Poster Generation: A Piece of the Art in Science

Medical Student Training in Research Enrichment Session

Wed, July 29th, 2015

Douglas M. Bennion, MD-PhD Candidate

"A poster is basically an artistic expression of scientific data. Posters usually have eye-catching yet simple drawings, diagrams, graphs and/or photographs with clean and attractive layouts."

~from the Poster Guidelines for the American Heart Association International Stroke Conference 2015

Outline

- Why Posters? 
- Titles and Affiliations
- Abstract
- Introduction and Specific Aims
- Materials and Methods
- Results
- Conclusions
- Presentation Pointers

Why Poster Presentations?

- The Venue
  - Varies – large conference centers, hotel ballrooms, academic buildings, hospital lobbies
  - Poster boards, electronic displays
- The Audience
  - Varies – several dozen to tens of thousands, but…
  - Colleagues in your field
  - The judges
- The Content
  - Stay tuned
- The Point
  - *Enthusiastically and efficiently* communicate your work to convince others to a commit to your cause and get feedback and insight to guide your future efforts

Getting Started – Read the Instructions

- Virtually all conferences/symposia have explicit poster criteria
- Pay careful attention to the dimensions and the deadlines
- Within these limits, let your creativity abound
- Example: http://my.americanheart.org/professional/Sessions/InternationalStrokeConference/Programming/For-PresentersModerators-ISC_UCM_424151_Article.jsp

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Crafting a Poster Title

- The title is the only thing that most people will read about you or your work – make it count
- Avoid lengthy titles with lots of technical language
  - Acronyms are usually not appropriate
  - Familiar terms and catchy phrases are enticing
  - E.g. “Practicality of Intermittent Fasting in Humans and its Effect on Oxidative Stress and Genes Related to Aging and Metabolism”

    versus

    “Feast then Famine: How Fasting Makes Our Cells More Resilient to Stress”
- Positive Statement versus the Effect Statement

Poster Titles

- Positive Statement

  Ischemic Stroke Increases Activity of the Neuroprotective Angiotensin Converting Enzyme 2

  Antisense Oligonucleotide to Connective Tissue Growth Factor Inhibits Rabbit Corneal Scarring

- Effect Statement

  Effect of Ischemic Stroke on Activity of the Neuroprotective Angiotensin Converting Enzyme 2

  Effects of an Antisense Oligonucleotide to Connective Tissue Growth Factor on Rabbit Corneal Scarring

Titles and Affiliations

- Read the instructions – can be variable
- In general, list in author order (presenter first) each author's first name, middle initial, and last name
- If affiliations are all the same, list affiliation on a separate line without superscripts; if different, denote with numerical superscripts just after author last names for all authors, e.g.:

Douglas M Bennion[1], Colin Sumners[1], Michael F Waters[2]

[1]Department of Physiology and Functional Genomics, College of Medicine, University of Florida; [2]Neurovascular Division, Department of Neurology, College of Medicine, University of Florida

Poster Title Practice

- Two minutes to craft your own title
- Use a template of your choice
- Keep your audience in mind (level of technicality/jargon)
- Show and Tell Time

Go to http://discovery.education.med.ufl.edu for poster instructions for Medical Student Research Day

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Abstract

- For those who make it past the title, this is the only other thing that most people will read (e.g. review committee members) – make it count
  - May be printed in the program and is the only permanent record of your presentation
- Can be included in its entirety on the poster, but rarely required
- Effective to break up for use in subsequent sections of the poster
- Can be rolled in with the Introduction section

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Introduction Section

- Can also be labeled as BACKGROUND
- Emphasize the "research gap"
- Report key findings from previous work
- Use bullet points (2-3) rather than paragraphs – visual appeal and much easier to rapidly digest
- Leads directly to the Specific Aims

Specific Aims Section

- Can also be labeled as OBJECTIVE or HYPOTHESIS
- Should be clear, concise, and easy for non-experts to understand
- If more than one, use numbers or bullet points
- Oft-used phrases: “We hypothesized that…” or “We tested the hypothesis that…” or “To determine the effect of…” or “To examine the impact of…”
- A diagram or visual of some kind can be incredibly helpful and allows you to refer back easily

Intro/Specific Aims Practice

- Five minutes to draft several introductory bullet points and specific aims
- Keep your audience in mind (level of technicality/jargon)
- Show and Tell Time

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Materials and Methods

- Rule of Thumb: Less is more
  - Describe any essential methods/techniques verbally
  - Use citations (*sparingly!*) to save space; example:

    We used methods previously established in our laboratory for inducing experimental stroke (Mecca A et al. *Exp Phys* 2011;23(1):125-32)
- Things to include:
  - Sources of key/unique reagents or animal models
  - Brief outline of experimental design
  - Numbers of replicates (n values) and statistical tests
  - Define of all abbreviations

Materials and Methods Practice

- Three minutes to draft Materials and Methods bullet points:
  - Relevant citations
  - Cohort sizes and brief experimental design
  - Statistics (paired t-test, two-way ANOVA, multiple linear or logistic regression
- Keep your audience in mind (level of technicality/jargon)
- Show and Tell Time

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Results Section

- Usually takes up the bulk of the poster space
- Includes graphs and tables prepared *as large as possible* to enhance readability
- Should be neat in appearance, uniform, and high resolution (no fuzzy figures!!!)
  - Utilize **COLOR** to differentiate treatment groups
  - Don't forget legends
  - Should be self-contained – i.e. can be basically understood without you there to explain it
  - Label X and Y axes correctly and carefully
- This is where the rubber meets the road – know your data and be ready to defend it

Fuzzy vs Fantastic

Figure 1. Activity of ACE2 in serum and brain is altered following stroke in rats

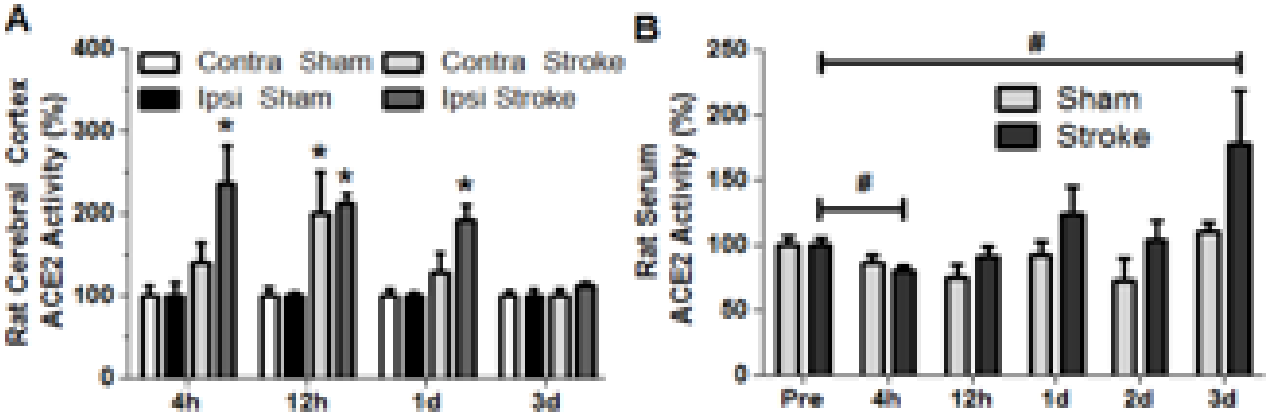
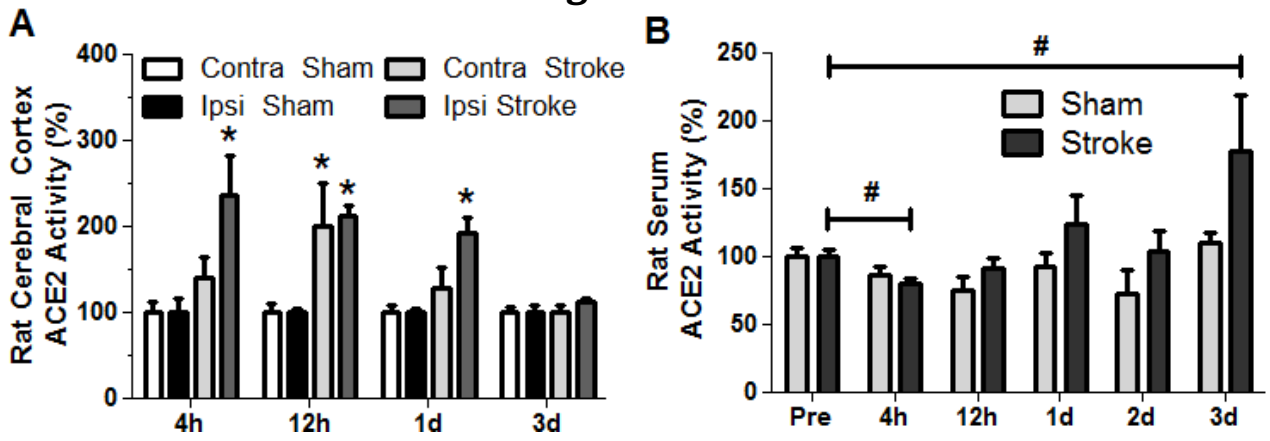


Figure 1. Activity of ACE2 in serum and brain is altered following stroke in rats



Results Section – other points

- Figure titles can be very helpful
- Full figure legends are completely optional
  - Adds quite a bit of text to poster and makes it appear more dense
  - Allows the poster to stand alone during display hours
  - If not used, ensure methods section contains clear information about cohort numbers and different experimental designs
- Learn your figure-generating software well enough to get fantastic figures and tables; ask for help if you don't know how

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Conclusions Section

- For anyone who reads through the title *and* the abstract/introduction, this may be the only other thing that they read – make it count
- Numbered or bulleted (the Rule of 3's)
- Try to place your findings in the context of the larger research field
- Appropriate to mention strengths and weaknesses

References and Acknowledgements

- References can be cited in line (e.g. Rosado et al. *J of Hypert*. 2015;66(1):215-9.) or using superscripts with a separate references section.
  - Try to limit references 5 max
  - Use references to save space, when possible
- Acknowledge sources of funding – a one-liner near the Conclusions section is sufficient.
  - For example: We gratefully acknowledge support from the National Institute of Neurological Disorders and Stroke and the UF McKnight Brain Institute.

Conclusions Practice

- Five minutes to draft Conclusions bullet points:
  - Summarize findings
  - Statement of potential significance and future direction
  - Strengths and Weaknesses
- Keep your audience in mind (level of technicality/jargon)
- Show and Tell Time

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Presentation Pointers

- Practice, practice, practice – this is your time to shine!
- Be excited, smile, and talk loud and interestingly enough to be heard
- Use 10 seconds to get an idea of your listeners' background and interest
  - Ask the person 'What is your background in (topic)?'
  - Tailor your message to their experience and time
  - Have 30 second, 2 min, and 5 min versions ready to go
- Always finish strong – hit your main conclusion points and end with a smile

Questions?

Patterns in sea otter resource selection in Kachemak Bay, Alaska

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Abstract

This study relates patterns in sea otter resource selection to benthic habitat type and available sea otter prey quantity and quality in order to understand why otters frequent certain geographic areas over others. Findings suggest that hard-bottom habitats and their associated prey communities are more heavily utilized by otters in the greater Kasitsna Bay area of Kachemak Bay, Alaska.

Introduction

The ability of sea otters to significantly reduce prey abundance, limit prey size, and consequently alter community structure has been well documented (Estes & Palmisiano 1974, Estes et al. 1978). Much of this research, however, has focused on sea otter interactions with rocky habitats. Relatively little is known the otters ability to limit prey populations in soft-bottom communities (Kvitek et al. 1992) or how patterns in sea otter space use and foraging ecology respond to heterogeneous landscapes.

In South Central Alaska, sea otters occupying the shallow broad shelf habitats of Kachemak Bay have equal access to both rocky and soft-bottom habitat types within their natural range. The proximity of different grain sizes in the bay provides a unique opportunity to relate known sea otter foraging activity to a particular substrate type and associated prey community. In this study, patterns in sea otter space use detected by telemetry and aerial observations will be described in terms of available habitat and prey. Biomass and energy per unit area will be used as currencies to compare the potential contribution of habitat types to sea otter diet.

Understanding how otters interact with a variety of available habitat types and prey fields in Kachemak Bay is critical to the monitoring and management of this species as it continues to stabilize in an ecologically, commercially, and recreationally important area in coastal Alaska.

Objectives

- Determine if patterns in sea otter resource selection can be described by habitat type.
- Determine if patterns in sea otter resource selection can be described by available prey quantity and quality.

Hypotheses

1. Given equal access to soft bottom and rocky habitats, sea otter will select habitats with larger grain sizes.
2. The magnitude of site utilization will relate directly to available biomass and energy density per unit area in potential prey species.

Methods

Fig. 1: Map of the greater Kasitsna Bay area, Alaska (inset). Tagged sea otter locations indicated by circles (female in red and male in blue). The Kasitsna Bay Lab is denoted by an asterisk. (Image courtesy of A. Doroff, USFWS)

Fig. 2: Sea otter utilization distribution determined by aerial (blue transect lines) and coastal (red transect lines) VHF telemetry surveys during 2007. Bubble size corresponds to frequency of use. (Image courtesy of A. Doroff, USFWS)

Study Area

This study was carried out in the greater Kasitsna Bay area (59° 20' 49N, 151° 30' 37W), located on the southern shore of the Kachemak Bay Research Reserve, Lower Cook Inlet, Alaska (Fig. 1).

Site Selection

Sites in the Kasitsna Bay area were selected using utilization distribution data (Fig. 2), accessed by small boat from the Kasitsna Bay Laboratory, and sampled using SCUBA.

Methods

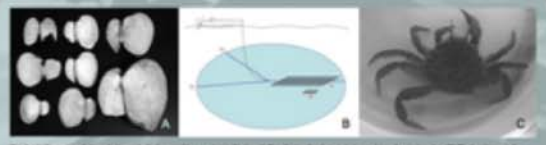


Fig. 3: (A) Examples of discarded prey shells deposited by sea otter in Kachemak Bay. Notice the characteristic smashing of a single valve. (B) The benthic sampling protocol used to sample live prey (22) and discard shells (72) at each site. (C) Sample of a dominant live prey species, the helmet crab (*Telmessus cheiragonus*).

Sampling Design

Discarded Prey Shells (Fig. 3A) were sampled via three 20m x 2m belt transects (40m²) and total shell counts per transect (Fig. 3B) were used to determine mean shell density (per m²) for each habitat type.

Live Potential Prey (Fig. 3C) were sampled using three .5m x .5m x 20cm quadrats (.05m³) using an airlift suction dredge (see Kvitek and Oliver 1992). All live prey were collected and measured.

Size to Mass and Energy to Mass Calculations

Length measurements (mm) were taken on all discarded prey and live prey samples collected in each habitat type. Lengths were used to calculate available biomass (mg of dry mass per m²) and energy density (J mg⁻¹dry mass) per unit area using conversion factors for each distinctive species (see Dean et al. 2002).

Prey Species	Dry mass (mg) vs. size (mm)	Energy (J mg⁻¹dry mass)
Saxidomus gigantea	Mass = 0.0001 x length$^{3.355}$	18.81
Telmessus cheiragonus	Mass = 0.000046 x length$^{3.394}$	11.94

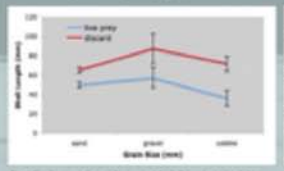
Results

Which Habitats do sea otter utilize most?

27 sea otter foraging sites were sampled: 71% occurred in cobble habitats (grain size 64-256 mm), 22% in gravel habitats (grain size 2-64 mm) and 6% in sandy habitats (grain size 1-2 mm).

Discarded Prey Shells

- Sea otter cracked shells were equally abundant in gravel habitats (0.43 ± .06/m², n=105) and sandy habitats (0.40 ± .01/m², n=49) yet were noticeably smaller and more size limited in sandy habitats.
- Shell records associated with gravel habitats provided both the highest calculated biomass (.82 ± .27 mg/m²) and total available energy per unit area (15.42 ± 18.68 kJ m⁻²) of all three habitats (sand: .34 ± .05 mg/m², 6.93 ± 9.88 kJ m⁻², and cobble: .29 ± .04 mg/m², and 5.49 ± 12.62 kJ m⁻²).
- A notable discrepancy was detected between mean length of bivalves in the shell record and mean length of living bivalve species (Fig. 4).



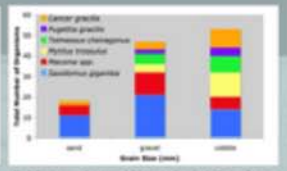


Fig. 4: Size discrepancy between live prey and the shell record in various habitat types. Axis note the discrepancy in size class indicated by deviation from the mean.

Fig. 5: Species counts from various habitat types collected in the Kasitsna Bay area.

Live Potential Prey

- 6 major prey species were collected during this study (Fig. 5). *Saxidomus gigantea* were most abundant at all sites yet were noticeably larger in the shell record (Fig. 4, denoted in red).
- Two dominant species *S. gigantea* and *Telmessus cheiragonus* drove the separation of sand, gravel, and cobble habitats (SIMPER analyses, $p<0.01$). Bubble plots of biomass (Fig. 8, 9) and energy density (Fig. 10, 11) per habitat type illustrate how the size and caloric value of these two dominant prey vary with substrate type.

Results

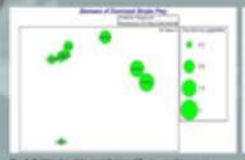


Fig. 8: Bubble plot of the contribution of *S. gigantea* biomass to the gradient in habitat separation.

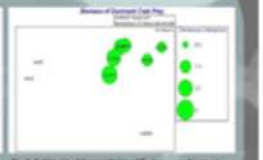


Fig. 9: Bubble plot of the contribution of *T. cheiragonus* biomass to the gradient in habitat separation.

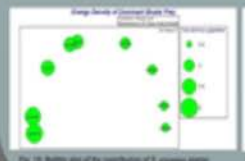


Fig. 10: Bubble plot of the contribution of *S. gigantea* energy density to the gradient in habitat separation.

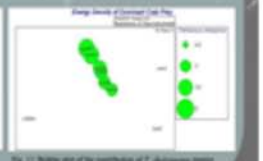


Fig. 11: Bubble plot of the contribution of *T. cheiragonus* energy density to the gradient in habitat separation.

Discussion and Conclusions

- Gravel habitats were the most profitable habitat type in the Kasitsna Bay area, providing the highest biomass and energy per unit area. Larger and more evenly distributed size classes of *S. gigantea* and *T. cheiragonus* were largely responsible for this finding (Fig. 8, 9, 10, 11).
- The importance of *S. gigantea* to sea otters is reflected both in the otter-cracked shell record and the live bivalve assemblage. Over-representation in the predation record may be the result of either sea otter preference or the tendency for shells of larger butter clams to persist longer than those of smaller species.
- Prey communities in sand habitats show evidence of either intensive sea otter predation pressure or are the result of long term occupancy. Sea otter prey biomass and size have been shown to vary inversely with duration of sea otter occupancy. It is possible that sea otters initially foraged on and rapidly depleted bivalve populations in the Kasitsna Bay area during re-colonization and that present populations are size limited and thus less preferred.

Future Implications

- The side-scan mapping of Kachemak Bay (NOAA 2008) will enable habitat information gathered in the greater Kasitsna Bay area to be extrapolated to the entire Kachemak Bay system.
- Future analysis will focus on (1) the development of probability fields to describe sea otter foraging in various habitats across seasons and (2) the estimation of habitat availability and prey energy per km (kJ km⁻²) for available habitats in Kachemak Bay.

Acknowledgements

I would like to thank Brenda Konar (UAF), Angela Doroff (USFWS), Dana Thomas (UAF), Jim Bodkin (USGS), and Tim Tinker (USGS) for their guidance during this study.

Special thanks to Tamil Ellal (UAF) for his dedicated assistance in the field, as well as Michelle Stewart and the staff at the UAF NOAA Kasitsna Bay Laboratory for their dedicated topside support.

Soil Microbial Diversity in a Mongolian Climate Change Experiment

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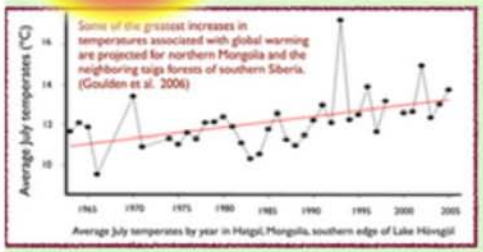
NSF PIRE Mongolia Project — Partnerships in International Research & Education

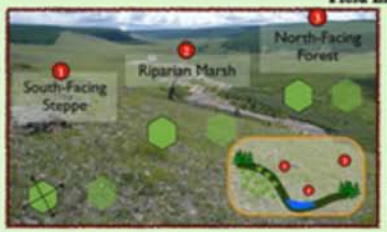


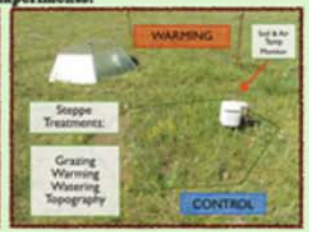
How will microbial communities be affected by, and in turn, affect climate change?

Introduction - 2009 Baseline:

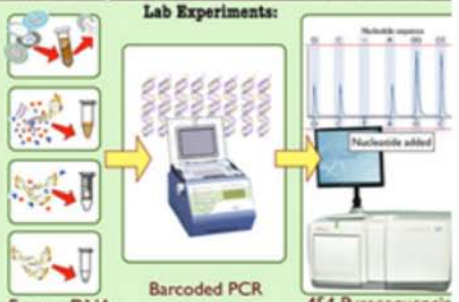
Hypothesis: Microbial diversity highly correlated with moisture regime
- A: Between habitats
  - Arid steppe - lowest diversity
  - Moist forest - intermediate diversity
  - Wet riparian - highest diversity
- B: Within steppe habitat
  - more arid upper slope - lowest diversity
  - less arid lower slope - higher diversity

Field Experiments:





Lab Experiments:



Experimental Design:

- Valley 1:
  - Warming across 3 habitats (replicated 4x)
- Valley 2:
  - Steppe only
    - Upper Slope: Warming & Watering (7x)
    - Lower Slope: Warming & Grazing (8x)
- Soil Cores
  - 2cm x 10cm
  - Stored in MoBio LifeGuard (Carlsbad, CA, USA)

Molecular Work:

- PCR:
  - 16S barcoded primers (McKenna et al. 2008)
- Pyrosequencing:
  - Roche 454 Genome Sequencer Junior System
  - Stored in MoBio LifeGuard (Carlsbad, CA, USA)
- Bioinformatics software:
  - QIIME (Caporaso et al. 2010)
  - Mothur (Schloss et al. 2009)

Results:

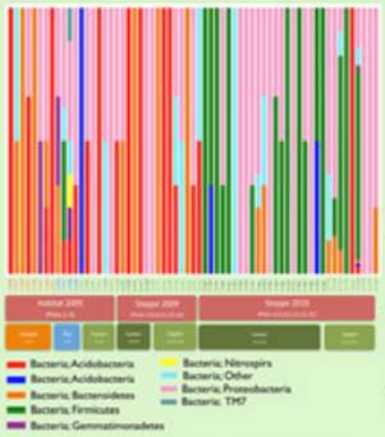


Figure 1. Taxonomic composition at the phyla level (in percentage) of bacterial communities in soil samples from various experimental treatments.

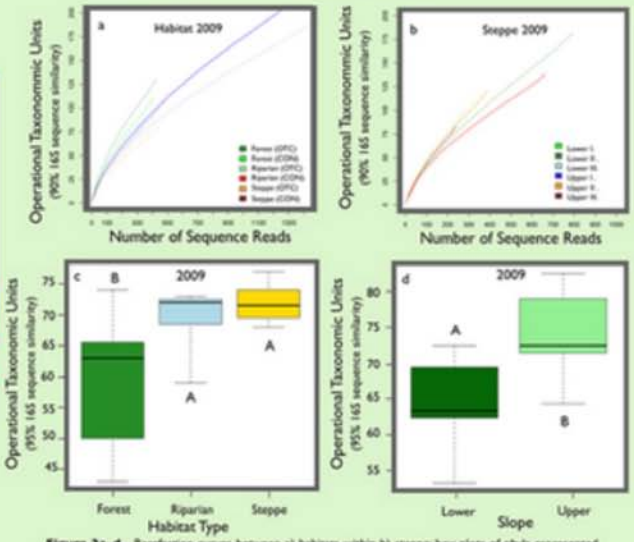


Figure 2a-d. Rarefaction curves between a) habitats within b) steppe; box plots of phyla represented between c) habitats within d) steppe along topography gradient (100m elevation difference). OTC: Open-

Discussion:

- **Taxonomic composition across habitats and years** (Fig. 1):
  - The community composition varied significantly between years within the steppe habitat ($F=3.15$, $p<0.01$)
  - Neither habitat nor topography had an effect on composition at the phyla level
    - Studies over a longer time period and finer taxonomic resolution needed
- **Taxonomic composition across habitats** (Fig. 2 a,c):
  - Habitat type significantly affected bacterial phyla ($F=7.13$, $df=2, 20$ $p<0.01$).
  - The forest had significantly lower diversity than either the riparian or steppe habitats.
- **Taxonomic composition within steppe habitat** (Fig. 2b,d):
  - There were significantly more species on the upper slope than on the lower slope in the steppe ($F=9.35$, $df=1,14$ $p<0.01$)
- **Hypotheses not supported by data!**
  - Moisture not the major variable affecting microbial diversity at phyla level

Future Directions:

- Compare samples from 2009-2013
- Denoise sequence reads
- Compare at species level
- RNA expression studies
- Enzymes assays

Acknowledgements:

Casper, Petraitis, Bushman, Adams & Gallagher Lab
NSF PIRE Mongolia Project
NSF EAPSI Program

References: Caporaso, J.G., et al. 2010: *Nature Methods*.; Goulden, C. E., et al. (Eds)., 2006: *The Geology, Biodiversity and Ecology of Lake Hövsgöl (Mongolia).*IPCC., *Climate Change 2007: Synthesis Report*.; McKenna, P., et al., 2008: *PLoS Pathogens*.; Schloss, P.D., et al., 2009: *Appl Environ Microbiol*.

Accomplishments and Status of SGP During 2008

Brad W. Orr[1] Dan J. Rusk[2] John Schatz[2]
David Breedlove[2] Richard Eagan[1]
[1]Argonne National Laboratory, Argonne, IL
[2]ACRF/SGP, Cherokee Nation Distributors, Stilwell, OK

INSTRUMENTS

- MFRSR UPGRADE COMPLETED AT SGP
  - New filters and loggers
  - Reworked ingest and collections
  - Heater board re-engineered
- IRT NETWORK INSTALLATION COMPLETED

FACILITIES

- Enhanced Dynamic Rain Gauge calibrations
- MFRSR Calibration capability fully functional

MFRSR Calibration bench and monochrometer in RCF

50 MHz Wind Profiler decommissioned

COMPUTER OPERATIONS

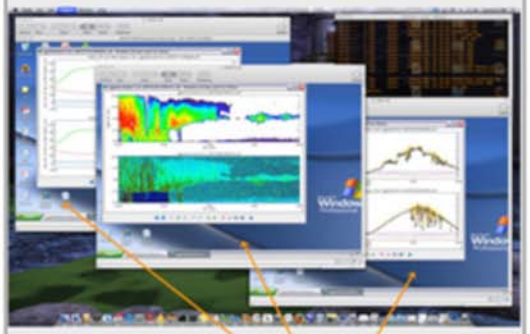
VIRTUAL MACHINE (VM) IMPLEMENTATION

CONCEPT: One host computer system runs one or more guest machines (VMs). The host and guest operating systems do not have to be the same (Solaris, Linux, Windows, ...). Each VM functions as a completely independent computer system minimizing the need for physical computers. Systems used for hosting instrument VMs will use server class hardware (i.e. very reliable).

STATUS: Design, testing and implementation being done at SGP.

OPERATIONAL SYSTEMS

- SGP Collector
- Instrument backup systems at SGP, NSA and TWP
- Instrument system at SGP running a VCEIL, MWR and IRT



"Artists" rendition of SMOS, MMCR and SIRS Virtual Machines on a single host computer system.

GENERAL STATISTICS

- **Instrument Availability** - Averaged over 95% during 2008.
- **Electronic Repair Lab** - $20,000 in savings
- **Calibrations** – Over 140 instruments calibrated
- **Guest Instruments Supported** – 40
- **Site visitors** – Over 100 visits by scientists and guests at the Central Facility.
- **Field Campaigns** – 18 Campaigns supported last year.

Orbiting Carbon Observatory (OCO) installed at CF – Charles Miller (PI)

915 MHz Profiler relocated and installed at Cement for vertical velocity study – Michael Jensen (PI)

Acknowledgments

We would like to thank the entire SGP staff for another year of excellence and for their continued support of all aspects of operations. This work was supported by the Office of Biological and Environmental Research of the U.S. Department of Energy as part of the Atmospheric Radiation Measurement Program.

Activity of the Neuroprotective Angiotensin Converting Enzyme 2 is Altered in the Acute Phase of Rat and Human Ischemic Stroke

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introduction

INTRODUCTION

- Stroke biomarkers may aid early diagnosis, clinical management, and treatment monitoring
- The renin angiotensin system plays an integral role in cardiovascular health overall and fluid homeostasis and blood pressure control during stroke
- ACE2 action is neuroprotective in ischemic and hemorrhagic stroke in pre-clinical studies, adding promise to its potential as a biomarker for stroke.

hypothesis

HYPOTHESIS

We explored the stroke-induced changes in activity of ACE2 following stroke in rats and in humans, and we tested the deleterious effects in stroke of blockade of endogenous ACE2 in the rat brain

methods

METHODS

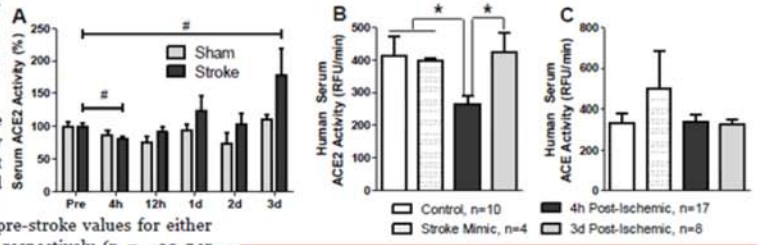
- Rats underwent either sham surgery or endothelin-1 (ET-1) induced middle cerebral artery occlusion, followed by serial serum collections. Some received central infusion of an saline or ACE2 antagonist, MLN-4760, with infarct size assessed 3d after stroke
- Human serum samples were collected by informed consent from controls or ischemic stroke or mimic (stroke-like symptoms) patients at Shands Hospital at UF at presentation and again at 3d after stroke onset
- Enzyme activity assessed by fluorometric assay

BASELINE CHARACTERISTICS

	Control	Mimic	Ischemic Stroke
#patients (M/F)	10 (3/7)	4 (0/4)	17 (10/7)
Age, mean ± SD	58.1±14.0	60.8±17.5	70.6±16.8
History of hypertension	60%	100%	40%
History of diabetes	40%	0%	52.9%
Time from onset, mean ± SD (hrs)	N/A	4.02±0.67	3.36±1.34

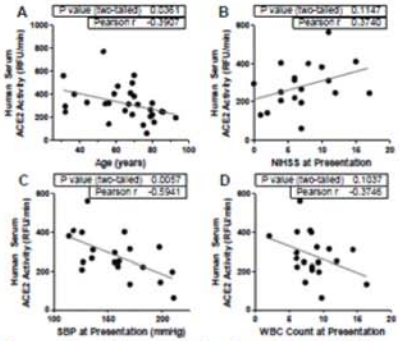
figures

Figure 1. Activity of ACE2 in the serum is altered following stroke in rats and in humans.



(A) Bar graphs are the average percent activity levels of ACE2 in rat serum at the indicated time points post-stroke. Data are normalized to pre-stroke values for either sham or stroke groups, respectively (n = ~20 per group) and are means ± SEM. # p<0.05 vs. respective pre-stroke values. **(B&C)** Bars represent the average percent activity levels of (B) ACE2 or (C) ACE in human serum from healthy controls or from ischemic stroke patients at 4h and again at 3d post-stroke. Data are are means ± SEM. * p< 0.05 vs. respective healthy controls. # p<0.05 compared to 4h post-stroke. RFU = relative fluorescence unit.

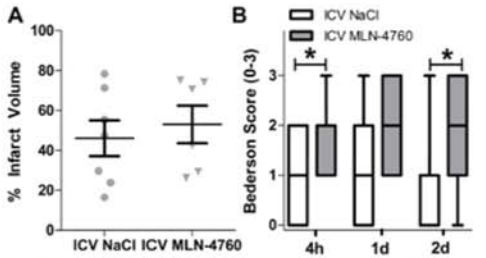
Figure 2. Levels of ACE2 activity correlate with clinical measures in stroke



Linear regression analysis showed correlation of ACE2 activity at presentation with the indicated measures. Significant correlations were not found for other variables of history of hypertension, type II diabetes, gender, length of hospital stay, ACE activity at presentation, or treatment with tPA, NIH stroke scale score or modified Rankin Score at discharge.

This work has been supported by the AHA (12PRE11940010), NHLBI (2T32HL083810-06A1), and UF McKnight Brain Institute - many thanks!

Figure 3. Effects of pharmacological inhibition or activation of ACE2 in rat ischemic stroke



(A) Infarct volume assessed at 3d post-stroke by TTC staining and image analysis did not show significantly larger stroke with ACE2 inhibition by MLN-4760 given by intracerebroventricular infusion (1mmol/L infused at a rate of 0.5µL/h, n = 6) for five days before and three days after ET-1 MCAO as compared to NaCl infusion (n = 7). **(B)** Neurological function at 4h and 3d post-stroke was significantly worse following MLN-4760 infusion. Data are means ± SEM. *p<0.05 compared to respective controls.

conclusions

CONCLUSIONS AND SIGNIFICANCE

1. We found dynamic alterations of the protective ACE2 pathway following stroke in both rats and humans
2. Endogenous brain ACE2 plays a protective role at preserving neurological function in stroke
3. Stroke therapeutics designed to target the ACE2/Ang-(1-7)/Mas axis may act in synergy with endogenous changes in the acute post-stroke setting, lending promise to further study of diagnostic/prognostic stroke biomarkers and potential neuroprotective agents