

BITE MARKS ON NIMRAVID CRANIA AND IMPLICATIONS FOR INTRACLADE INTERACTIONS WITHIN NIMRAVIDAE (MAMMALIA: FELIFORMIA)

CLINT BOYD^{1,2}, ELLEN STARCK³, ED WELSH³, MINDY HOUSEHOLDER^{2,3}

¹DEPARTMENT OF GEOLOGY AND GEOLOGICAL ENGINEERING, SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, 501 E. SAINT JOSEPH ST., RAPID CITY, SOUTH DAKOTA 57701

²MUSEUM OF GEOLOGY, SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, 501 E. SAINT JOSEPH ST., RAPID CITY, SOUTH DAKOTA 57701

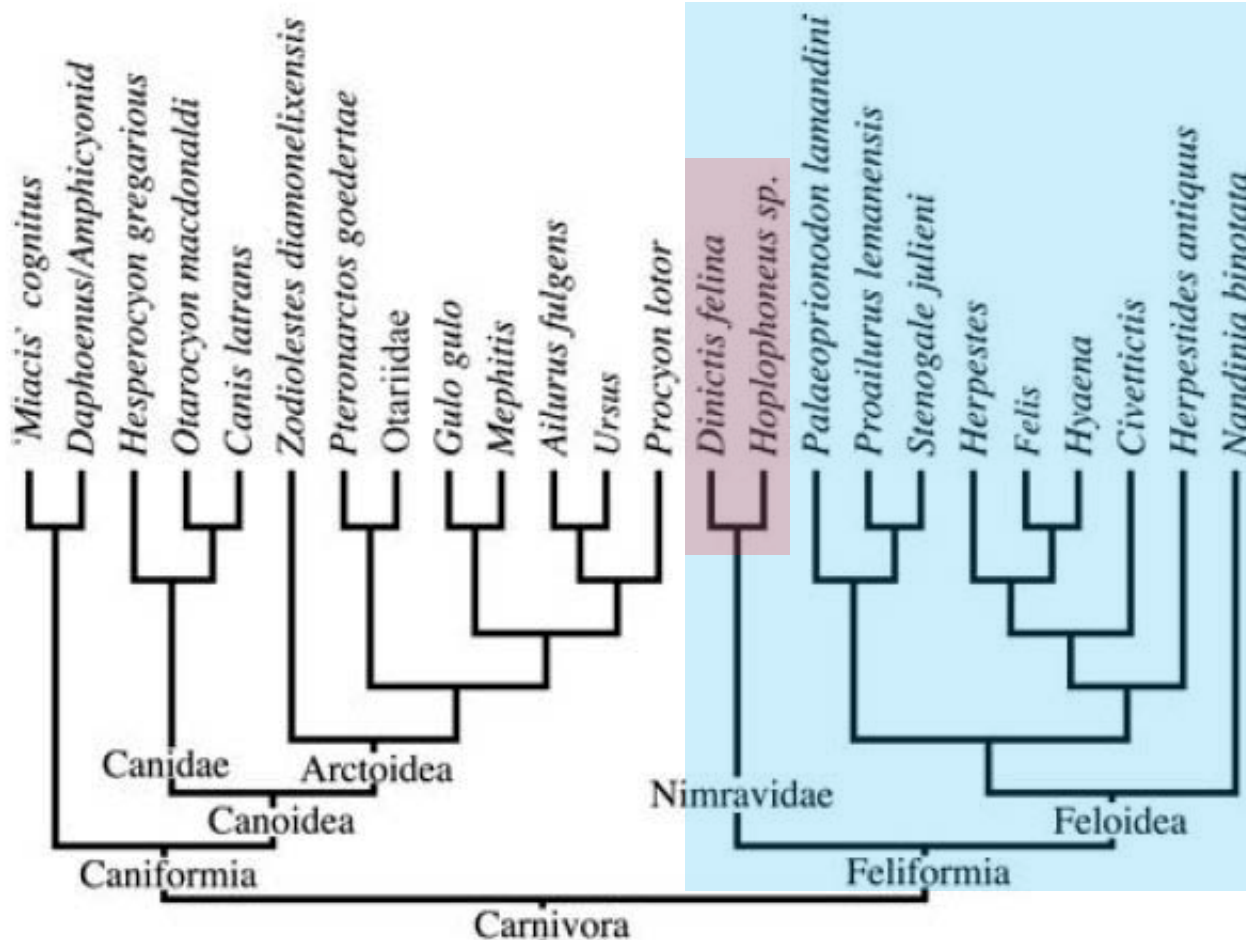
³BADLANDS NATIONAL PARK, INTERIOR, SOUTH DAKOTA, 57750

GSA ANNUAL MEETING, OCTOBER 30, 2013, 8:15 AM

WHAT ARE NIMRAVIDS?

- BASAL-MOST GROUP WITHIN FELIFORMIA (CAT-LIKE CARNIVORES)

- EOCENE THROUGH OLIGOCENE
- NORTH AMERICA, EUROPE, & ASIA



-Modified from Wesley-Hunt and Flynn (2005:fig. 3)

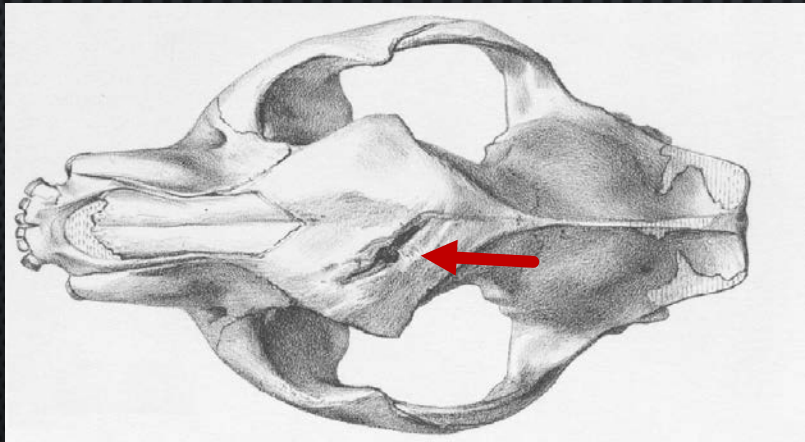


SDSM 2544: *Hoplophoneus primaevus*

PREVIOUS OBSERVATIONS: (SDSM 348)



-SDSM 348: *Nimravus brachyops*



-Modified from Scott and Jepsen (1936)

- THE FIRST OCCURRENCE OF INTRACLADE COMBAT IN NIMRAVIDAE IS DOCUMENTED IN SCOTT AND JEPSEN (1936)
- PUNCTURE WOUND ON THE LEFT FRONTAL.
- EVIDENCE OF HEALING



Bruce Horsefall painting at Museum of Geology, South Dakota School of Mines and Technology, Rapid City, SD

PREVIOUS OBSERVATIONS: "INNOCENT ASSASSINS" (1932)



-*Nimravus* specimen on display at UNSM (Mo-109 1091)



"The Innocent Assassins" painting by Jan Vriessen (2007)

PREVIOUS INTERPRETATIONS

- ATTACK FROM IN FRONT: DIRECT CONFRONTATION



Bruce Horsefall painting at Museum of Geology, South Dakota School of Mines and Technology, Rapid City, SD

- ATTACK FROM IN BEHIND: AMBUSH



"The Innocent Assassins" painting by Jan Vriessen (2007)

NEW OCCURRENCE:
BADL 59490



Hoplophoneus sp.

NEW OCCURRENCE: BADL 59490

- TRANSVERSELY COMPRESSED CANINE PUNCTURES DIAGNOSTIC OF NIMRAVIDS
- SPECIMEN DISPLAYS A SERIES OF PUNCTURING BITES, NOT A HEAD-CRUSHING BITE
- RULES OUT CARNIVOROUS MAMMALS SUCH AS CREODONTA AND ENTELODONTIDAE

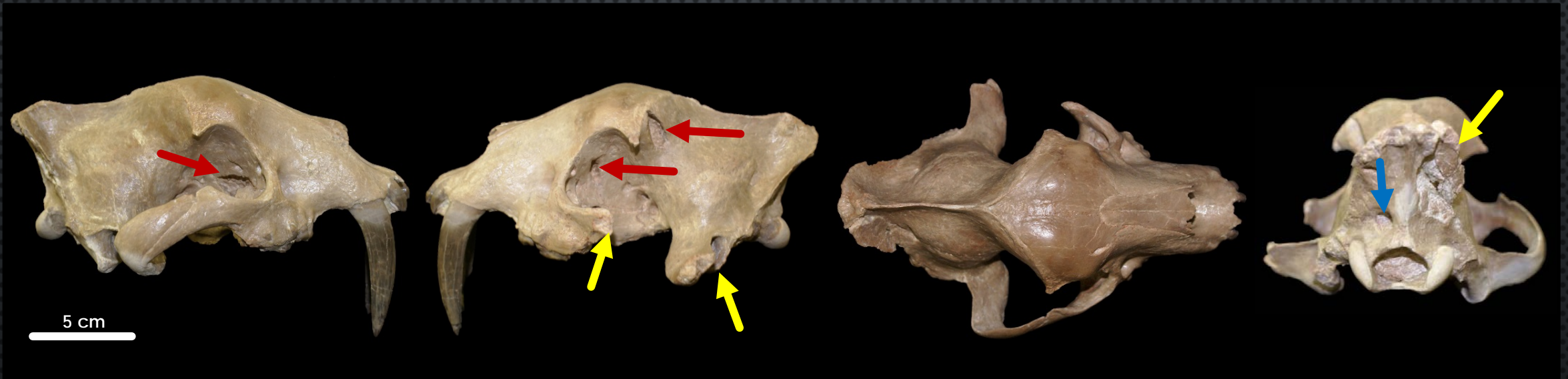


→ = Upper Canine → = Lower Canine → = Crushing

Hoplophoneus sp.

NEW OCCURRENCE: BADL 59490

- TRANSVERSELY COMPRESSED CANINE PUNCTURES DIAGNOSTIC OF NIMRAVIDS
- SPECIMEN DISPLAYS A SERIES OF PUNCTURING BITES, NOT A HEAD-CRUSHING BITE
- RULES OUT CARNIVOROUS MAMMALS SUCH AS CREODONTA AND ENTELODONTIDAE

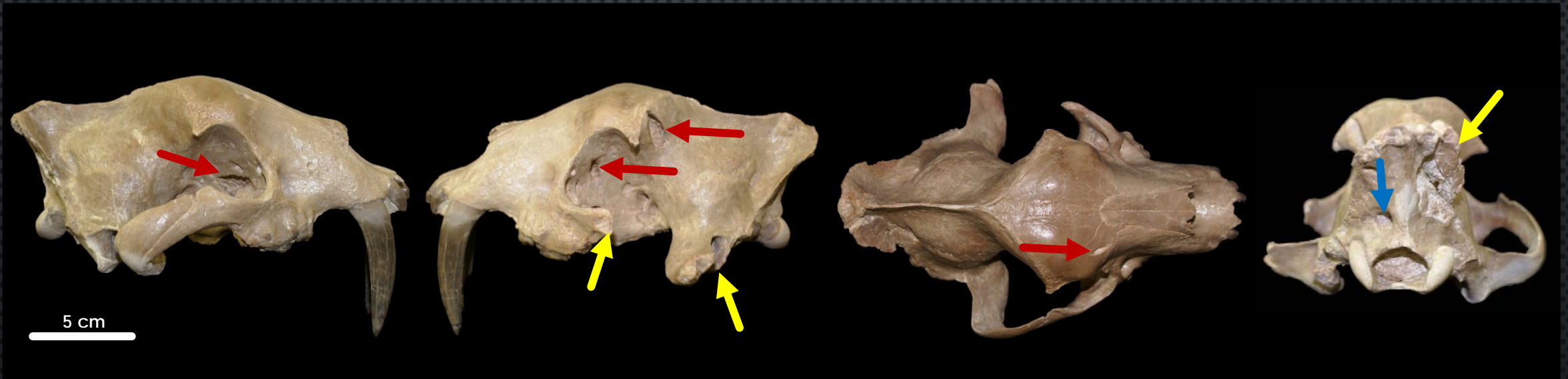


→ = Upper Canine → = Lower Canine → = Crushing

Hoplophoneus sp.

NEW OCCURRENCE: BADL 59490

- TRANSVERSELY COMPRESSED CANINE PUNCTURES DIAGNOSTIC OF NIMRAVIDS
- SPECIMEN DISPLAYS A SERIES OF PUNCTURING BITES, NOT A HEAD-CRUSHING BITE
- RULES OUT CARNIVOROUS MAMMALS SUCH AS CREODONTA AND ENTELODONTIDAE



→ = Upper Canine → = Lower Canine → = Crushing

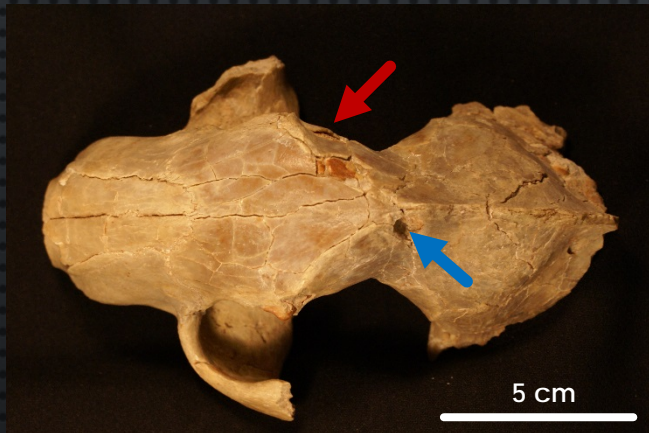
Hoplophoneus sp.

CAN WE FIND MORE?

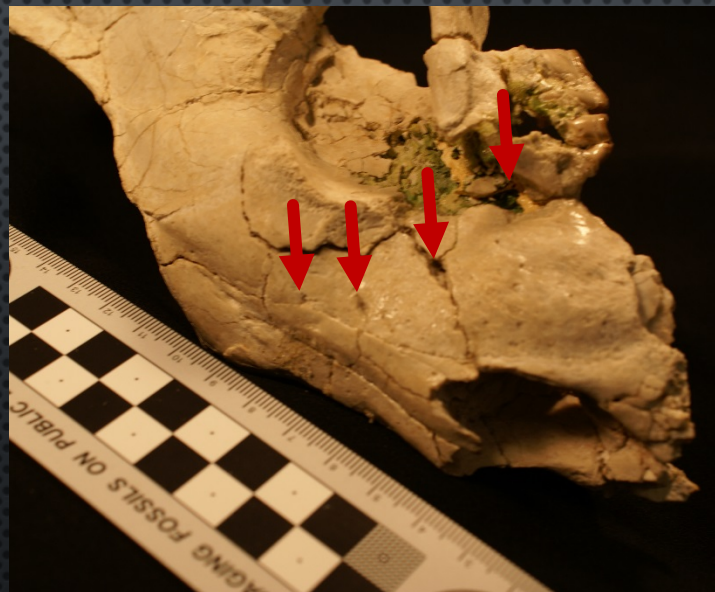
- RE-EXAMINED SPECIMENS AT SDSM&T AND BADL
- ADDITIONAL PREPARATION OF UNPREPARED AND RESTORED SPECIMENS

CAN WE FIND MORE?

- RE-EXAMINED SPECIMENS AT SDSM&T AND BADL
- ADDITIONAL PREPARATION OF UNPREPARED AND RESTORED SPECIMENS



SDSM 293: *Dinictis* sp.



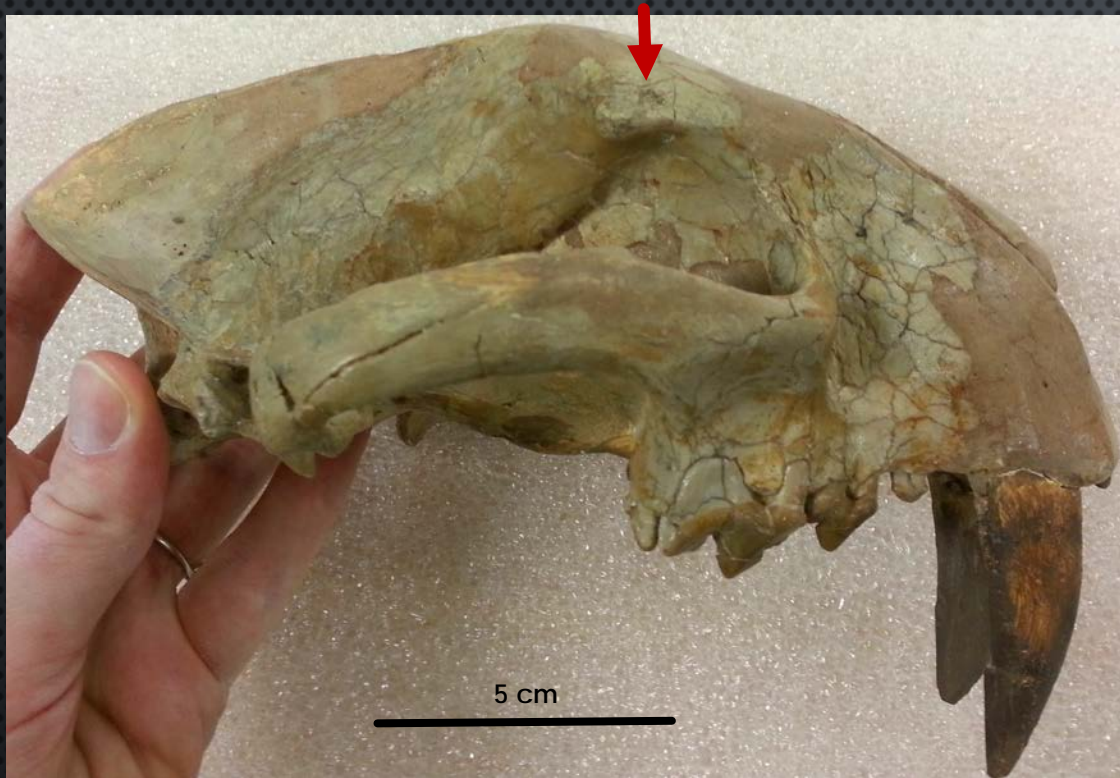
SDSM 2417: *Hoplophoneus mentalis*



BADL 42047: *Nimravus brachyops*

CAN WE FIND MORE?

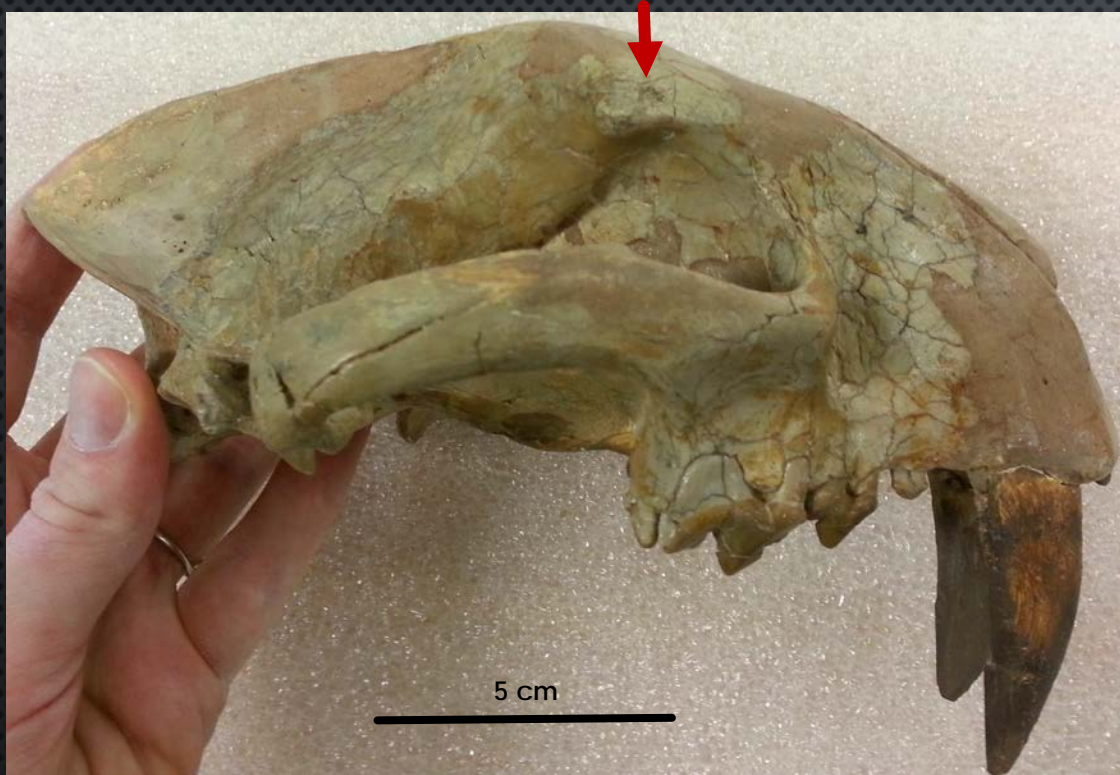
- RE-EXAMINED SPECIMENS AT SDSM&T AND BADL
- ADDITIONAL PREPARATION



SDSM 2663: *Dinictis felina*

CAN WE FIND MORE?

- RE-EXAMINED SPECIMENS AT SDSM&T AND BADL
- ADDITIONAL PREPARATION

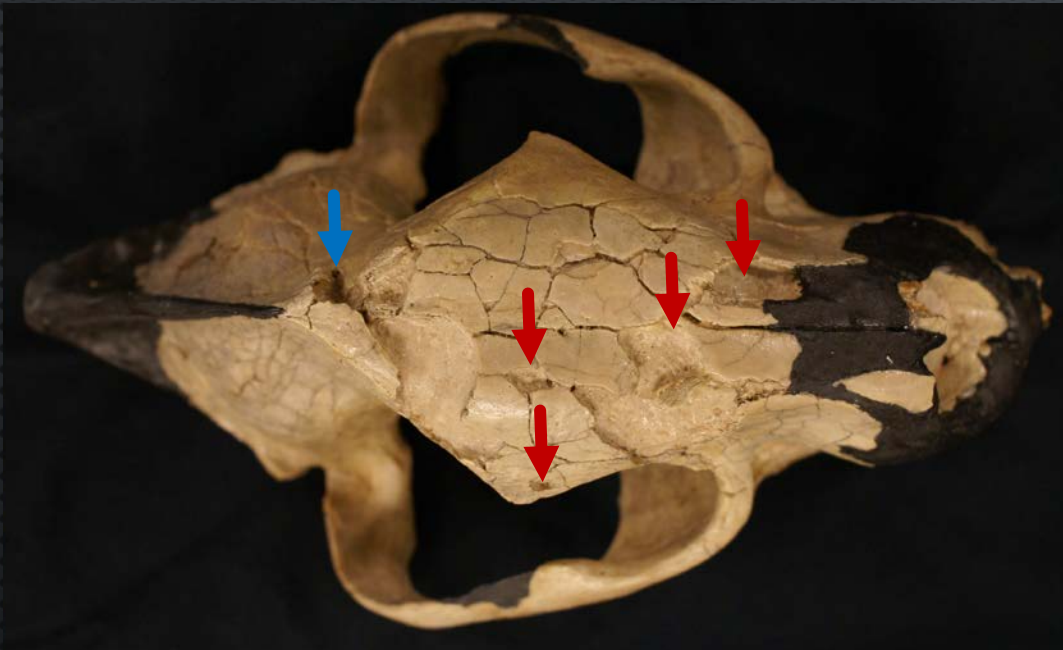


SDSM 2663: *Dinictis felina*



CAN WE FIND MORE?

- ROUNDED UP SPECIMENS AT SDSM&T AND BADL
- ADDITIONAL PREPARATION

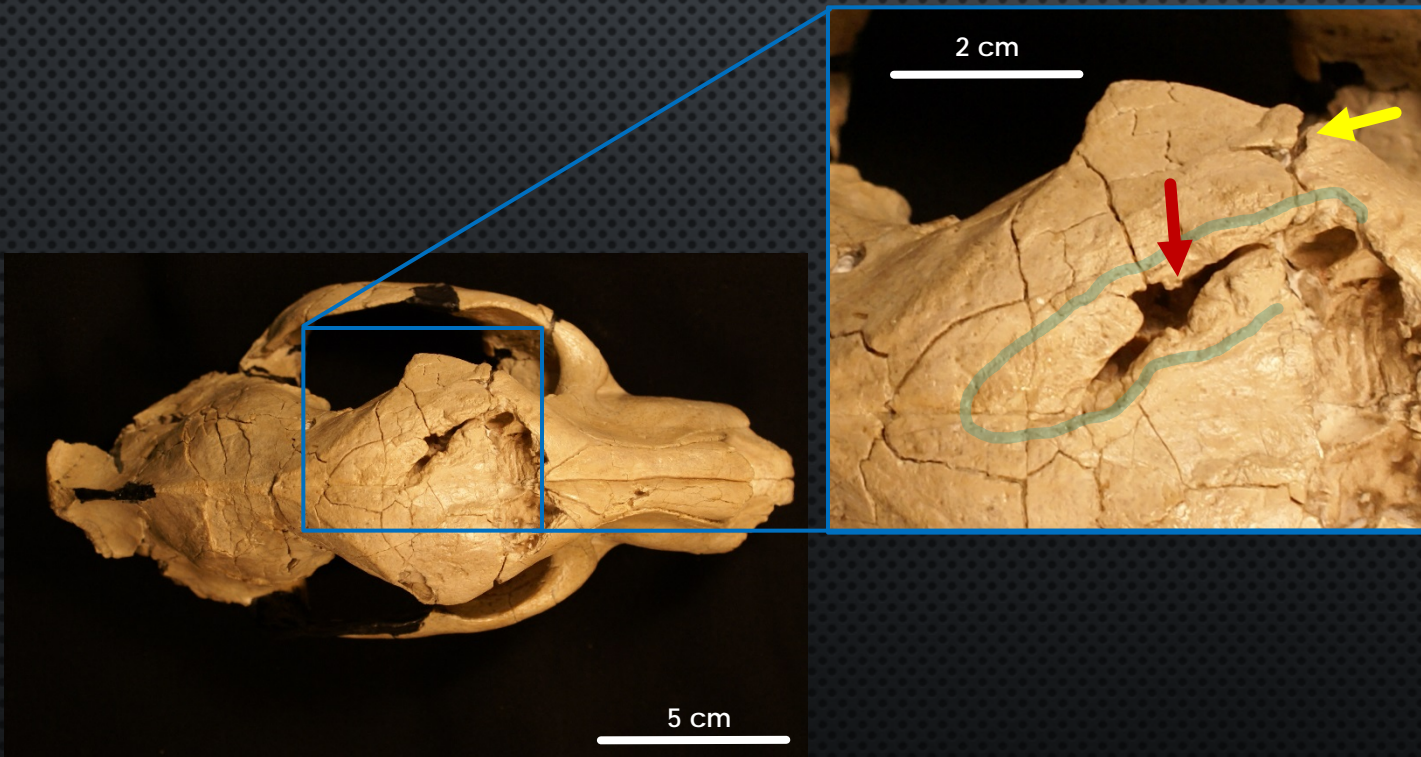


SDSM 2663: *Dinictis felina*



RE-EXAMINATION OF SDSM 348

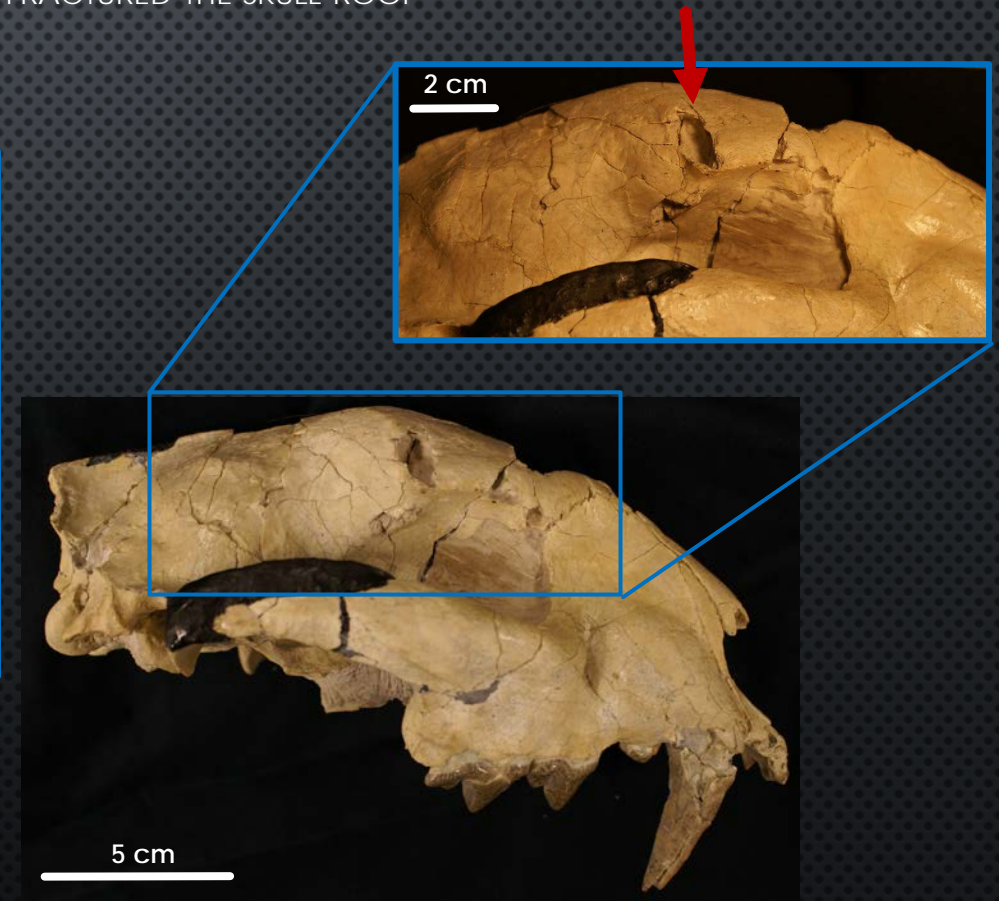
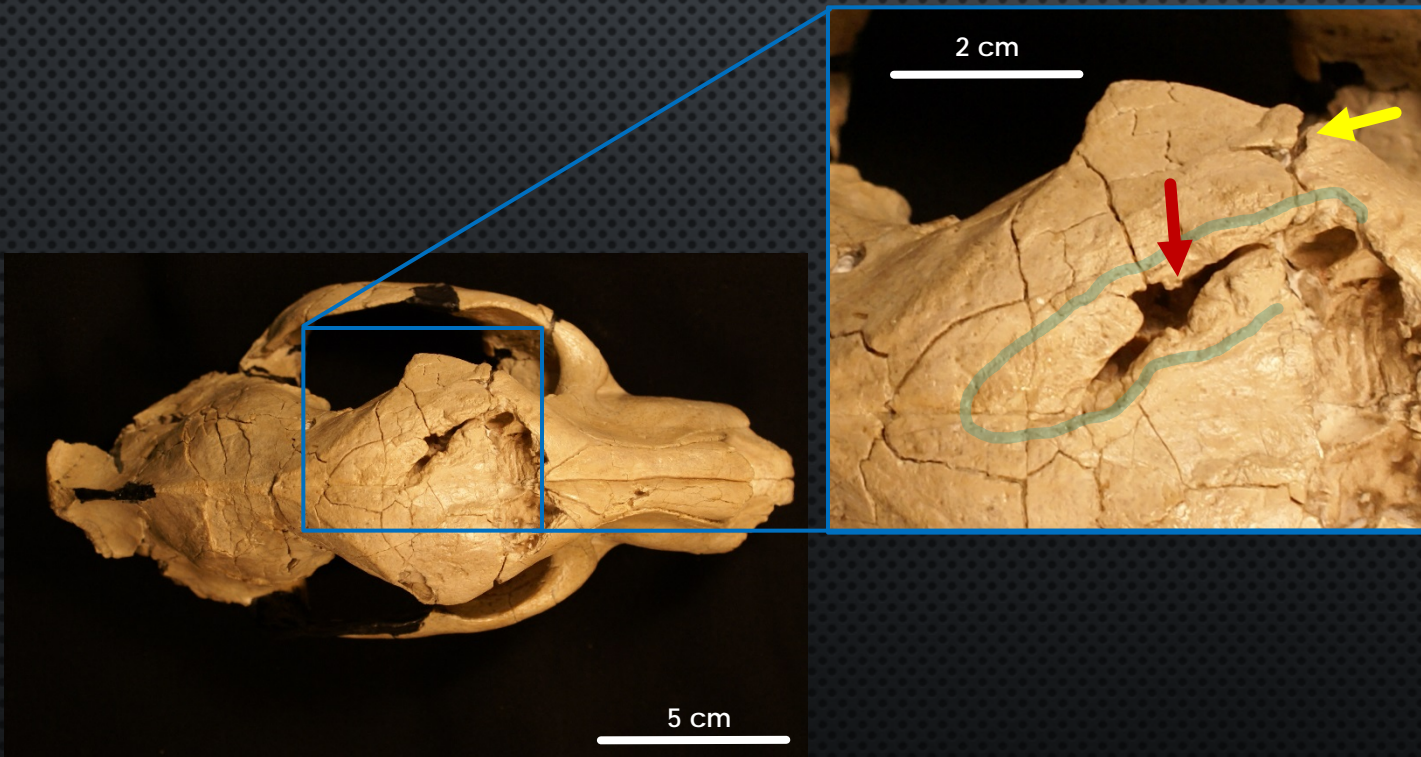
- PREPARATION AND CONSERVATION WORK REVEALED:
 - REHEALED BITE DISPLAYS BONE INFECTION (LIKELY OSTEOMYELITIS)
 - NOT A DEEP PUNCTURE, BUT A FAILED PUNCTURE THAT FRACTURED THE SKULL ROOF



Bruce Horsefall painting at Museum of Geology, South Dakota School of Mines and Technology, Rapid City, SD

RE-EXAMINATION OF SDSM 348

- PREPARATION AND CONSERVATION WORK REVEALED:
 - REHEALED BITE DISPLAYS BONE INFECTION (LIKELY OSTEOMYELITIS)
 - NOT A DEEP PUNCTURE, BUT A FAILED PUNCTURE THAT FRACTURED THE SKULL ROOF
 - A SECOND SET OF BITES WITH NO REHEALING



IS THERE A CONSISTENT PATTERN?

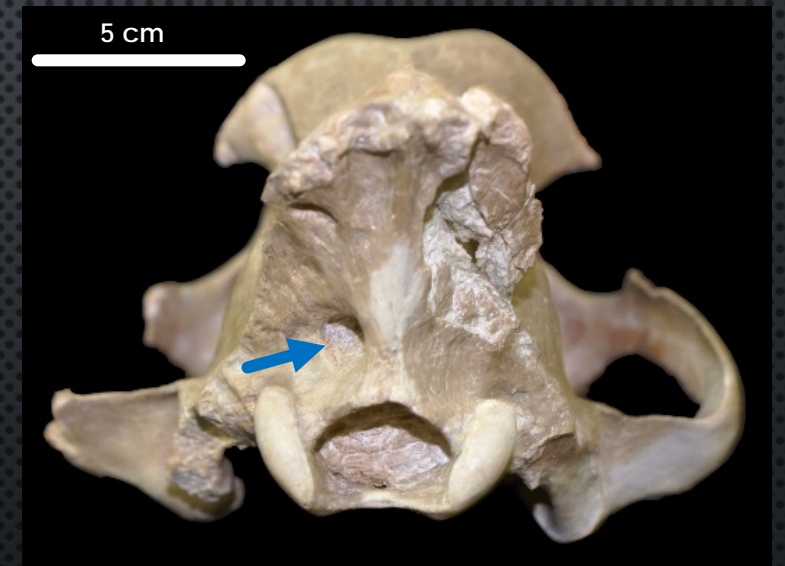
- LOWER CANINE PUNCTURES ARE ALWAYS AT BACK OF SKULL



SDSM 293: *Dinictis* sp.



SDSM 2663: *Dinictis felina*



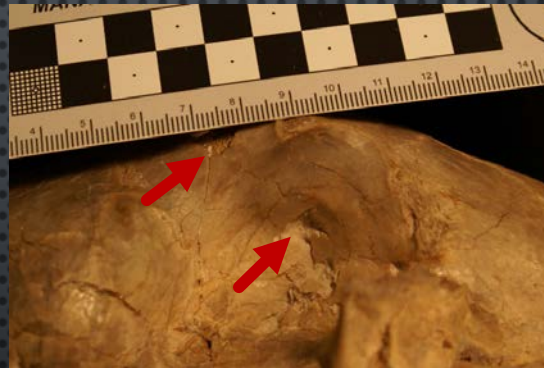
BADL 59490: *Hoplophoneus* sp.

IS THERE A CONSISTENT PATTERN?

- DEEP UPPER CANINE PUNCTURES IN OR AROUND ORBITS
- CLEAR ATTEMPTS TO BLIND AN OPPONENT



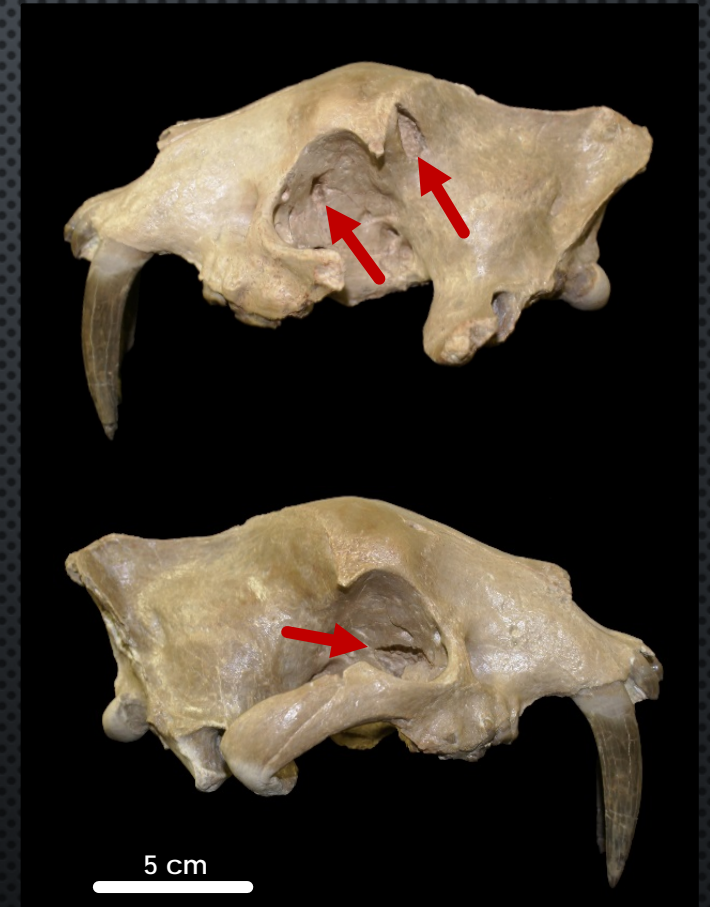
SDSM 2663: *Dinictis felina*



SDSM 293: *Dinictis* sp.



SDSM 348: *Nimravus brachyops*



BADL 59490: *Hoplophoneus* sp.

IS THERE A CONSISTENT PATTERN?

- IMPACTS TO THE FRONTAL ALWAYS FAIL



SDSM 348: *Nimravus brachyops*



BADL 42047: *Nimravus brachyops*

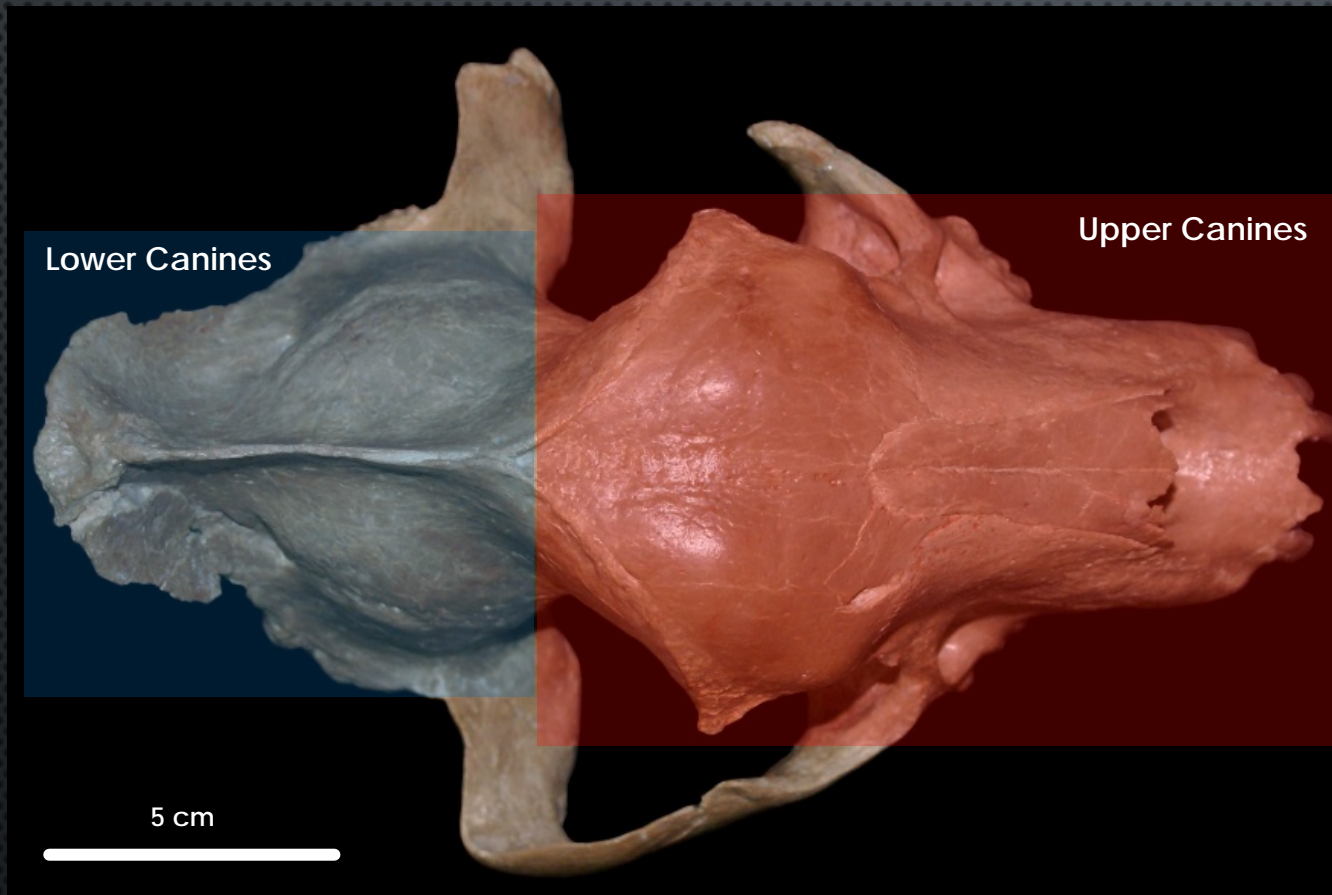


BADL 59490: *Hoplophoneus* sp.



SDSM 2663: *Dinictis felina*

PROPOSED BEHAVIOR: AMBUSH



BADL 59490: *Hoplophoneus* sp.



"The Innocent Assassins" painting by Jan Vriessen (2007)

IDENTITY OF ATTACKER

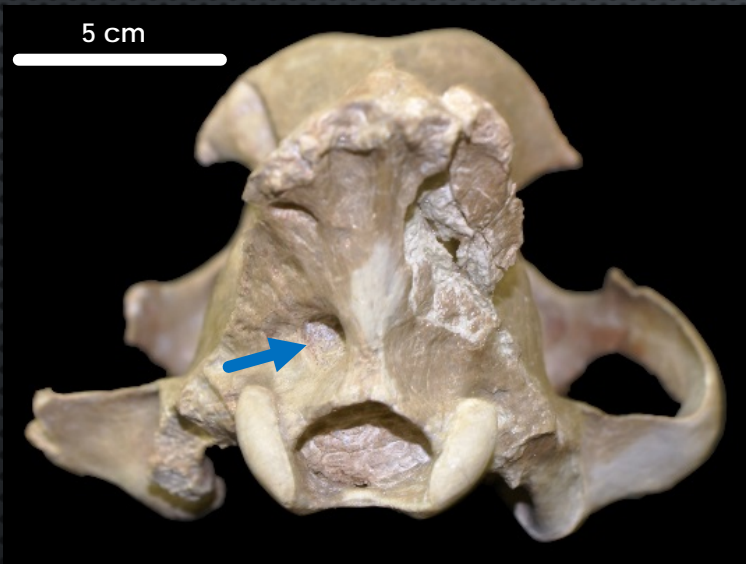
- *NIMRAVUS*



-*Nimravus* specimen on display at UNSM (Mo-109 1091)

IDENTITY OF ATTACKER

- *NIMRAVUS?*
- LOWER CANINE PUNCTURES ARE LARGE AND ROUNDED
- NO TRACE OF THE INCISORS

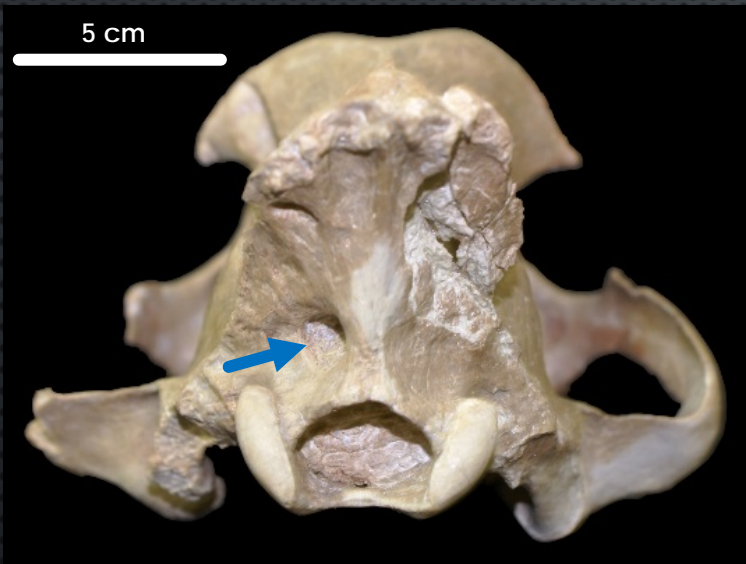


BADL 59490: *Hoplophoneus* sp.

IDENTITY OF ATTACKER

- *NIMRAVUS?*
- LOWER CANINE PUNCTURES ARE LARGE AND ROUNDED
- NO TRACE OF THE INCISORS

NO



BADL 59490: *Hoplophoneus* sp.



SDSM 2553:
Hoplophoneus primaevus

MAYBE



SDSM 2663: *Dinictis felina*

LIKELY



SDSM 348:
Nimravus brachyops

IDENTITY OF ATTACKER

- NIMRAVUS?
 - NOT ALWAYS: UPPER CANINE TOO SHORT



BADL 59490: *Hoplophoneus* sp.



SDSM 348: *Nimravus brachyops*

IDENTITY OF ATTACKER

- *NIMRAVUS?*
 - NOT ALWAYS: UPPER CANINE TOO SHORT?
 - NOT THE RIGHT AGE

Orellan NALMA



BADL 59490: *Hoplophoneus* sp.

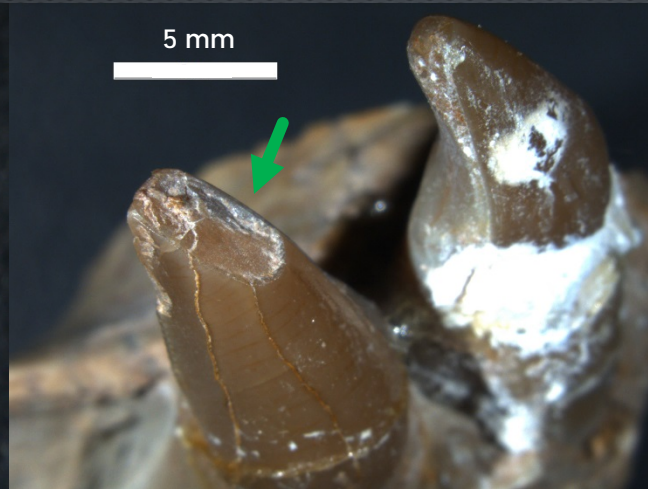
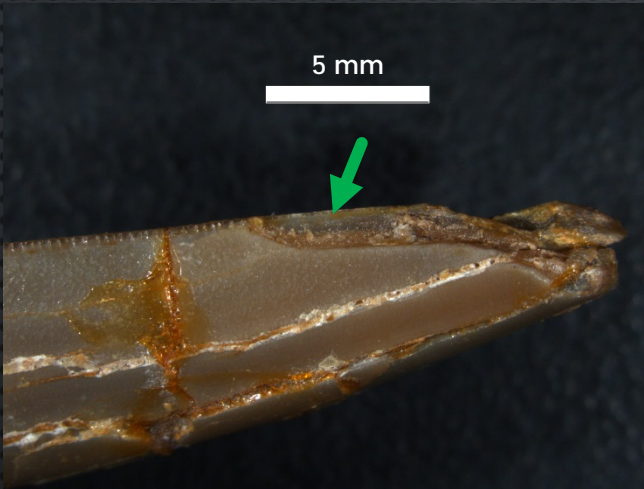
Whitneyan and Arikareean NALMAs



SDSM 348: *Nimravus brachyops*

ENAMEL SPALLING

- ENAMEL SPALLING ON CANINES AND INCISORS IS OBSERVED IN SEVERAL SPECIMENS
- CHIPPED TEETH LIKELY RESULTED FROM IMPACTS ON HARD OBJECTS (E.G., BONE)



SDSM 28153: *Hoplophoneus* sp.



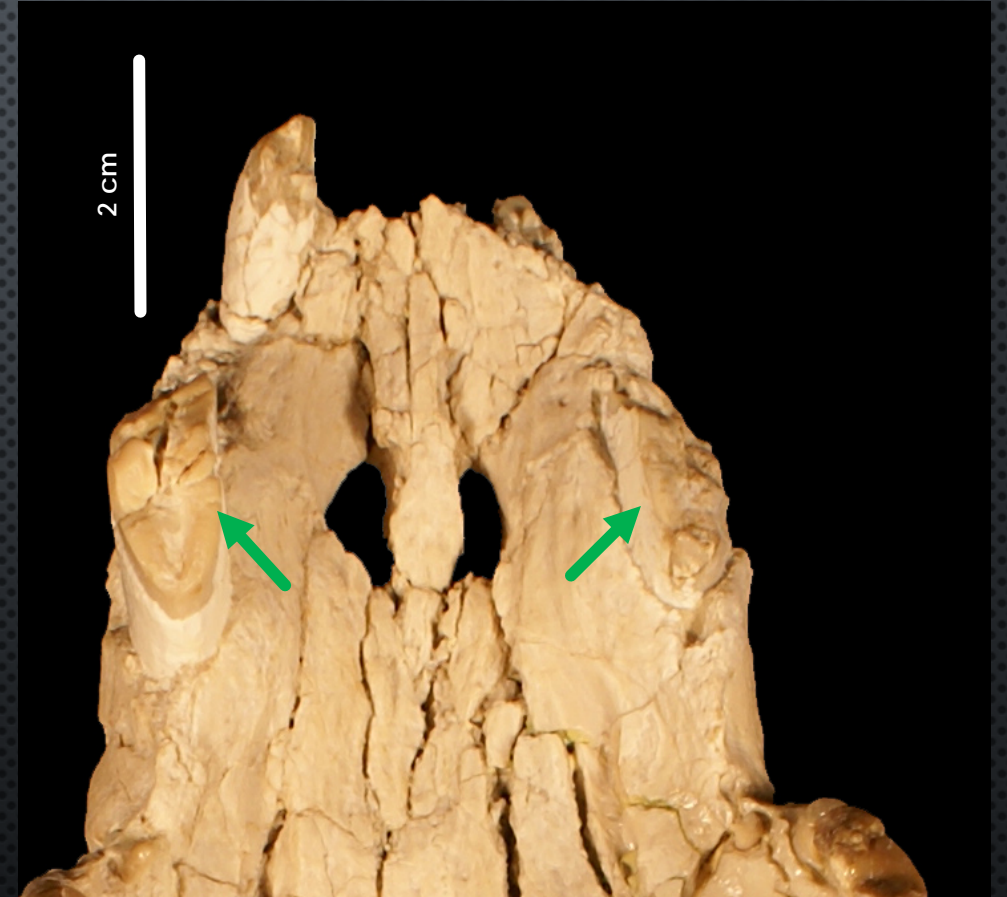
BADL 53913: *Nimravidae* indet.

BROKEN TEETH

- LIFE WITH BROKEN CANINES WAS POSSIBLE



SDSM 2417: *Hoplophoneus mentalis*



SDSM 2417: *Hoplophoneus mentalis*

HUNTING VS. SURVIVAL



Mural by Charles R. Knight



"The Innocent Assassins" painting by Jan Vriessen (2007)

CONCLUSIONS

- BITES ARE NOTED ON AT LEAST SIX SPECIMENS FROM THREE DIFFERENT NIMRAVID SPECIES
- NIMRAVIDS WERE WILLING TO ENGAGE IN “RISKY” BEHAVIOR (I.E. BONE BITING) WHEN IMMEDIATE SURVIVAL WAS ON THE LINE
- THESE SPECIMENS SHOW THAT INTRASPECIFIC COMBAT IN NIMRAVIDS WAS MORE FREQUENT THAN PREVIOUSLY THOUGHT
- SOME ATTACKS ARE CLEARLY REFERABLE TO *NIMRAVUS*, BUT NOT ALL ARE CONSISTENT WITH THIS TAXON



ACKNOWLEDGEMENTS

COLLECTIONS ACCESS:

- BADLANDS NATIONAL PARK
 - MEGAN CHERRY
 - RACHEL BENTON
- MUSEUM OF GEOLOGY, SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
 - SALLY SHELTON
 - DARRIN PAGNAC
- UNIVERSITY OF NEBRASKA STATE MUSEUM
 - GEORGE CORNER
 - GREG BROWN
 - ROSS SECORD