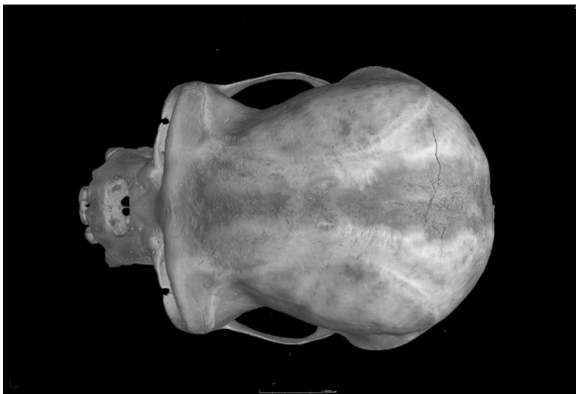
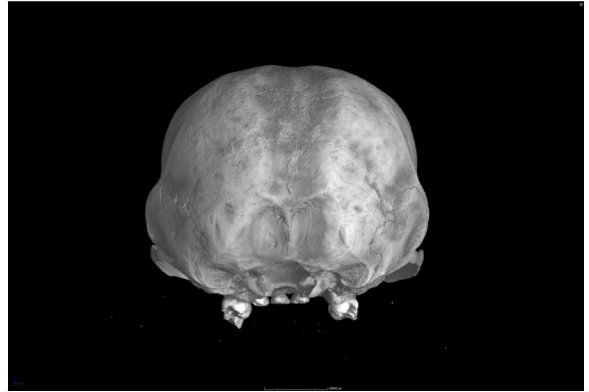
Full: 60 μ m resolution



Skull: 60 μ m resolution



Jaw: 60 μ m resolution

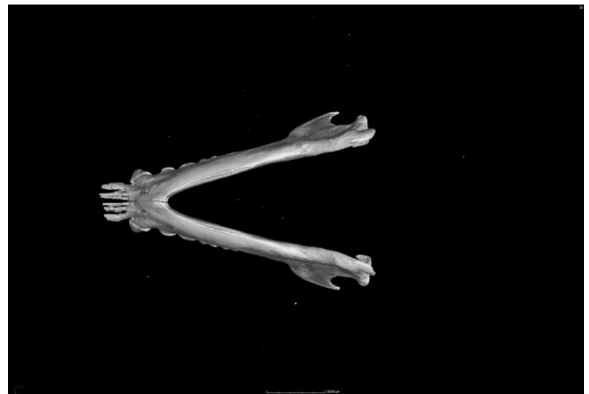
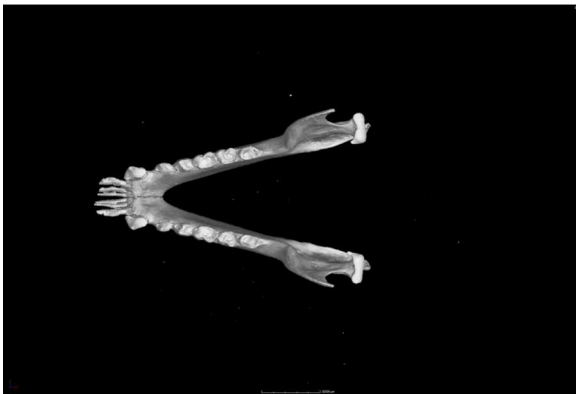
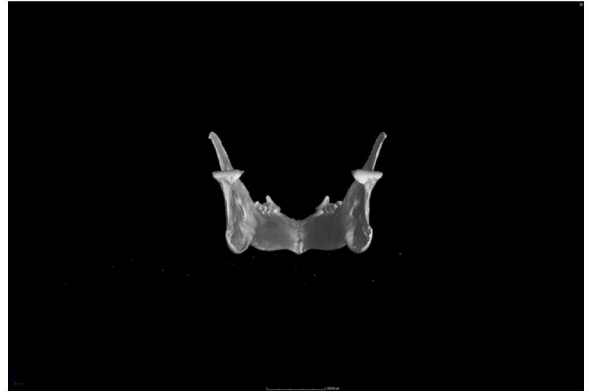
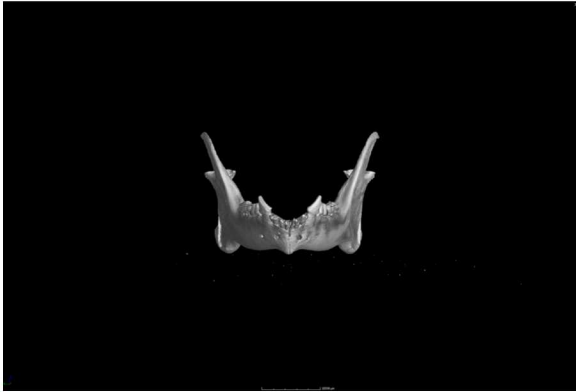


MSB 142900: *Lemur mococo*

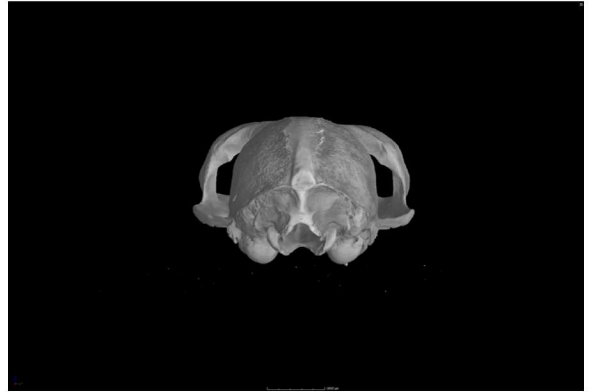
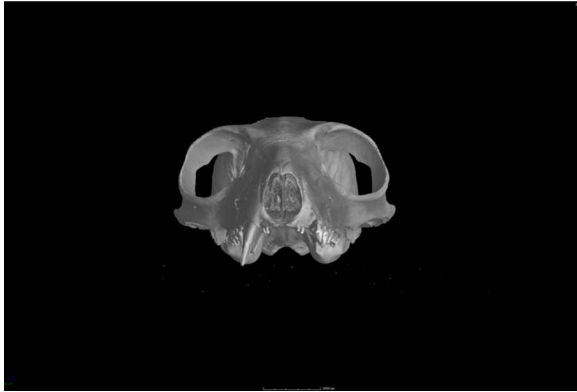
Full: 60 μ m resolution



Skull: 60 μ m resolution

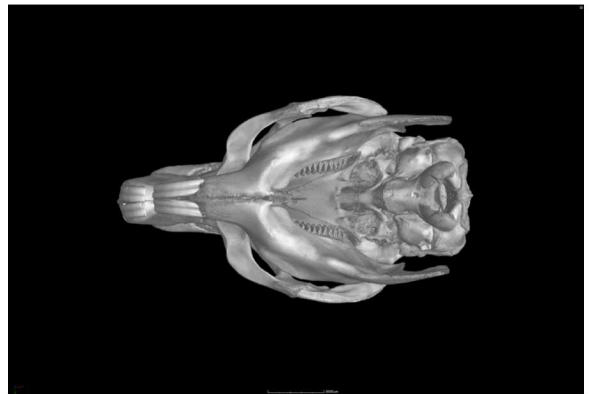
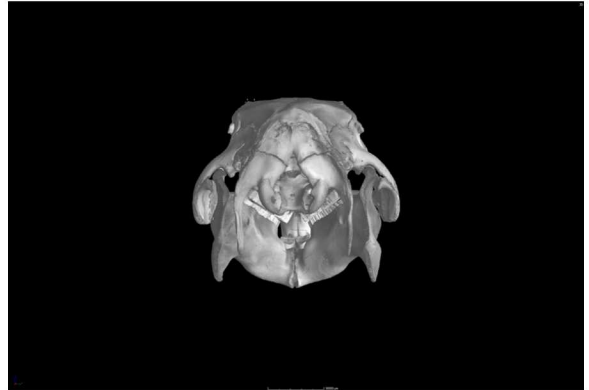
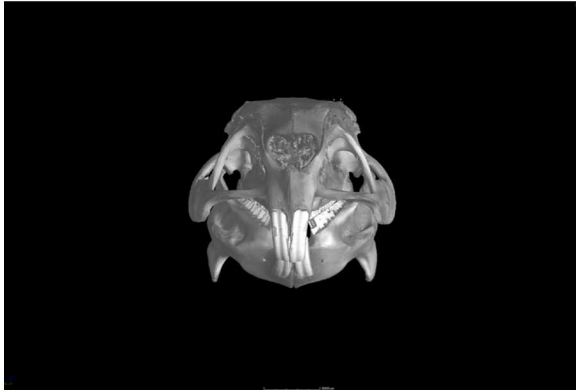


Jaw: 60 μ m resolution

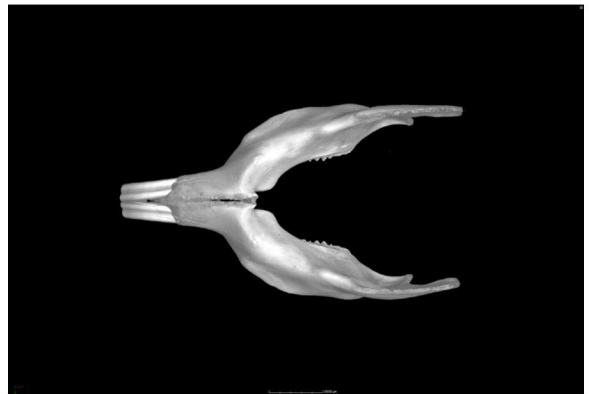
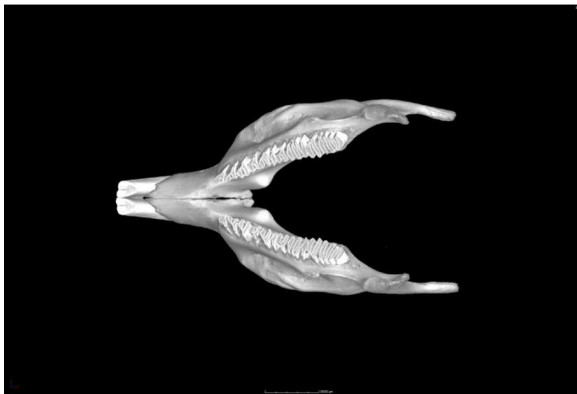
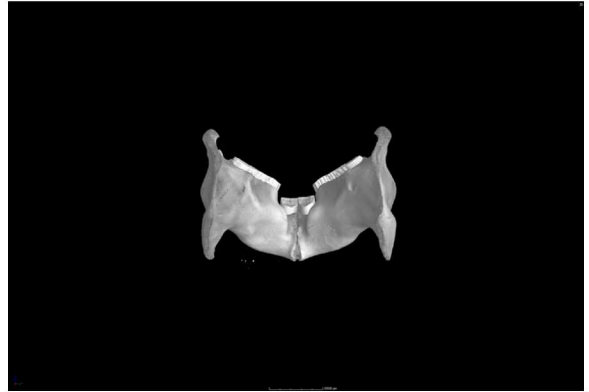
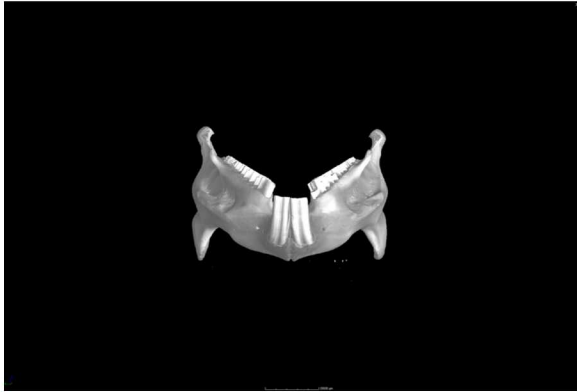


MSB 56081: *Hydrochoerus hydrochaeris*

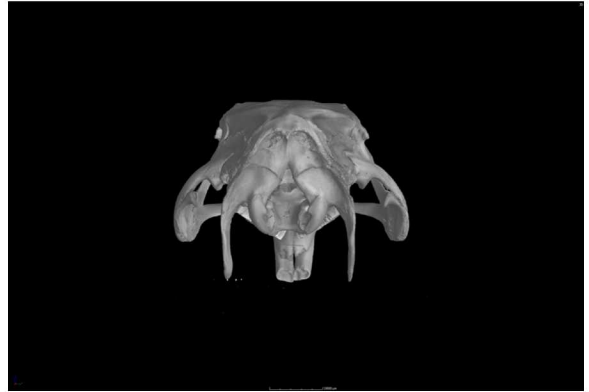
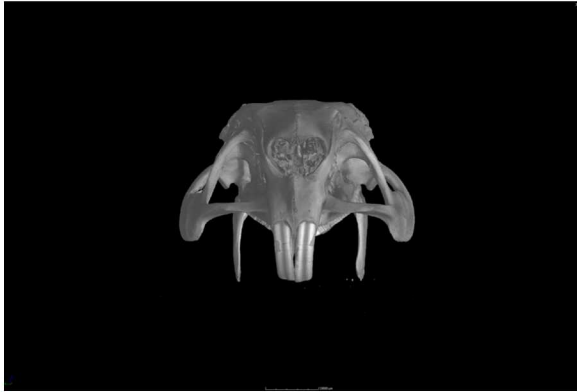
Full: 80 μ m resolution



Skull: 80 μ m resolution

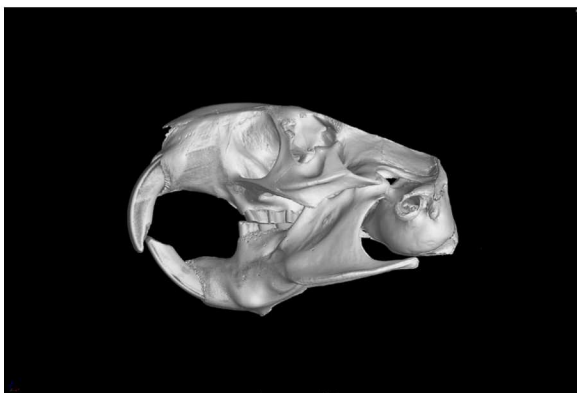
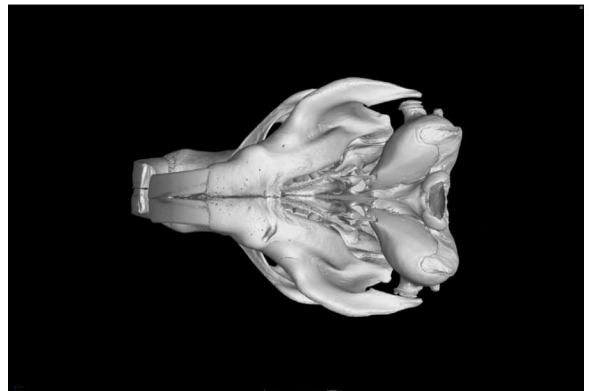
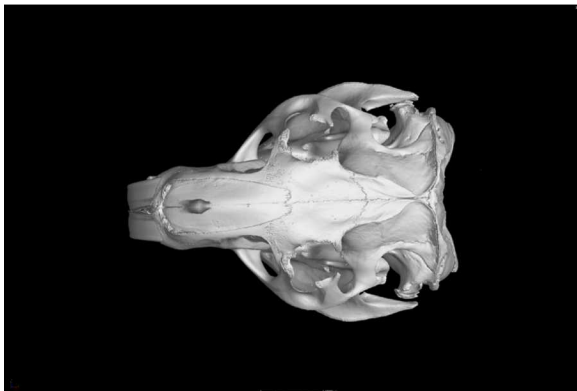
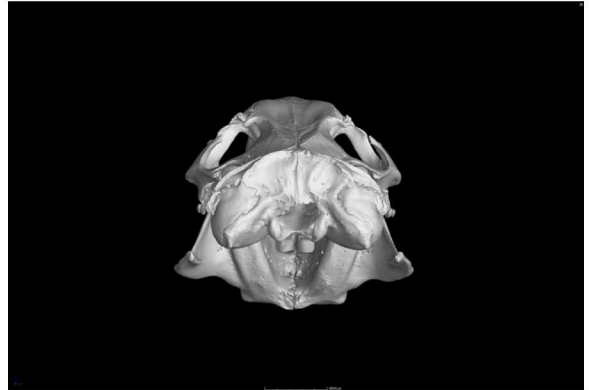
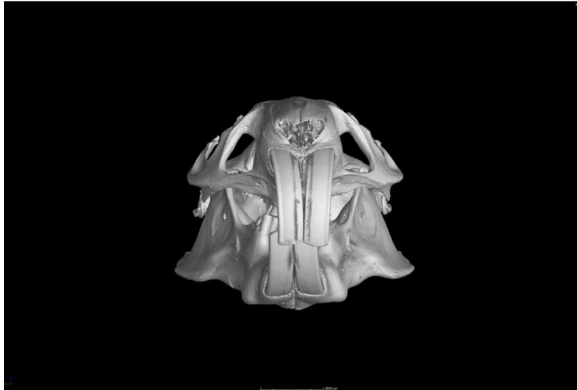


Jaw: 80 μ m resolution

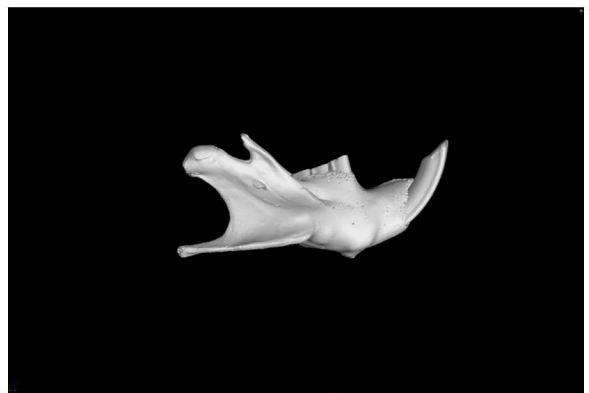
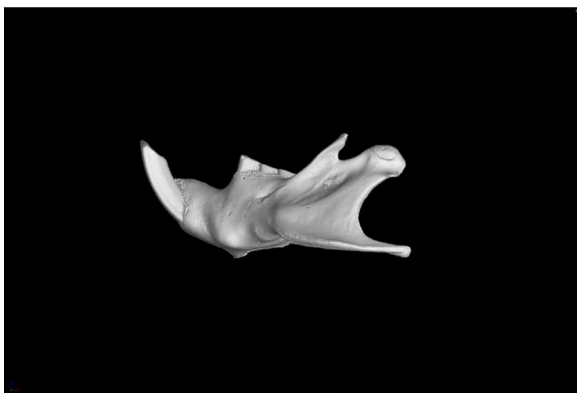
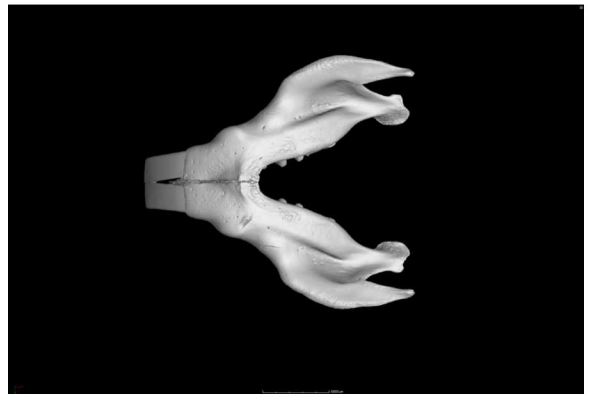
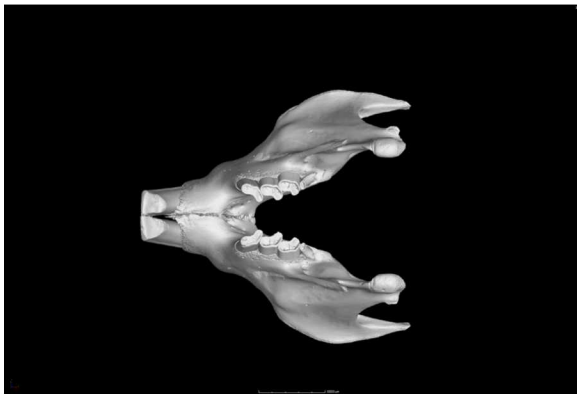
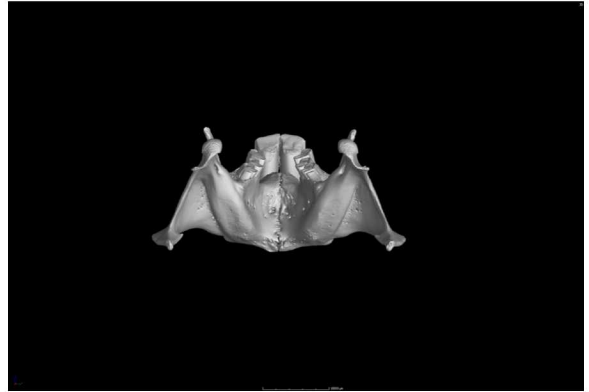
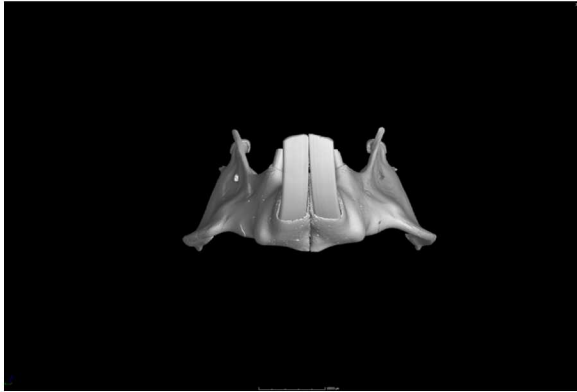


MSB 56088: *Ctenomys conoveri*

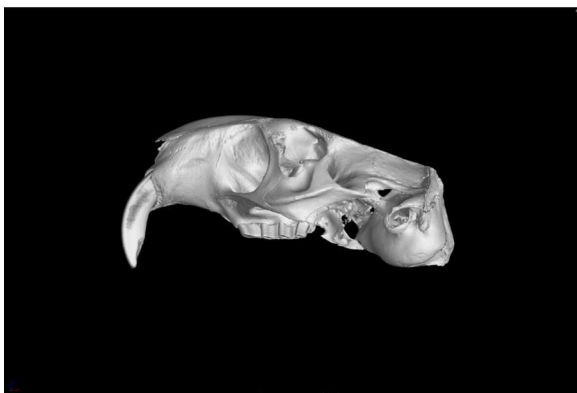
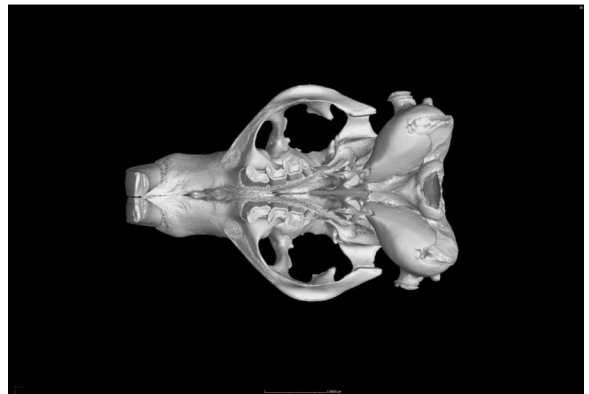
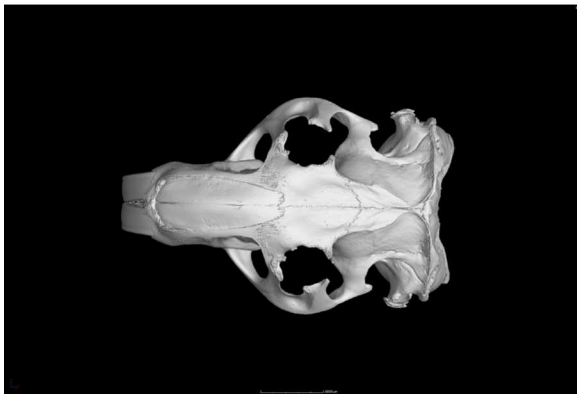
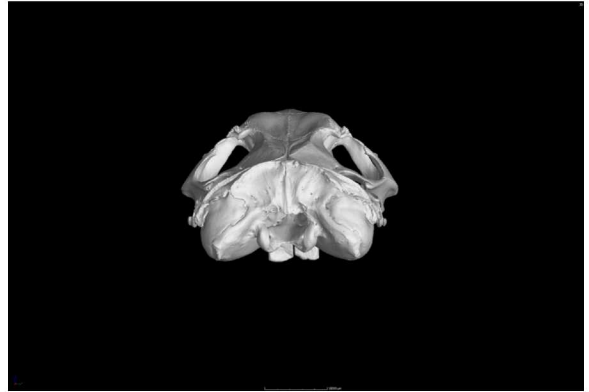
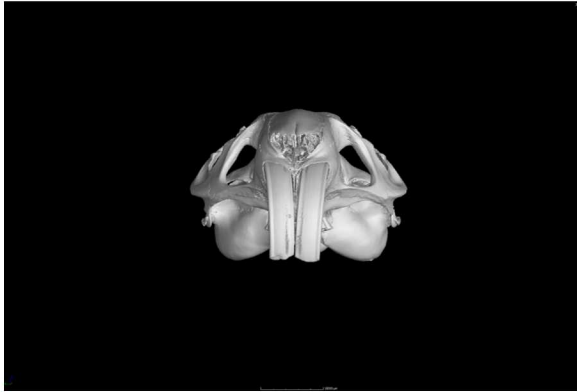
Full: 50 μ m resolution



Skull: 50 μ m resolution

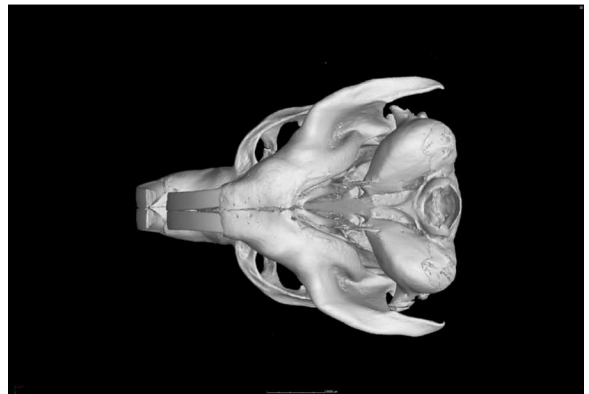
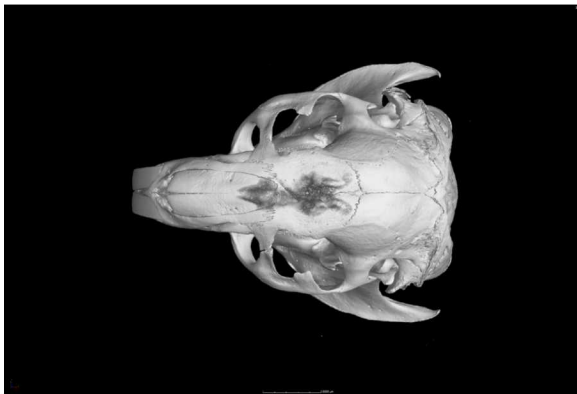
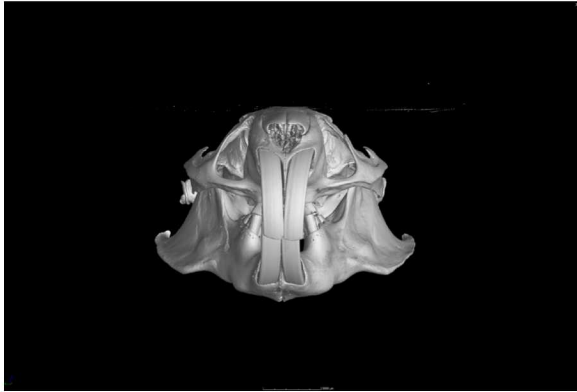


Jaw: 50 μ m resolution

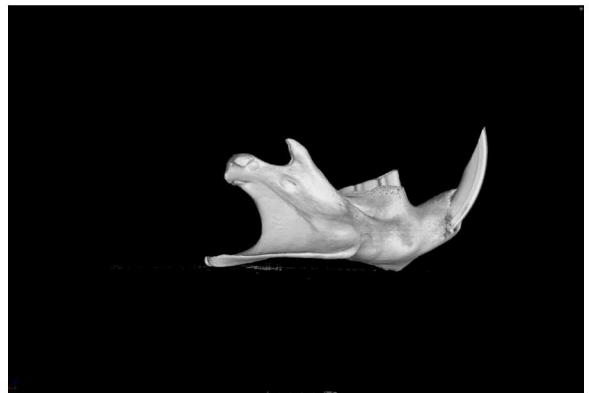
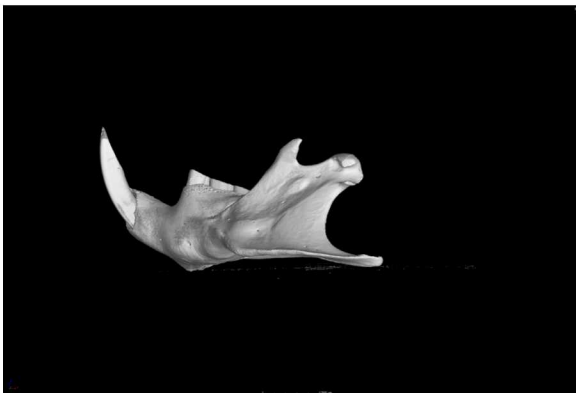
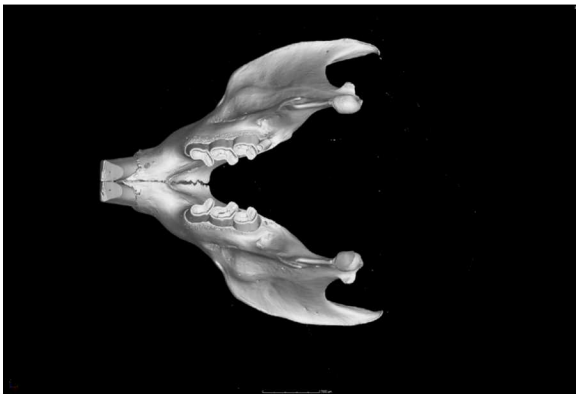
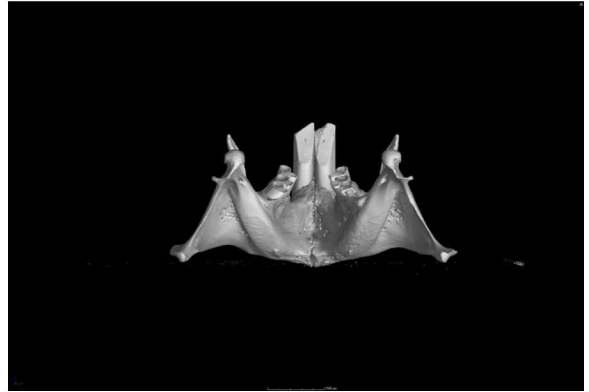
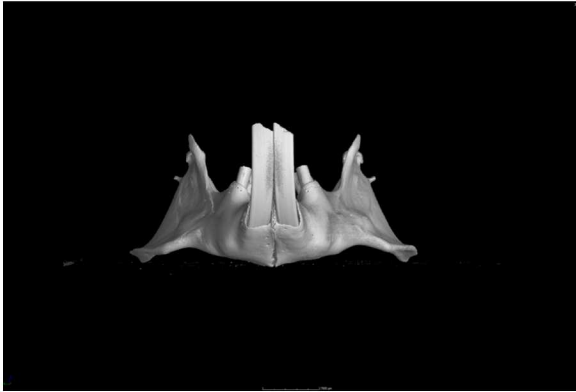


MSB 63381: *Ctenomys erikacuellarae*

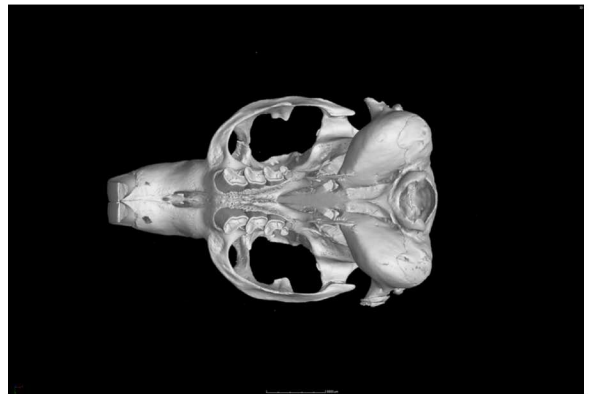
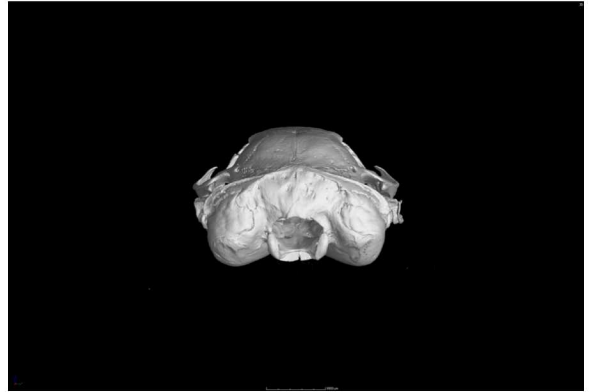
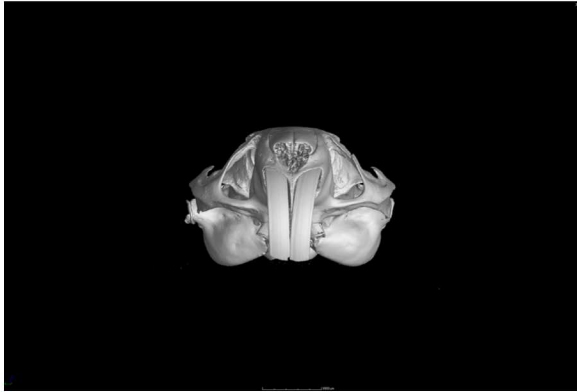
Full: 80 μ m resolution



Skull: 80 μ m resolution

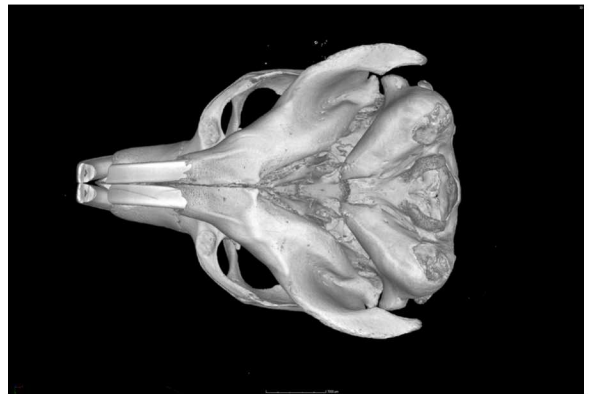
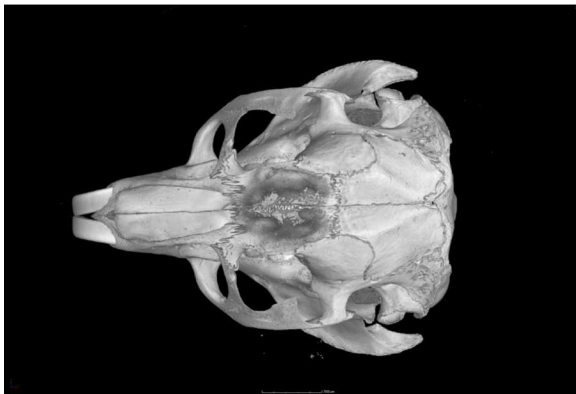
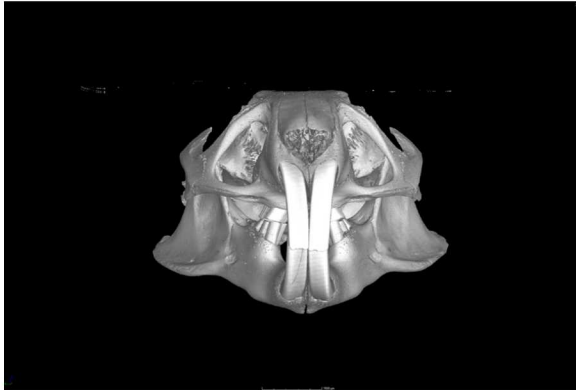


Jaw: 80 μ m resolution



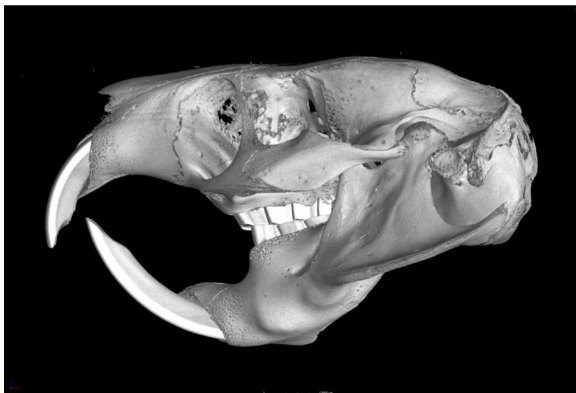
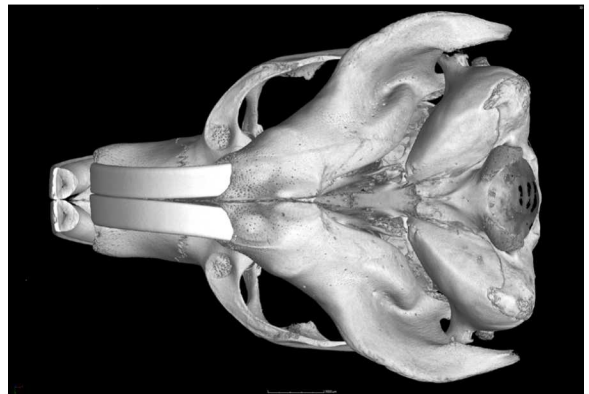
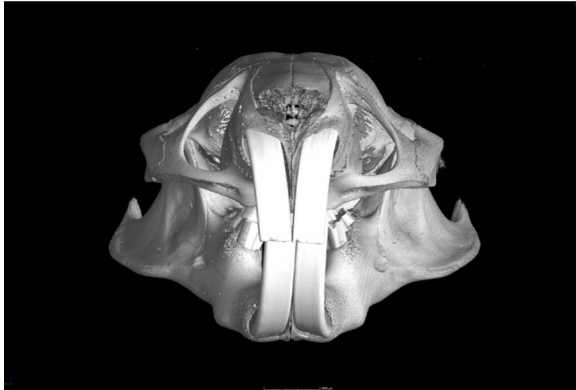
MSB 57192: *Ctenomys leucodon*

Full: 30 μ m resolution



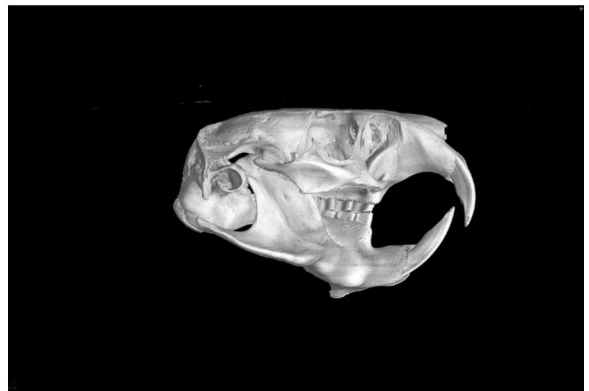
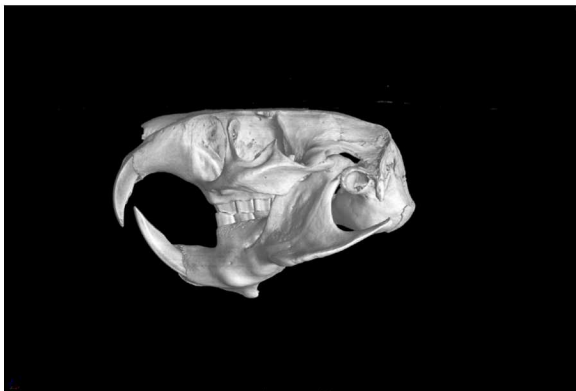
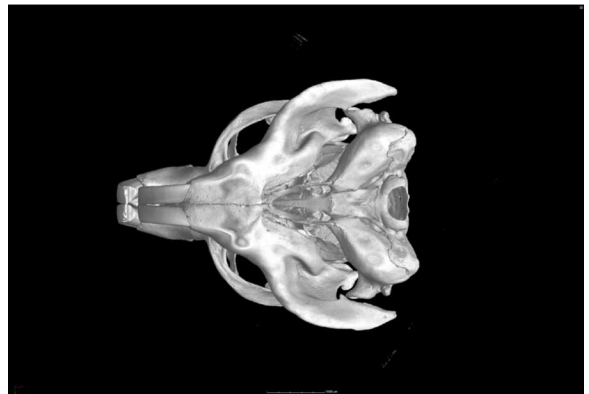
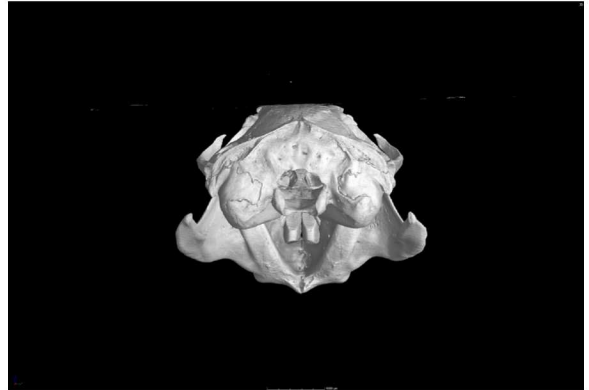
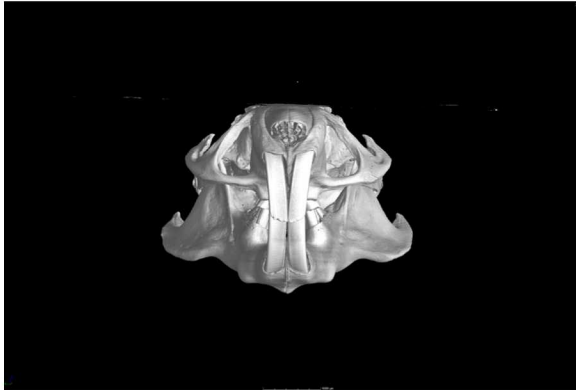
MSB 57186: *Ctenomys lewisi*

Full: 30 μ m resolution

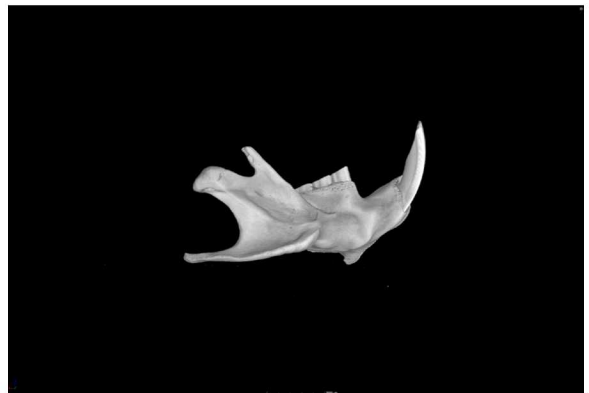
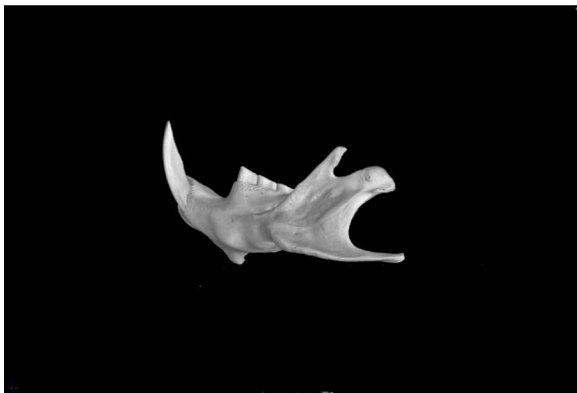
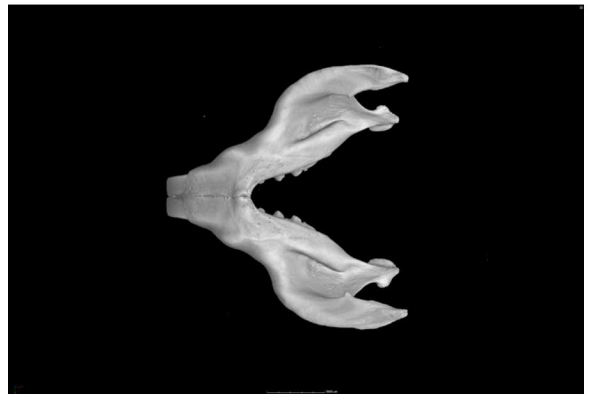
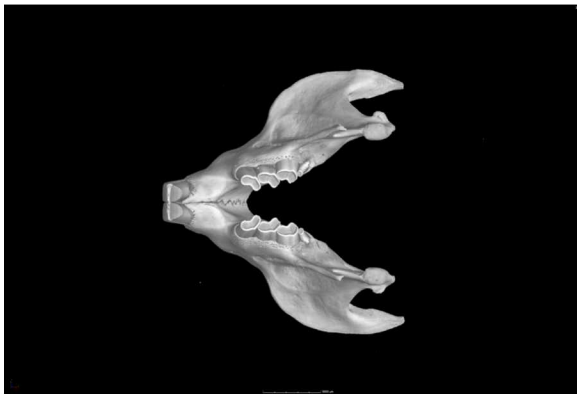
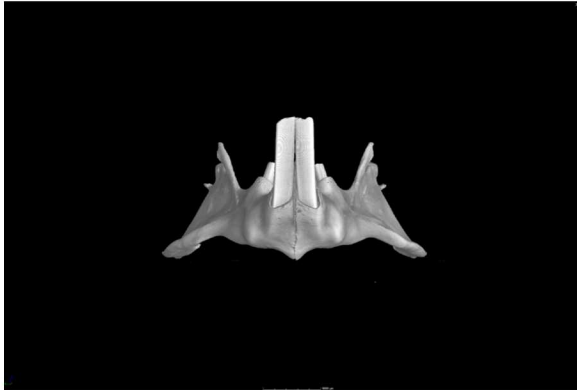


MSB 55360: *Ctenomys nattereri*

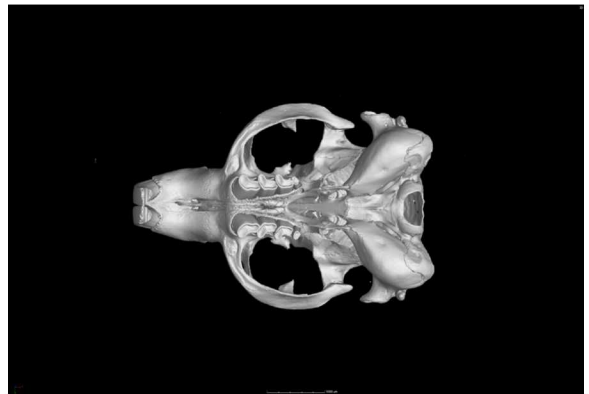
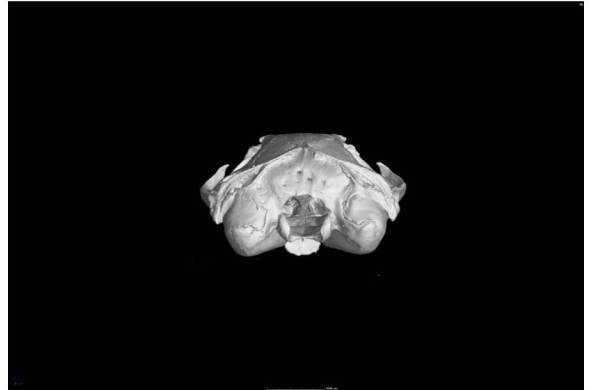
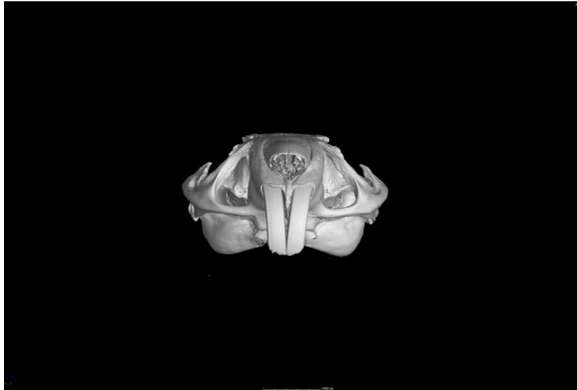
Full: 50 μ m resolution



Skull: 50 μ m resolution

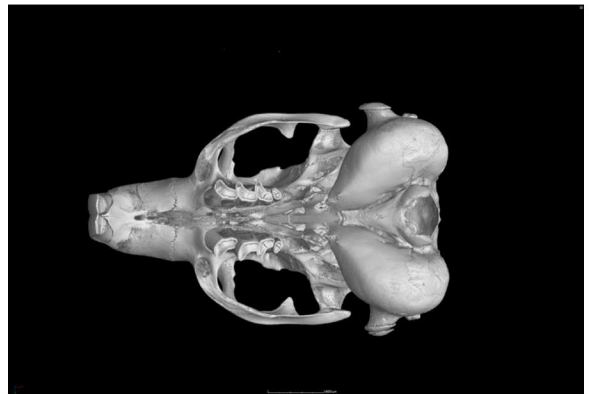
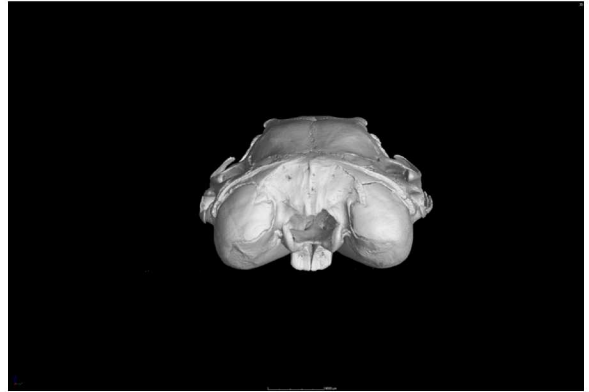
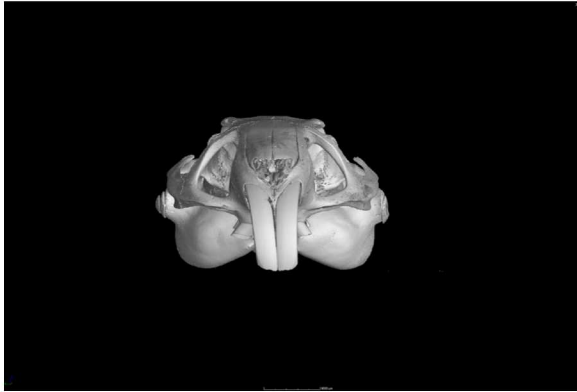


Jaw: 50 μ m resolution

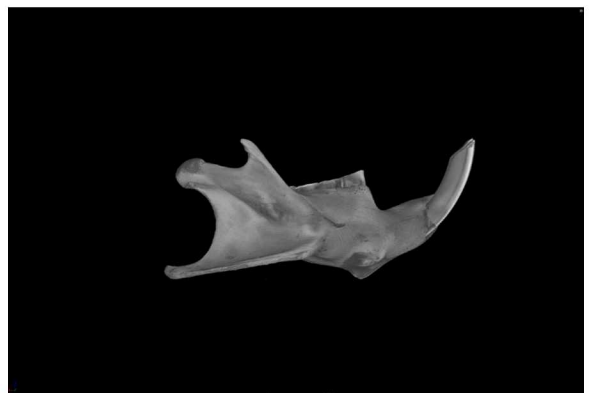
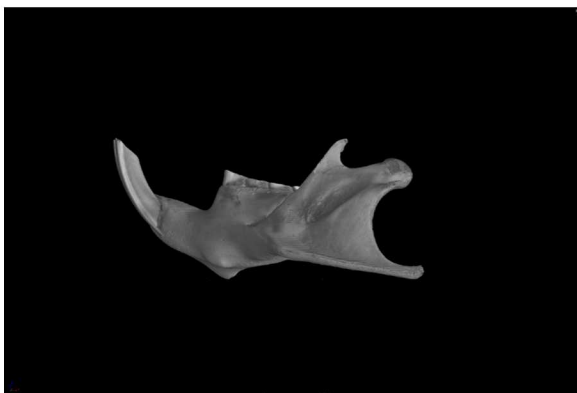
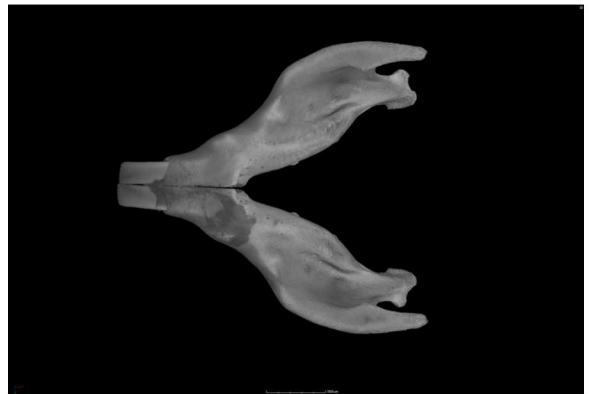
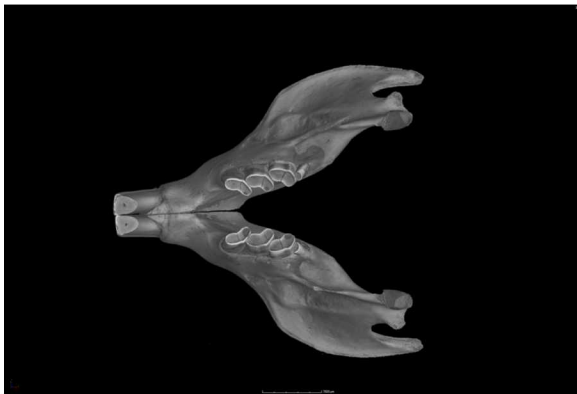
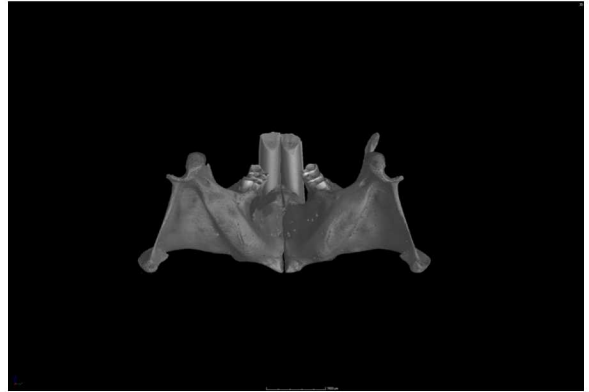
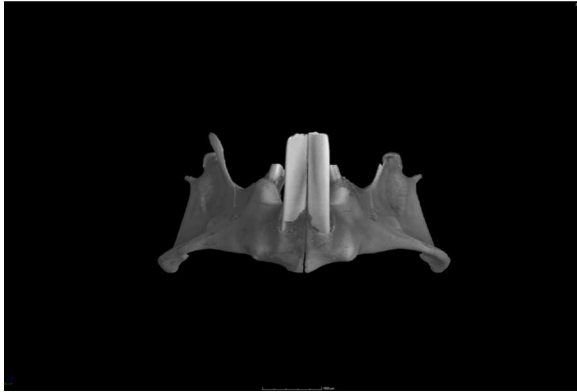


MSB 55373: *Ctenomys opimus opimus*

Skull: 30 μ m resolution

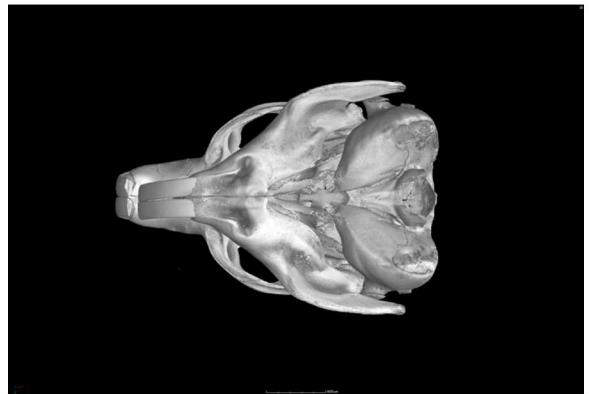
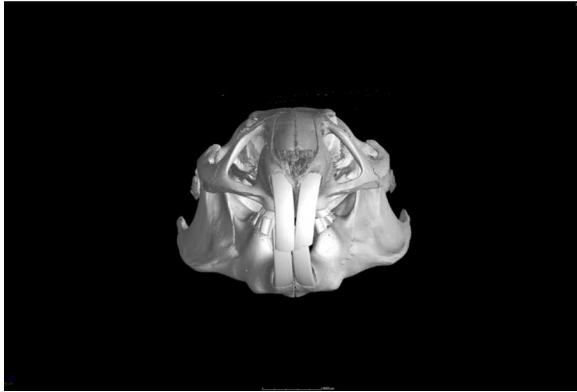


NA: NA μm resolution

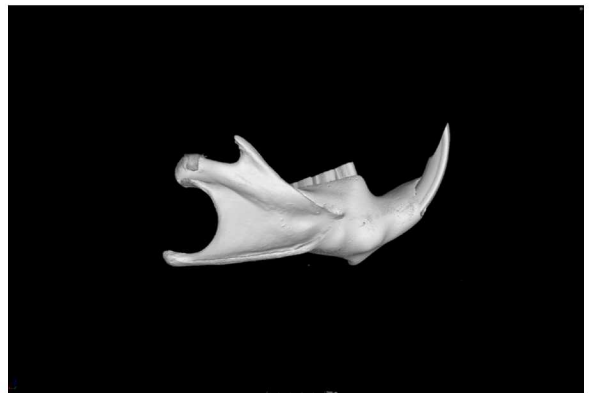
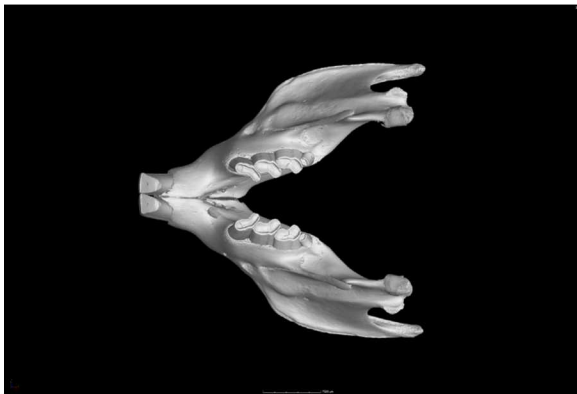
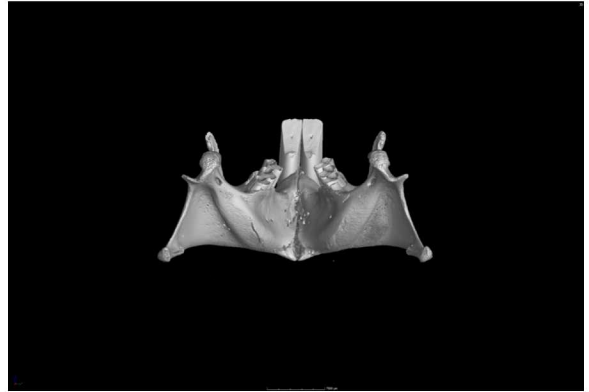
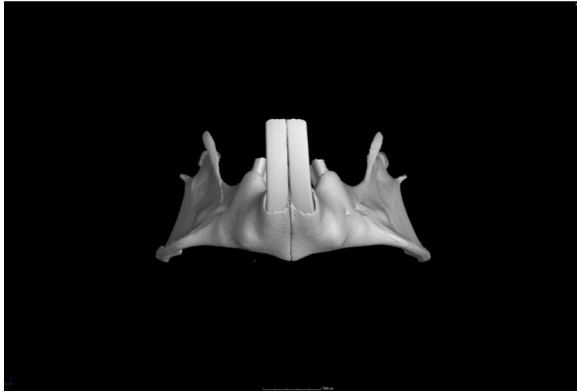


MSB 55376: *Ctenomys opimus opimus*

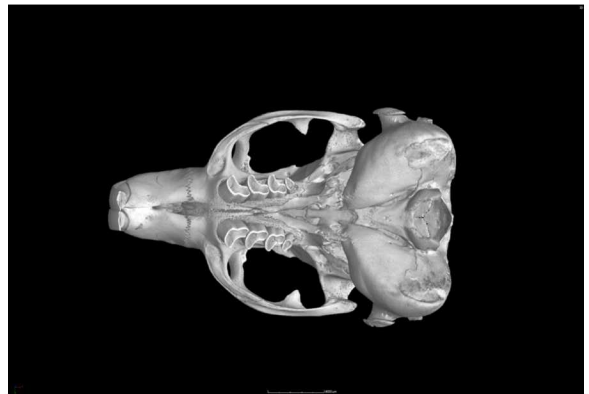
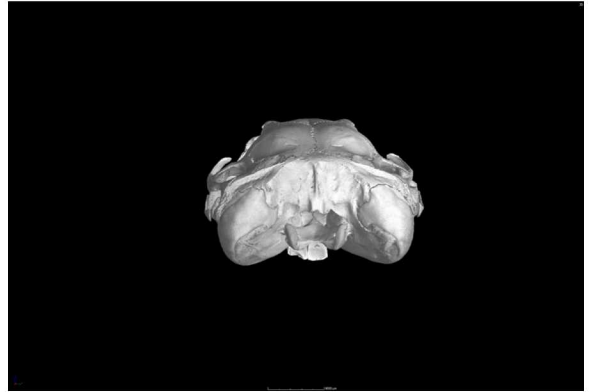
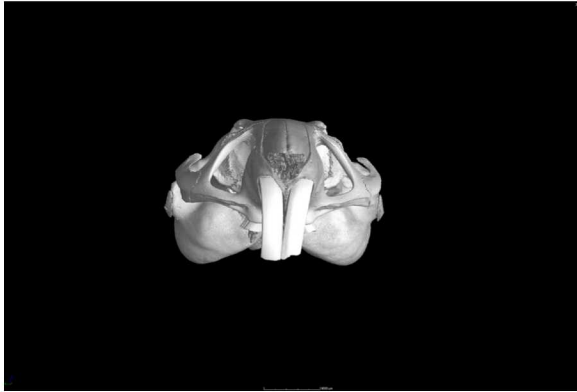
Full: 30 μ m resolution



Skull: 30 μ m resolution

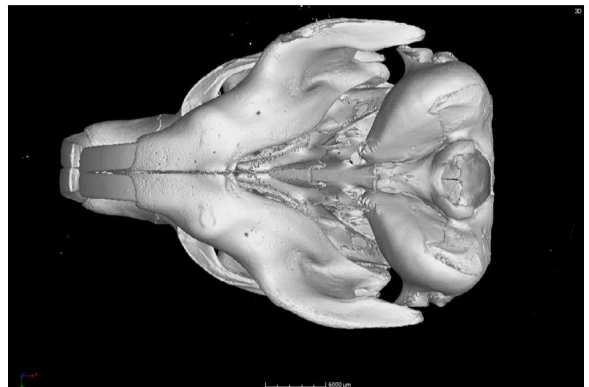
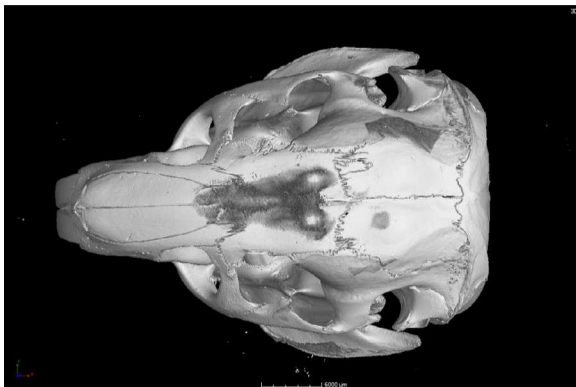
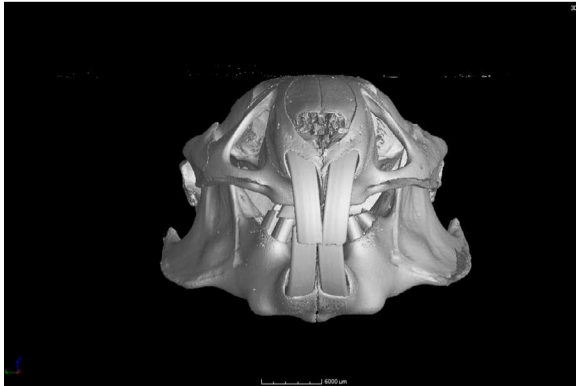


Jaw: 30 μ m resolution



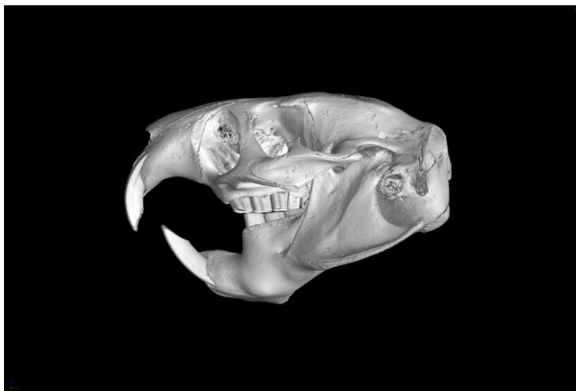
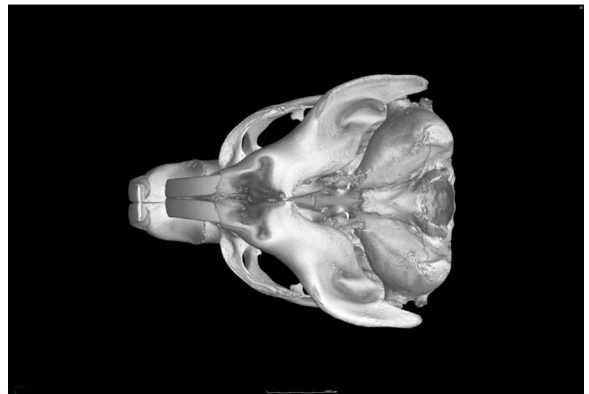
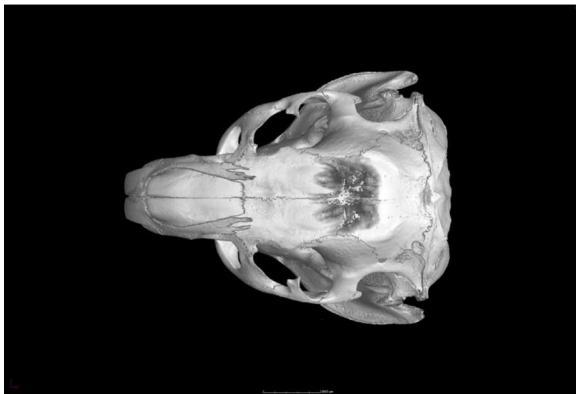
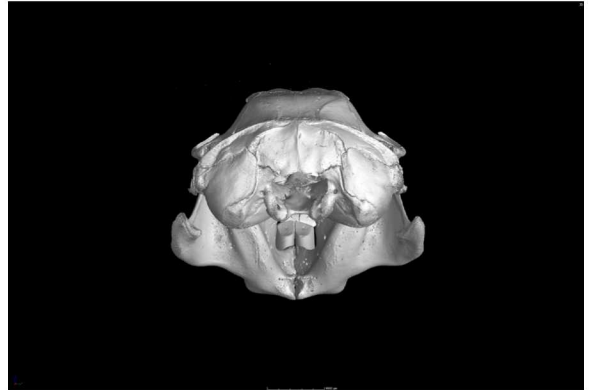
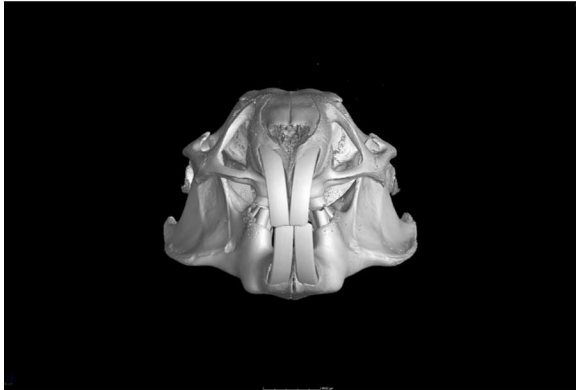
MSB 87078: *Ctenomys* sp

Full: 30 μ m resolution

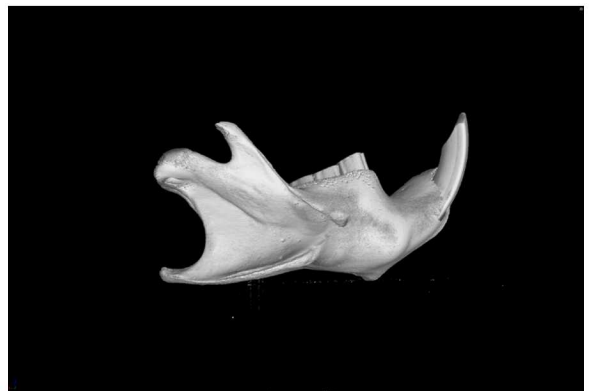
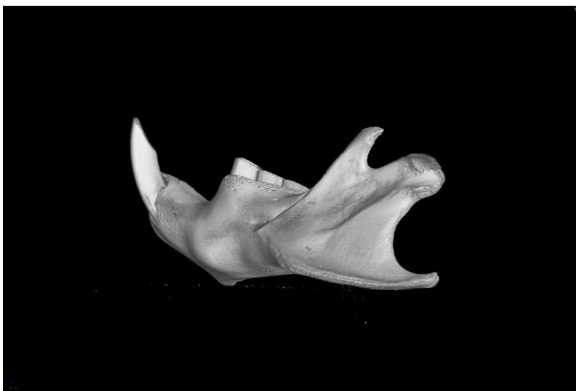
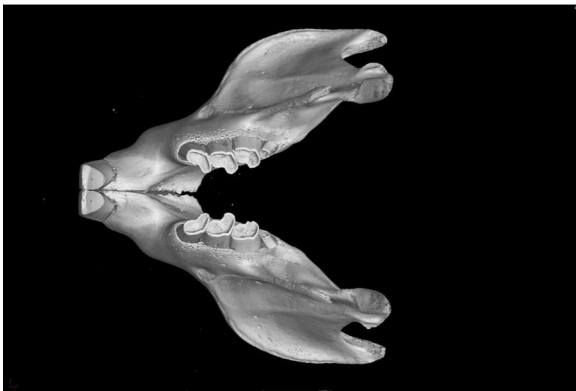
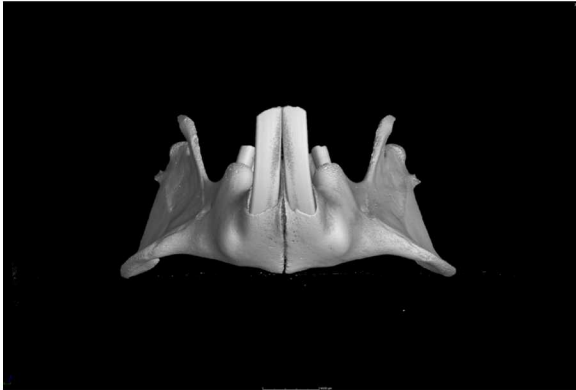


MSB 55368: *Ctenomys steinbachi*

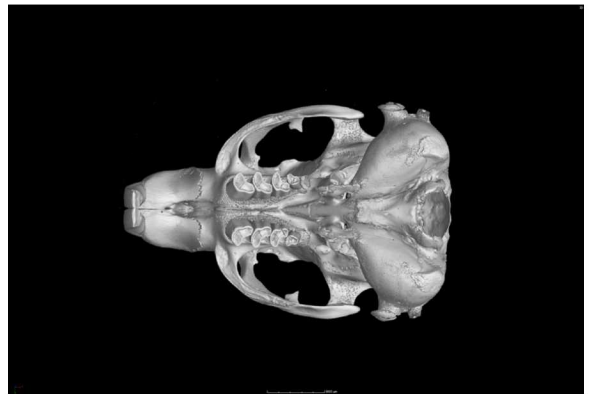
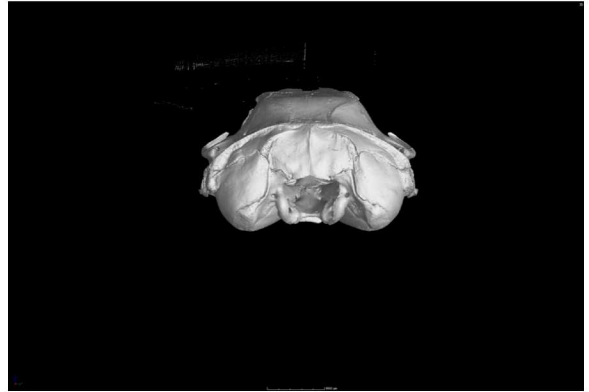
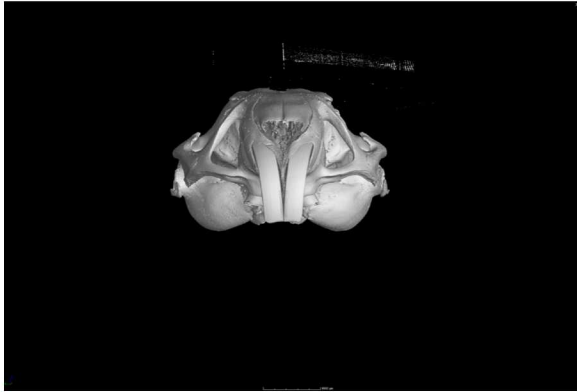
Full: 30 μ m resolution



Skull: 30 μ m resolution

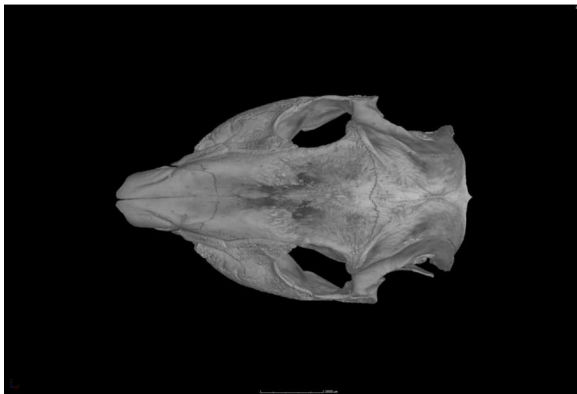
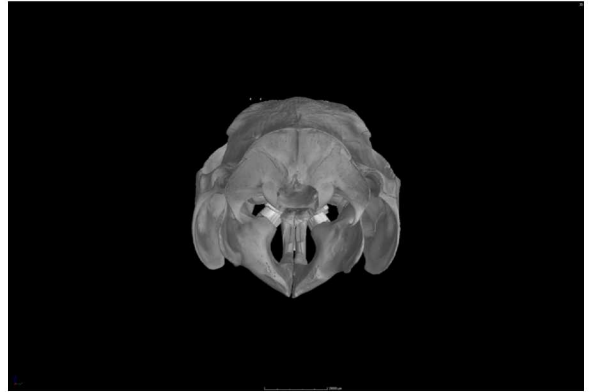
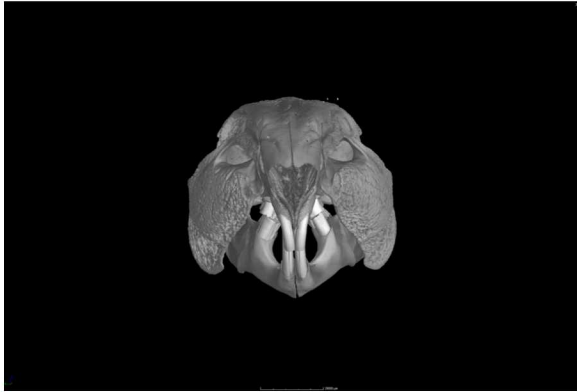


Jaw: 30 μ m resolution

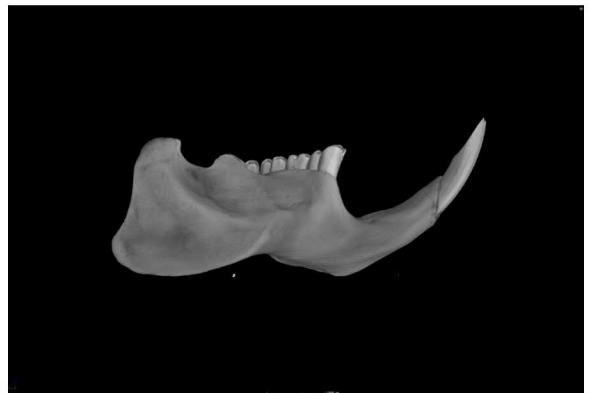
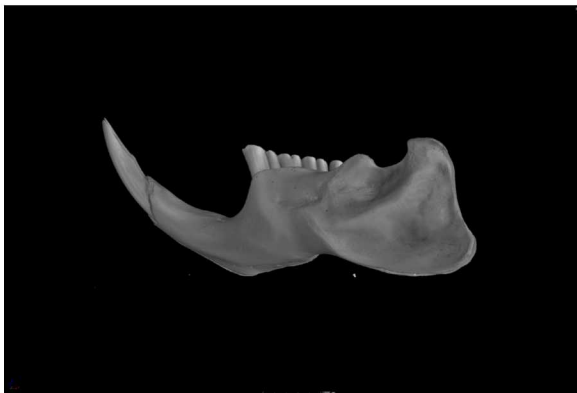
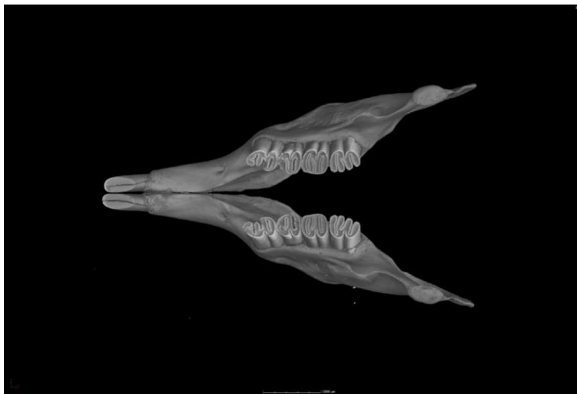
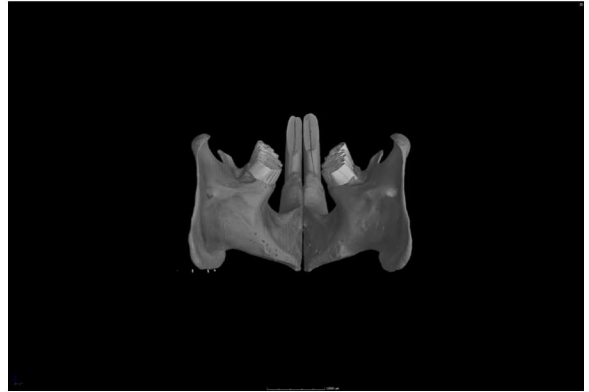
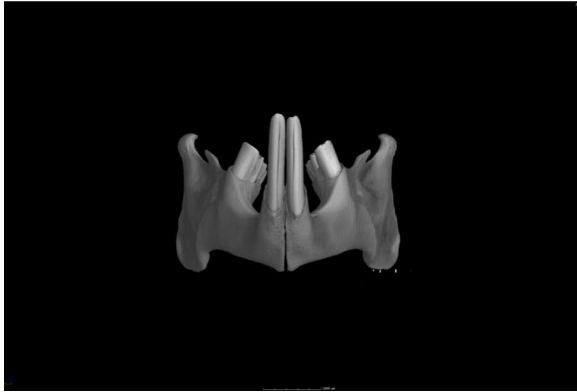


MSB 56084: *Cuniculus paca*

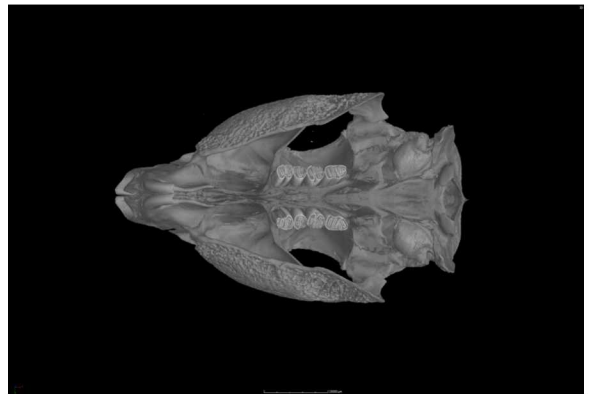
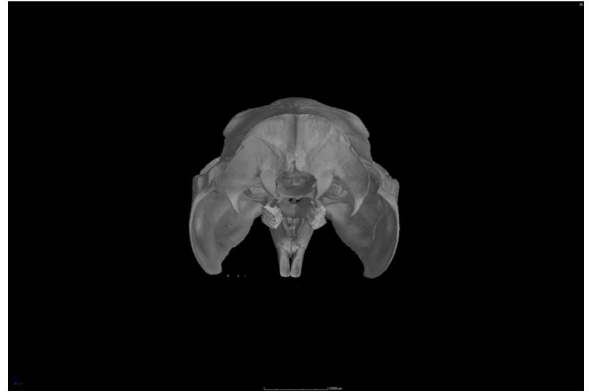
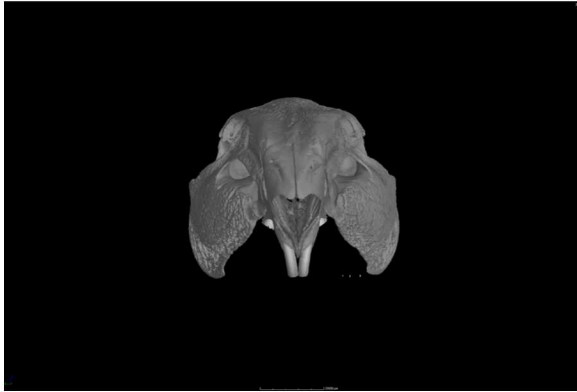
Full: 80 μ m resolution



Skull: 80 μ m resolution

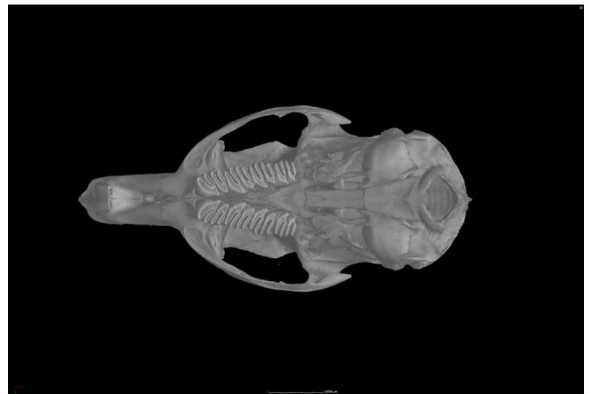
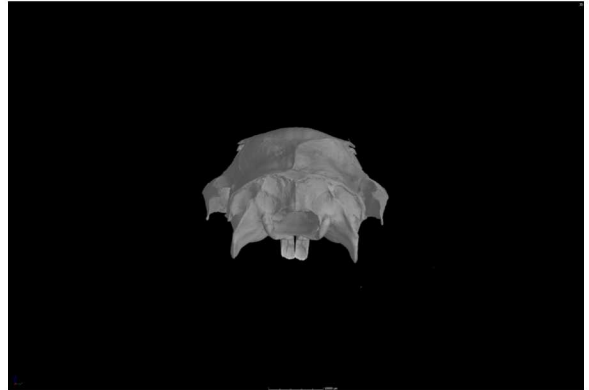
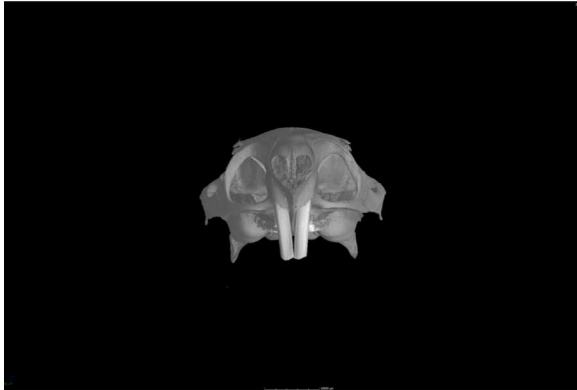


Jaw: 80 μ m resolution

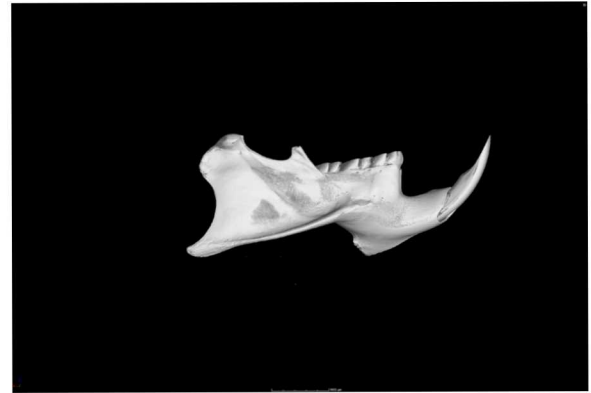
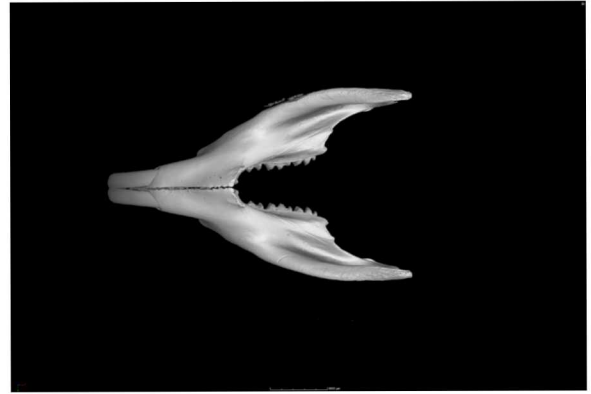
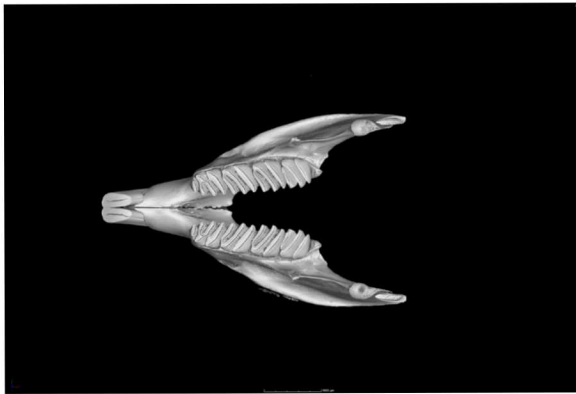
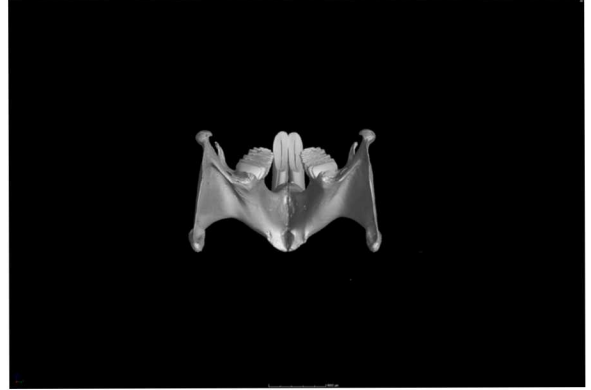
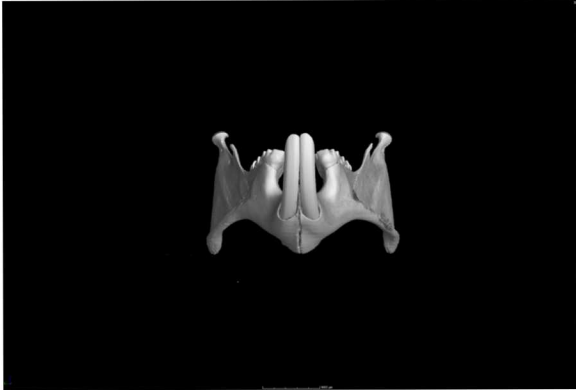


MSB 85627: *Dactylomys boliviensis*

Skull: 40 μ m resolution



NA: NA μm resolution



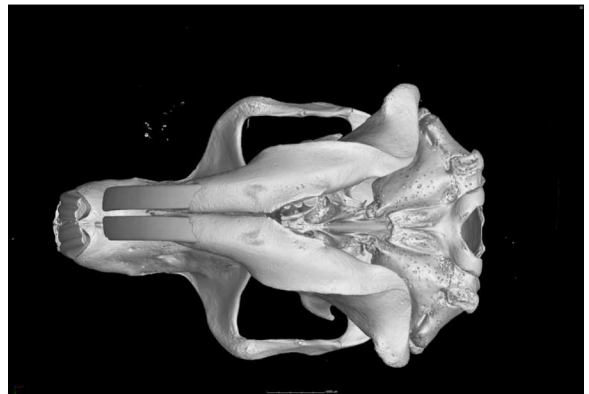
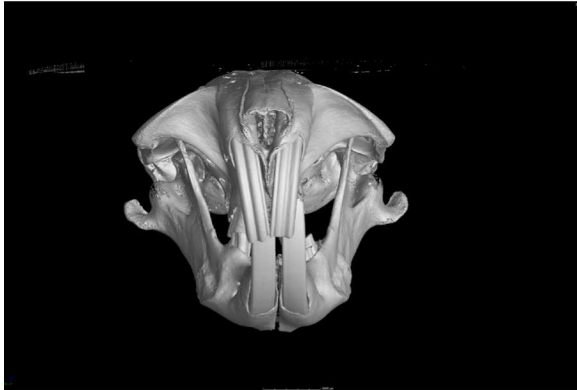
MSB 32600: *Geomys arenarius*

Full: 30 μ m resolution



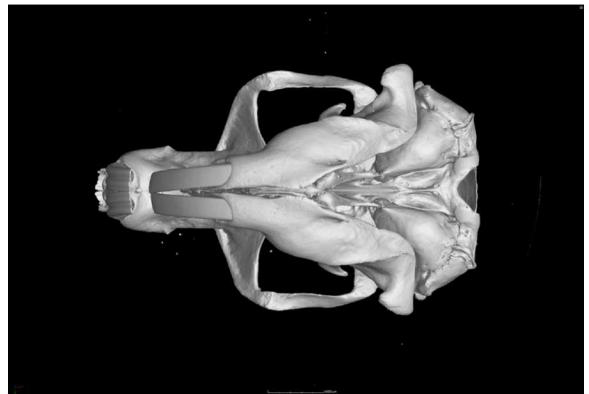
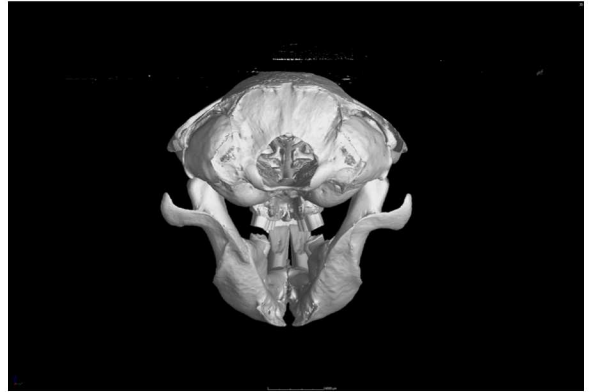
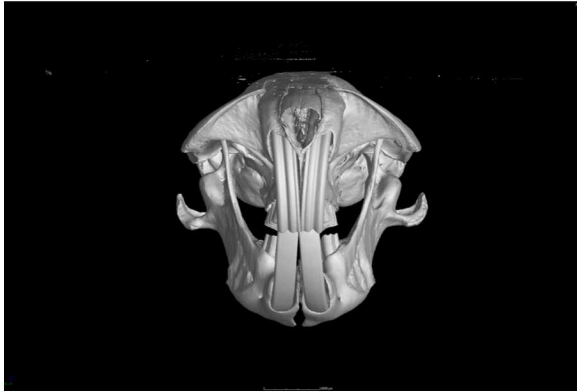
MSB 271072: *Geomys bursarius*

Full: 30 μ m resolution



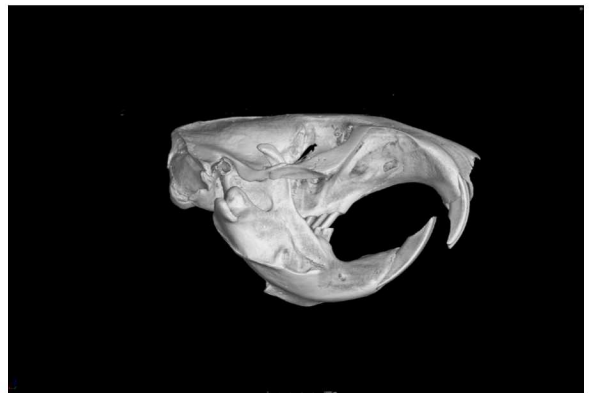
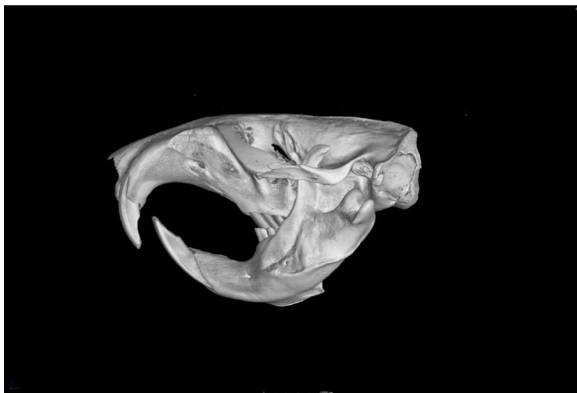
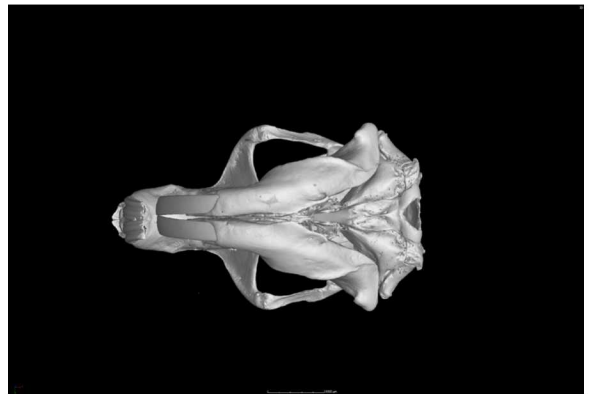
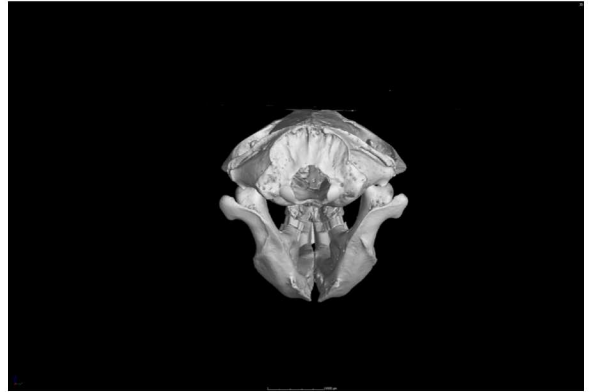
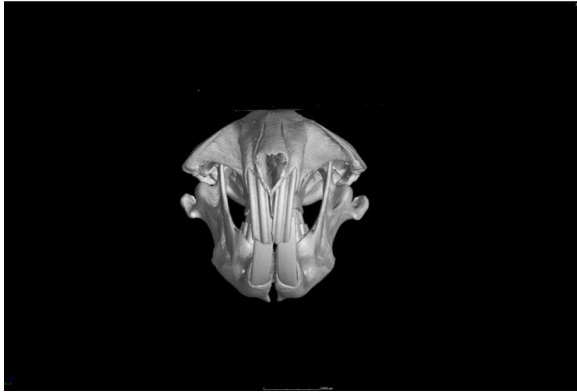
MSB 270888: *Geomys knoxjonesi*

Full: 30 μ m resolution

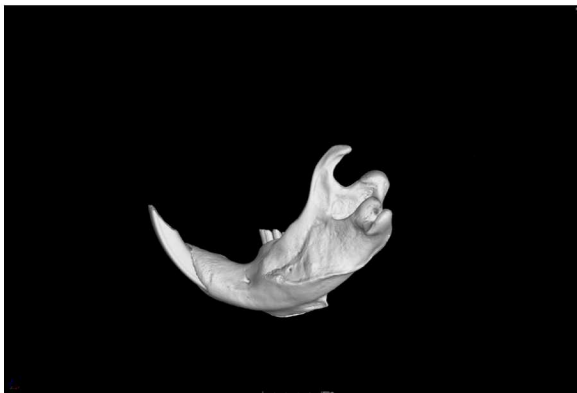
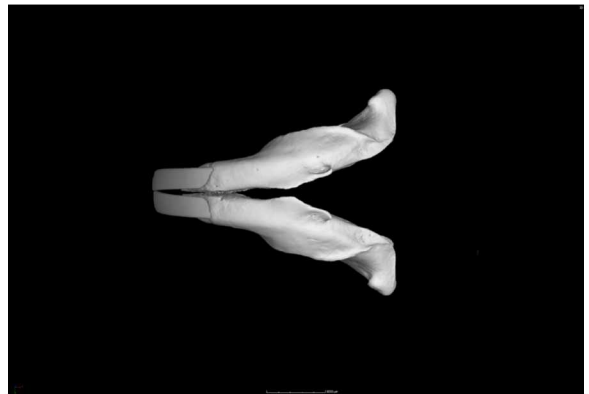
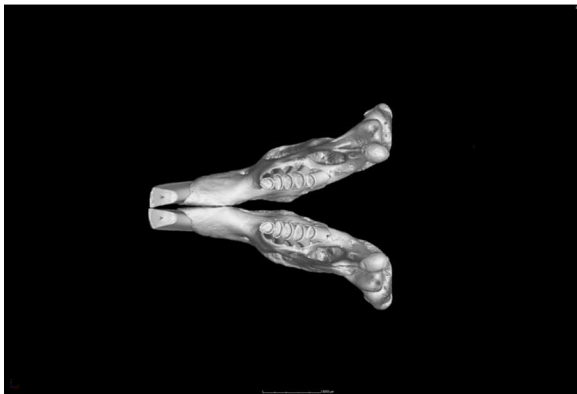
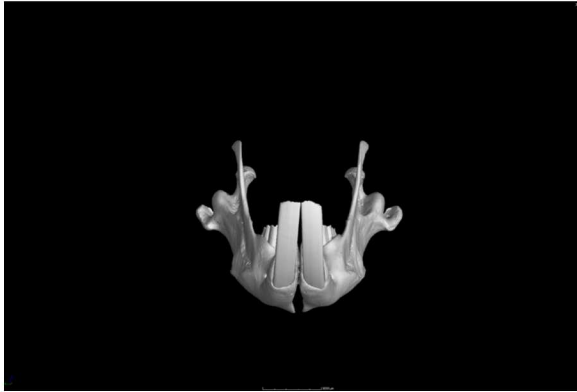


MSB 57470: *Geomys personatus*

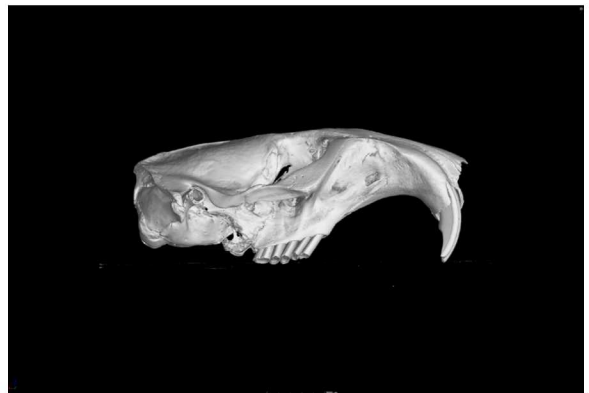
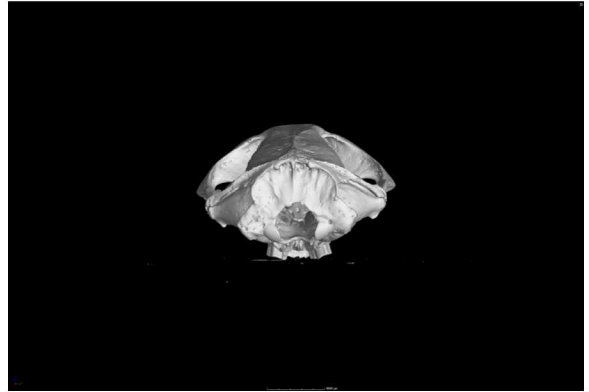
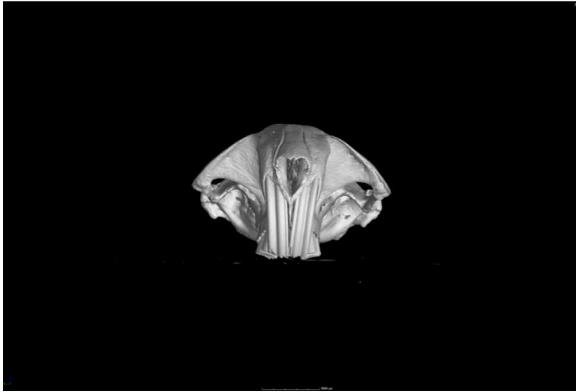
Full: 50 μ m resolution



Skull: 50 μ m resolution

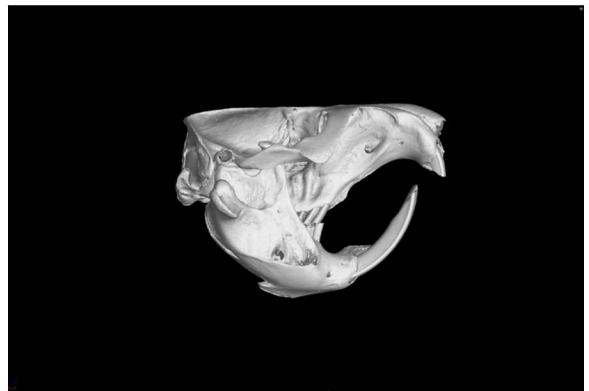
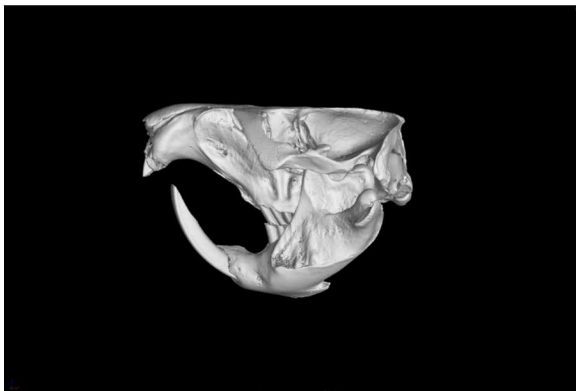
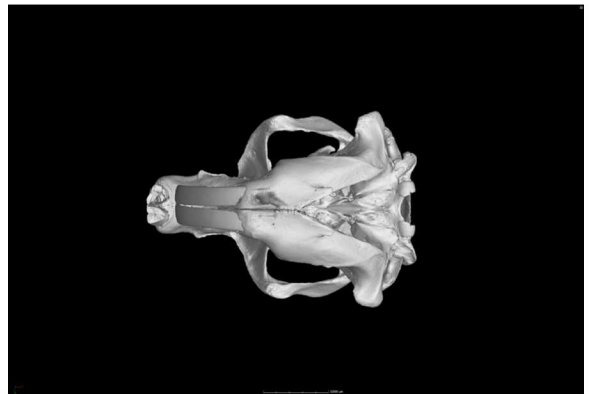
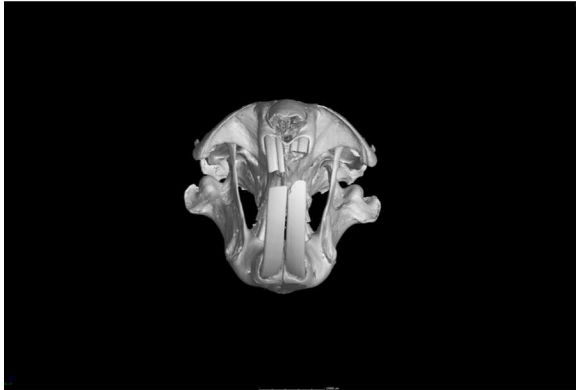


Jaw: 50 μ m resolution

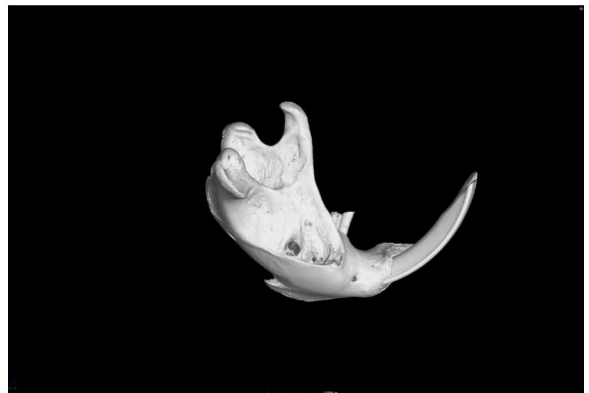
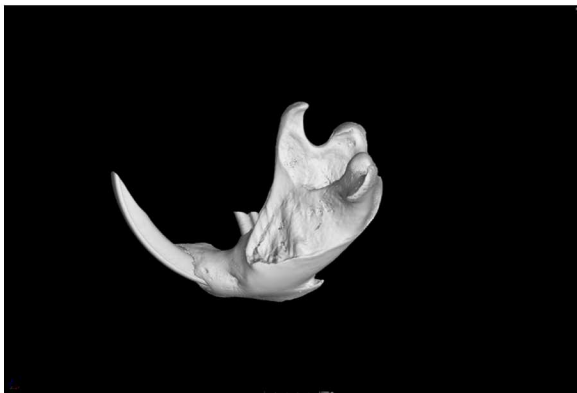
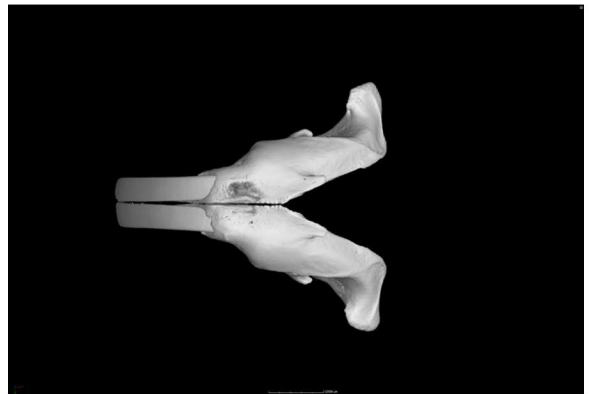
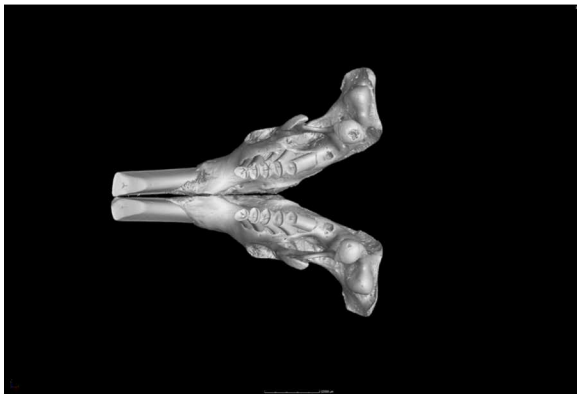
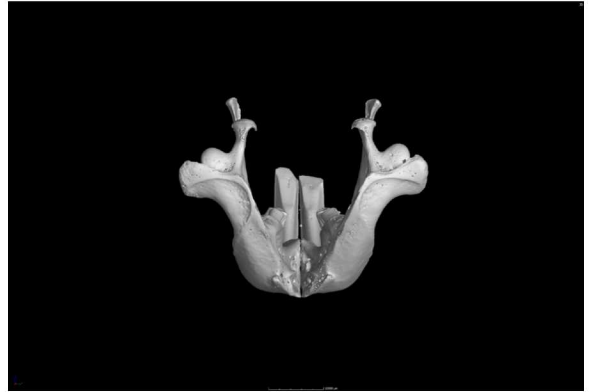
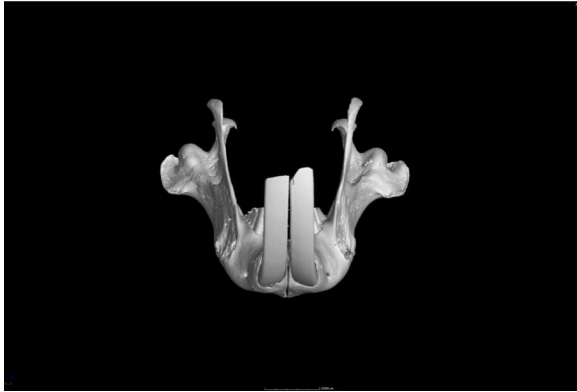


MSB 55630: *Orthogeomys grandis*

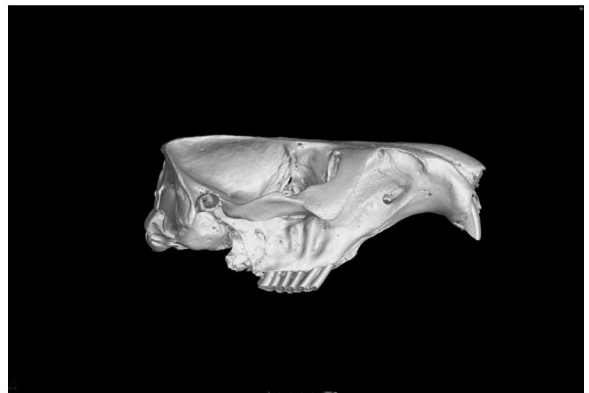
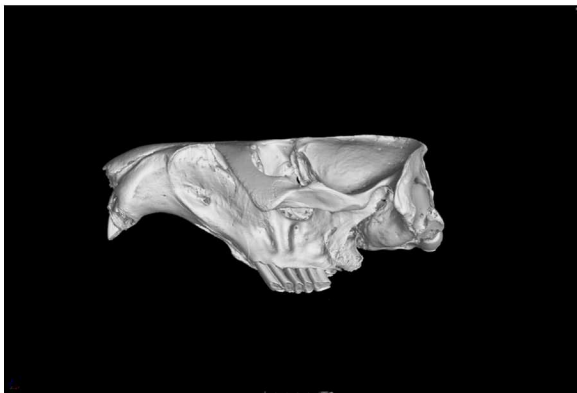
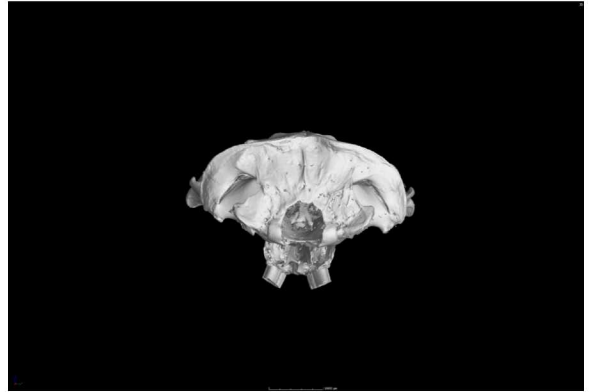
Full: 50 μ m resolution



Skull: 50 μ m resolution

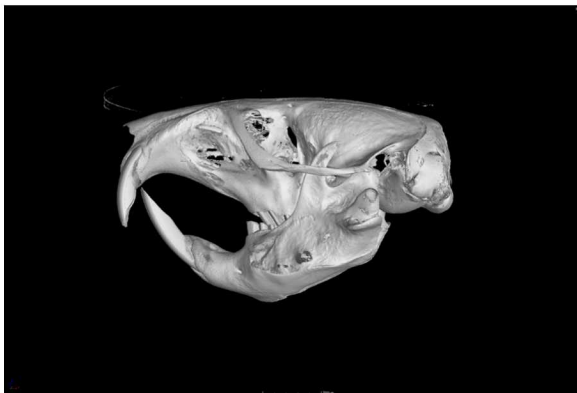
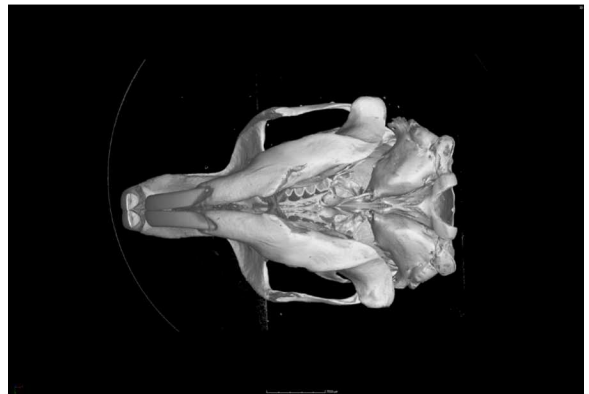
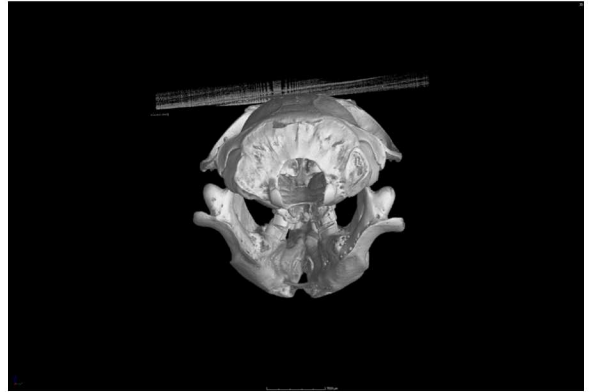
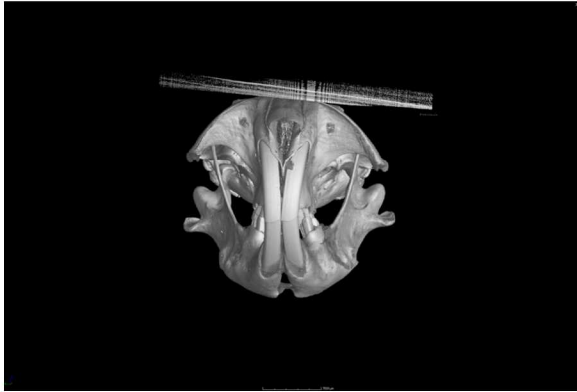


Jaw: 50 μ m resolution

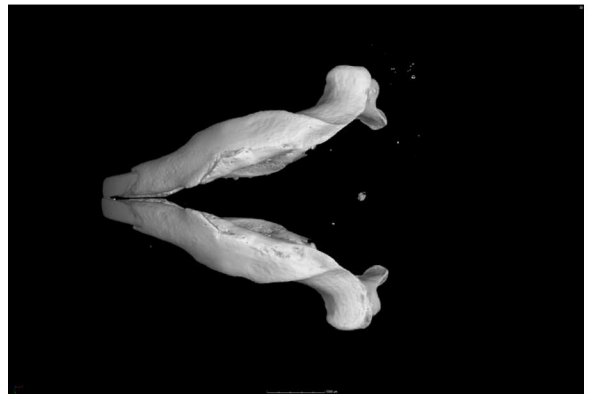
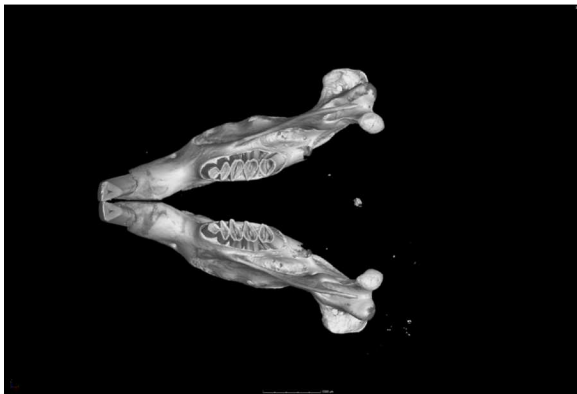
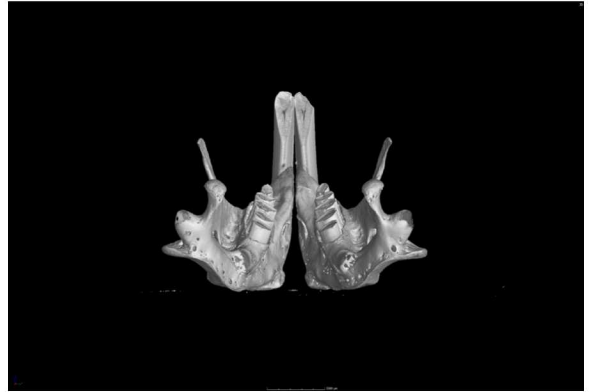
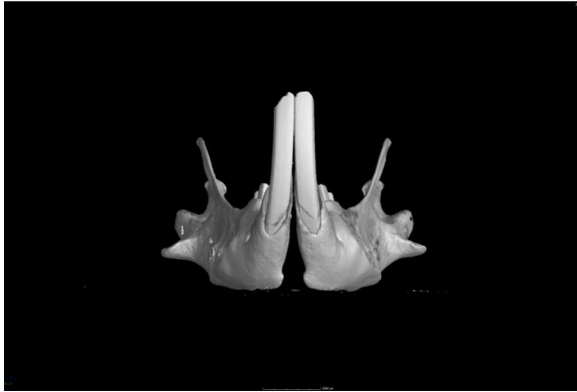


MSB 106753: *Thomomys talpoides retrorsus*

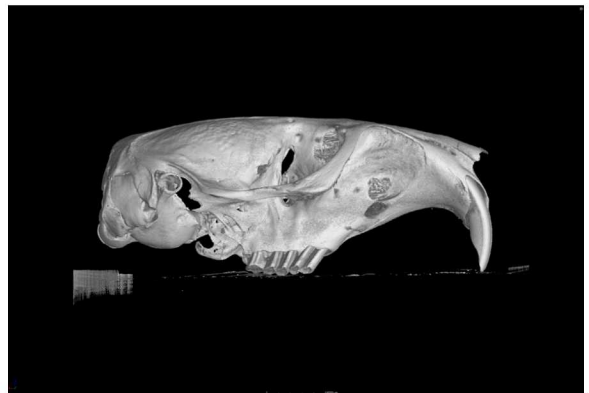
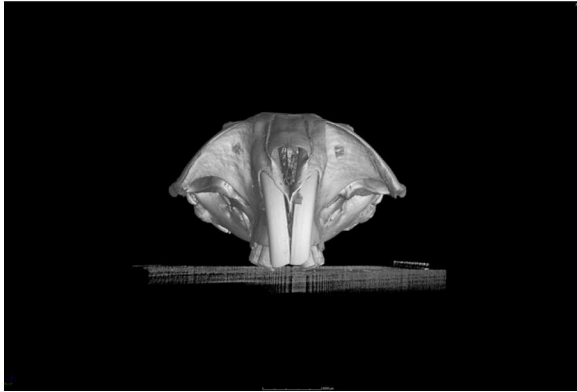
Full: 25 μ m resolution



Skull: 25 μ m resolution

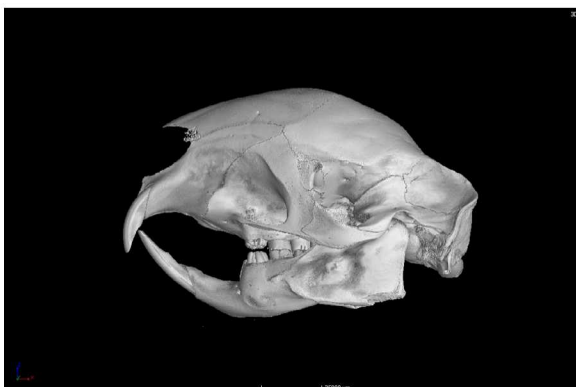
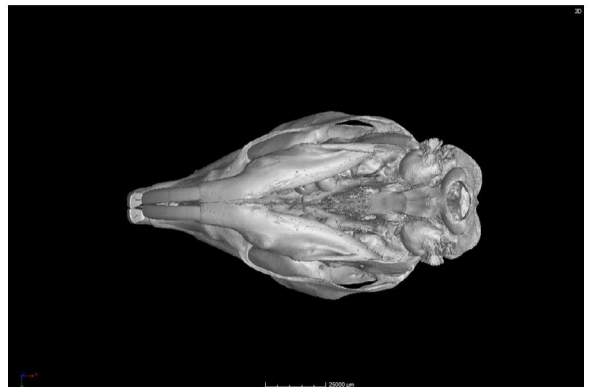
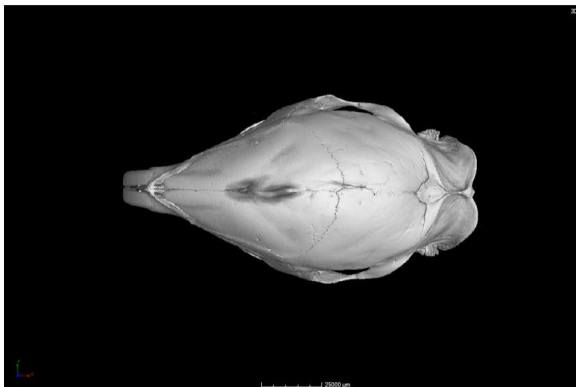
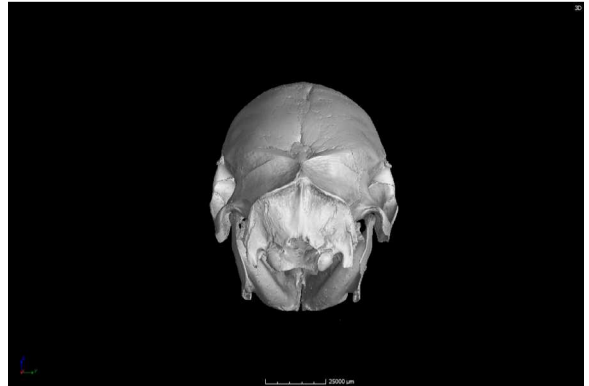
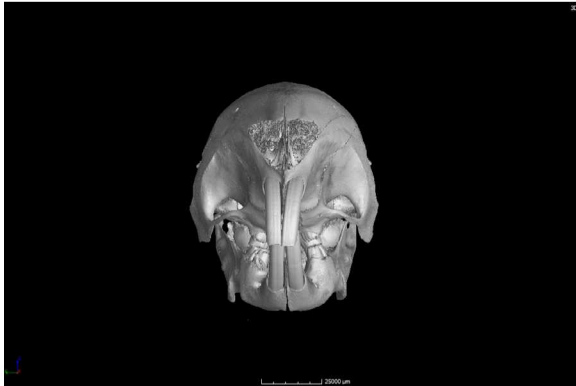


Jaw: 25 μ m resolution

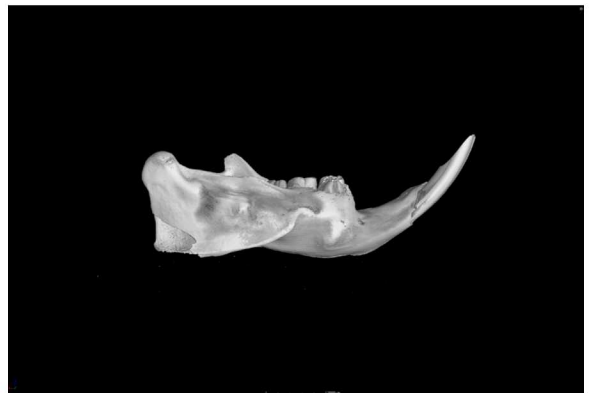
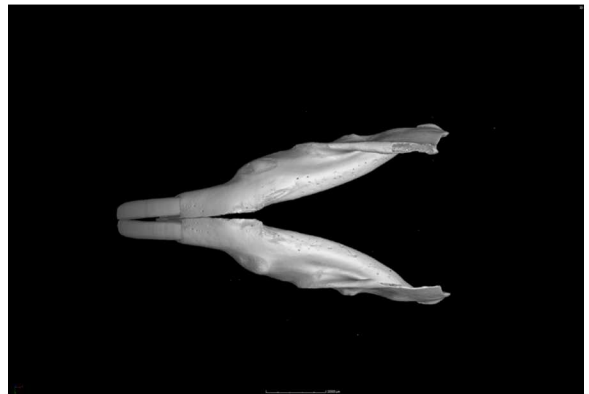
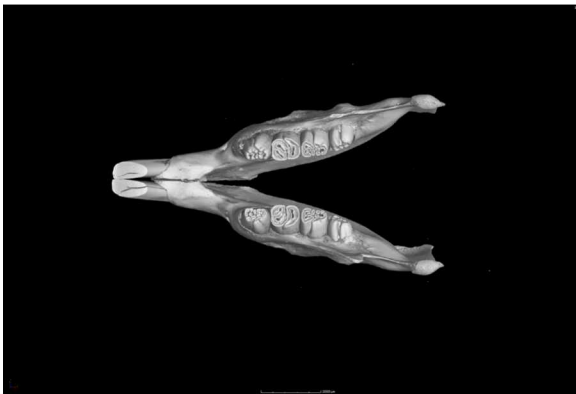
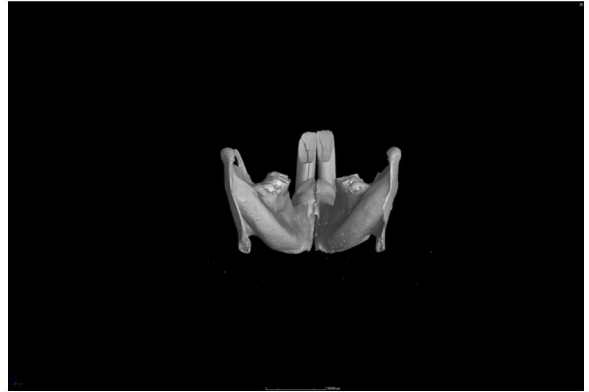
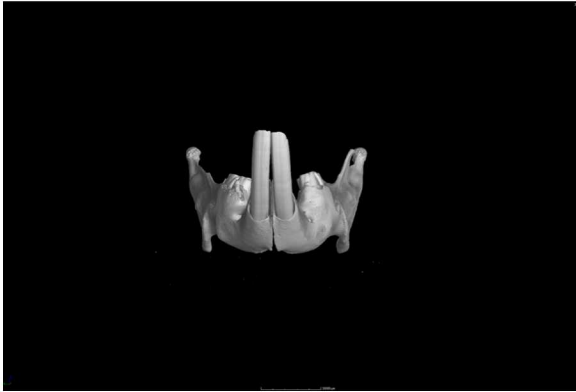


MSB 43032: *Hystrix africae-australis*

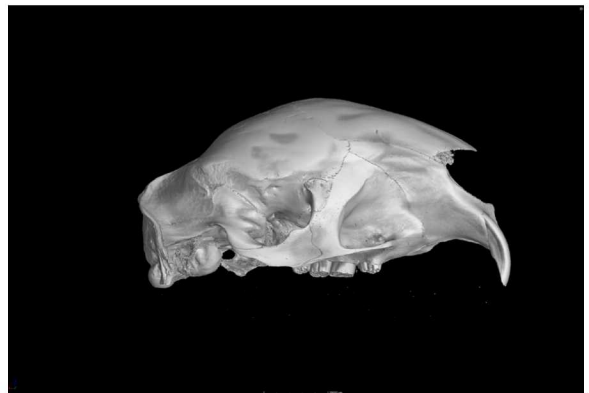
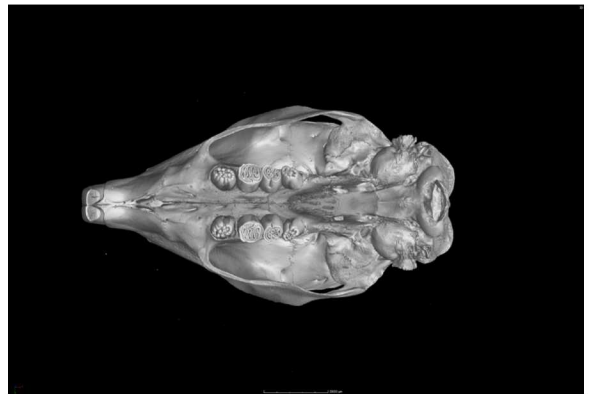
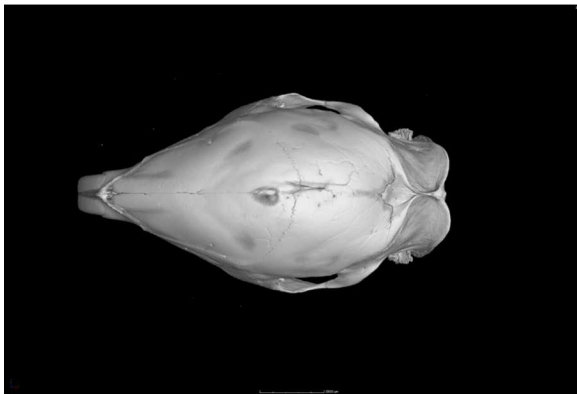
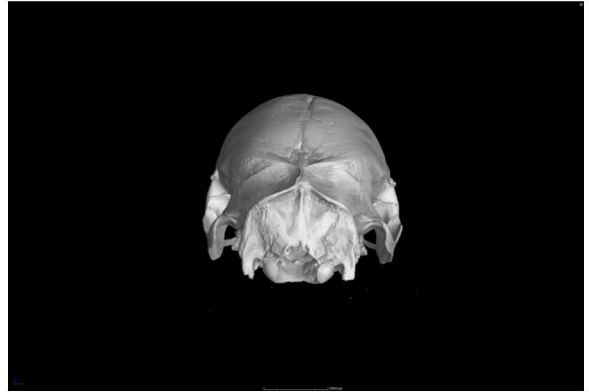
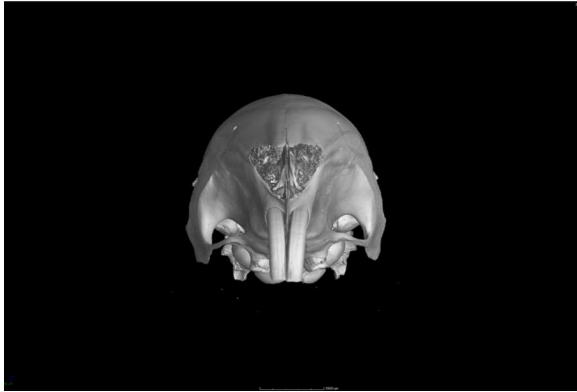
Full: 82.83 μm resolution



Skull: 80 μ m resolution

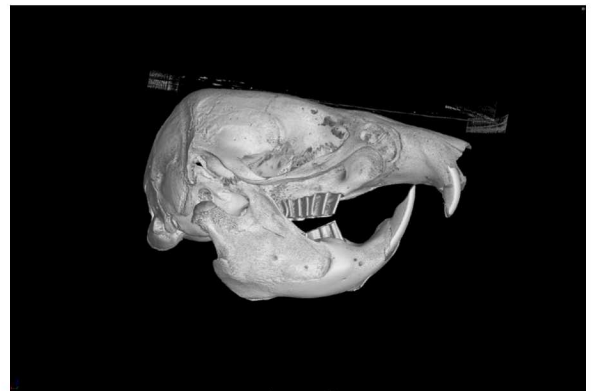
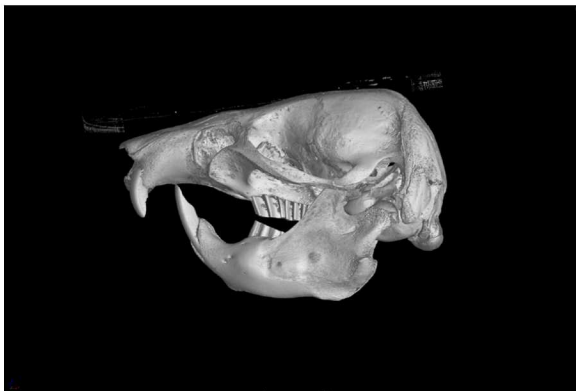
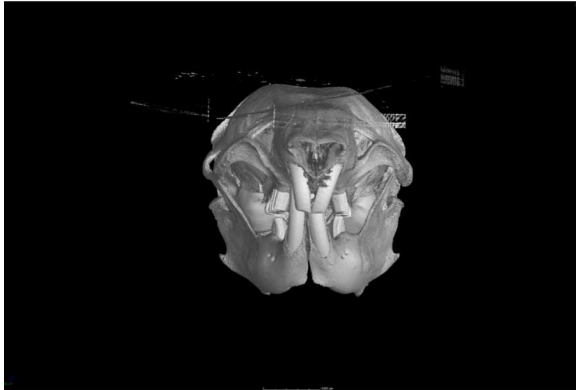


Jaw: 80 μ m resolution

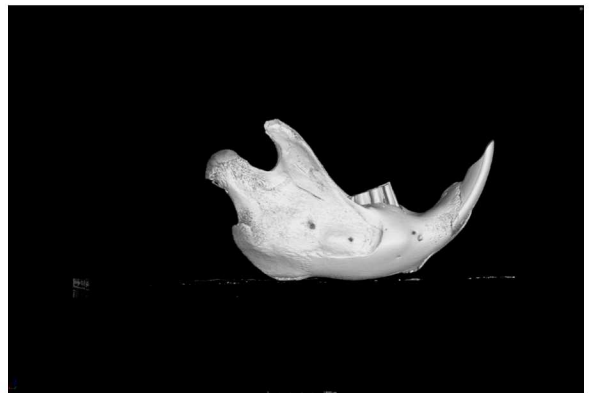
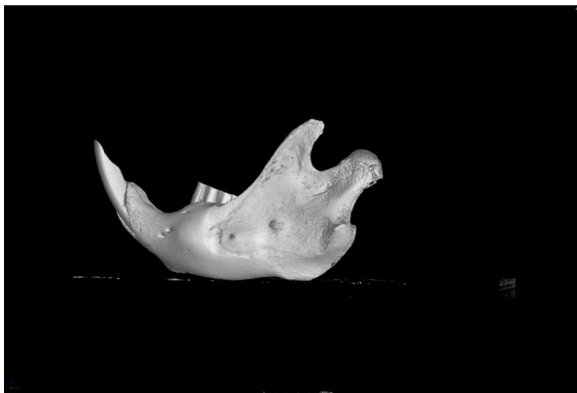
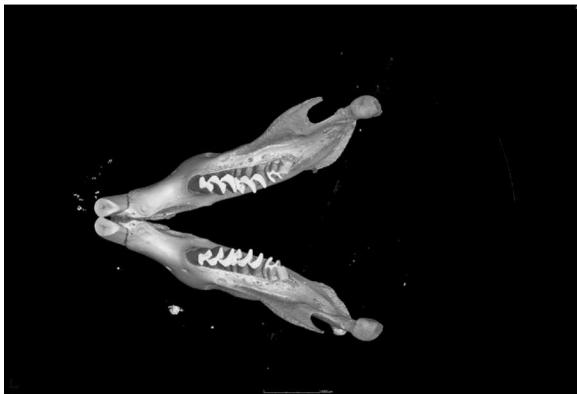
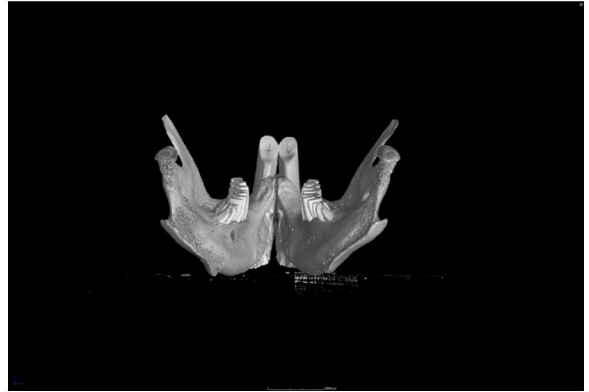
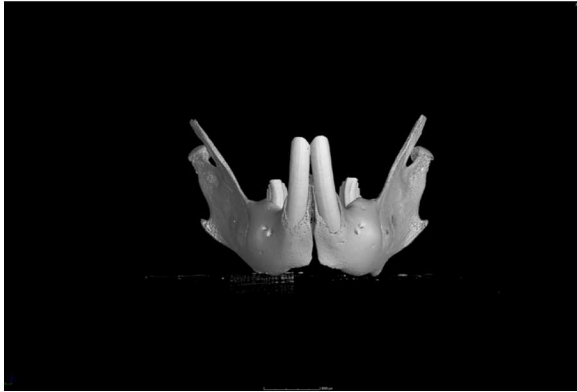


MSB 94336: *Myospalax aspalax*

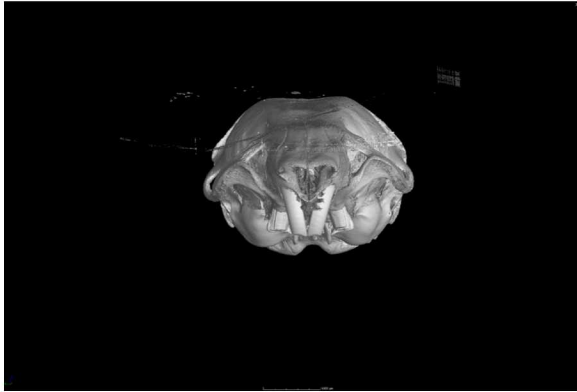
Full: 25 μ m resolution



Skull: 25 μ m resolution

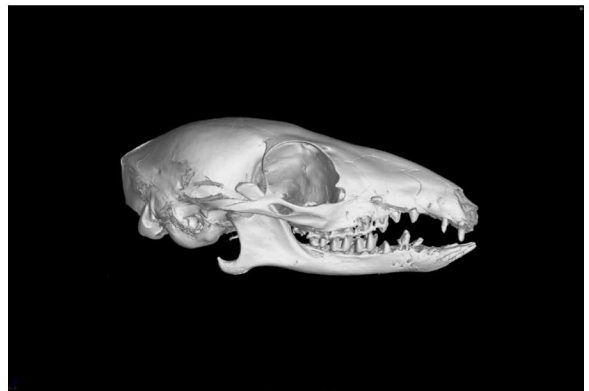
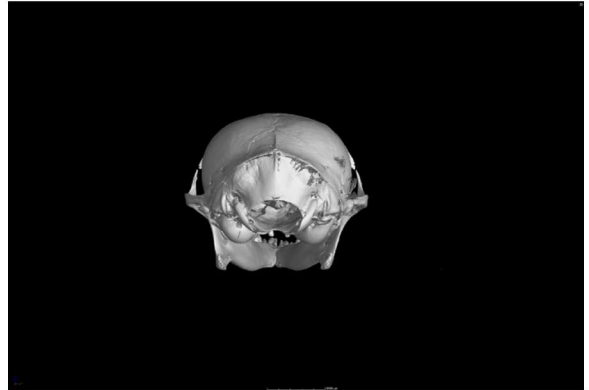
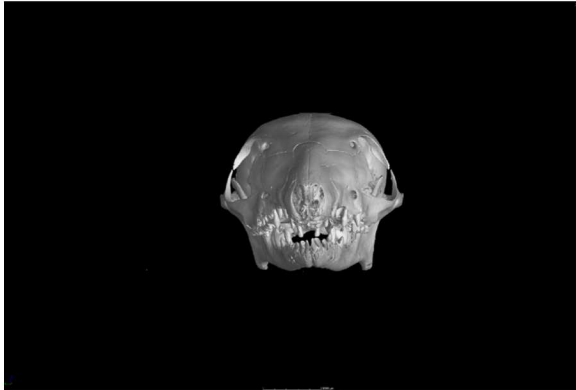


Jaw: 25 μ m resolution

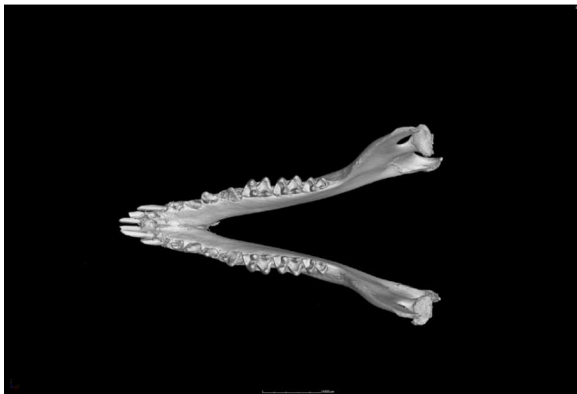
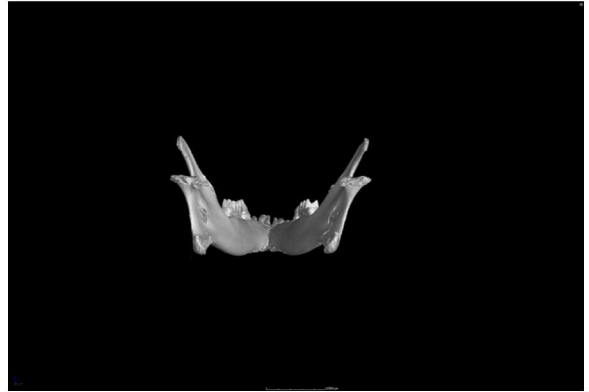
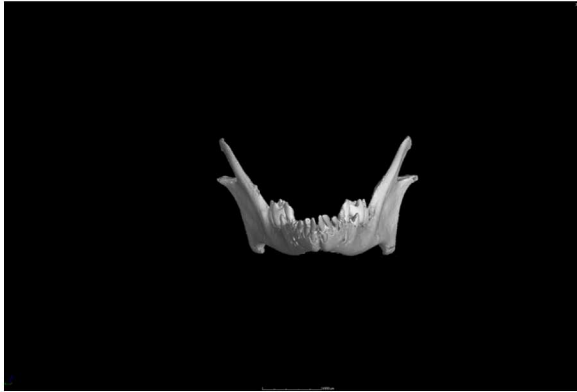


MSB 141251: *Tupaia belangeri*

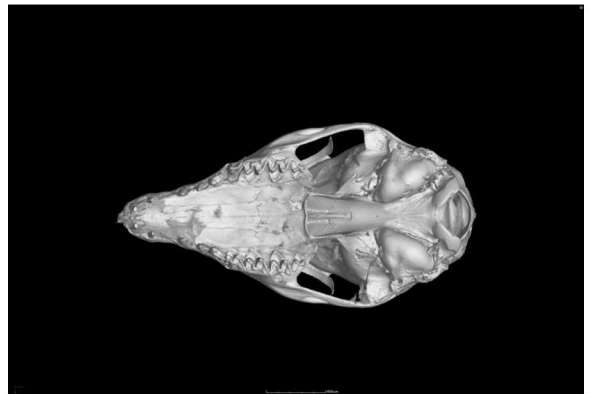
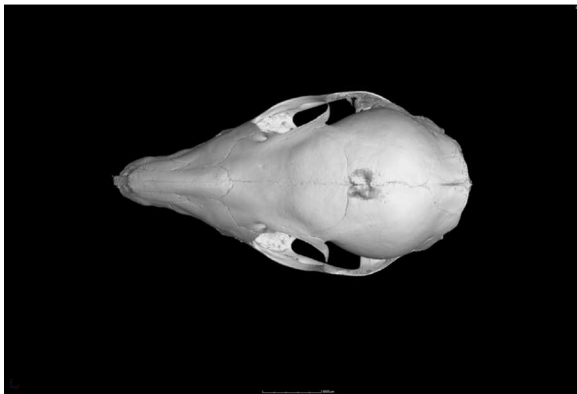
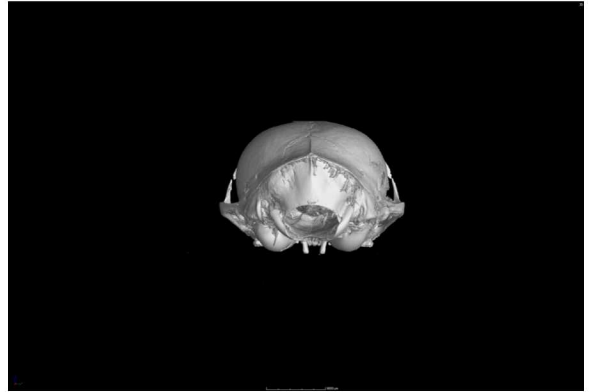
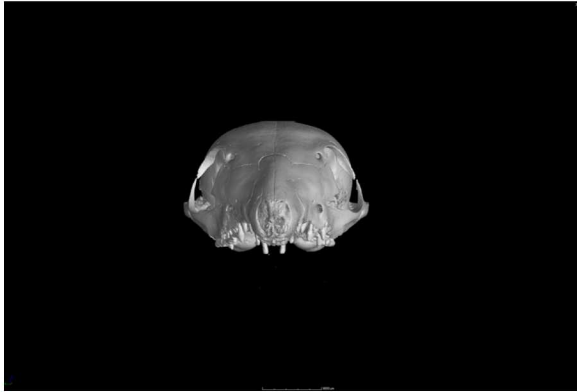
Full: 30 μ m resolution



Skull: 30 μ m resolution



Jaw: 30 μ m resolution



DISTRIBUTION

- 1 Museum of Southwestern Biology
Attn: Dr. Cook
1 University of New Mexico
MSC03-2020
Albuquerque, NM 87131

- 1 Field Museum
Attn: Dr. Noé U. de la Sancha
1400 S Lake Shore Dr.
Chicago, IL 60605-2429

- 1 University of Michigan Museum of Zoology
Attn: Dr. Cody Thompson
3600 Varsity Dr.
Ann Arbor, MI 48108

- 1 MS0899 Technical Library 9536 (electronic copy)

This page left blank



Sandia
National
Laboratories

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.