Ecological Knowledge and Predictions:
Integrating Across Networks and National Observatories

February 19-21, 2018
Environment & Natural Resources (ENR2) facility
http://enr2tour.arizona.edu/
University of Arizona
Tucson, AZ

A. Workshop Objectives

The science of ecology, and its relevance to society, are both in a period of rapid change. As a society, we are becoming increasingly globalized, while at the same time facing a growing number of environmental challenges, many of which are likewise international in scope and extent (e.g., climate change, invasive species, infectious disease). At the same time, our ability to measure and monitor the world around us has changed dramatically, both through technology development (e.g., remote sensing, automated instrumentation, high-throughput sequencing) and through the establishment of both top-down ecological observatories and bottom-up research networks. Our relationship with data has also shifted, becoming more open and interconnected rather than the protected, site-specific property of individual labs. These observatories and networks are changing the questions we are asking as a community and the scale we are asking them at.

Addressing both scientific hypotheses and environmental challenges at a global scale will require working across international networks and observatories. However, the aim of this meeting is not to get bogged down in well-trodden technical discussions of standards and interoperability, but to engage in a forward-looking and science-focused discussion about how networks and observatories can accelerate ecological knowledge-generation and predictive capacity. What scientific advances can we achieve in the near term, given data that is available or coming online? What new initiatives (e.g., training, education, tool development, cyberinfrastructure) would accelerate the scientific progress in, and societal relevance of, global ecology? Overall, this workshop is organized around three major themes:

1) **From Data Networks to Knowledge Networks:** A generation of ecologists has worked hard to shift the norms for data sharing, with the resulting data networks that have emerged being the direct result of that dream. As the research community has evolved, we are now well-positioned for a second paradigm shift that will take us to the next level – beyond storing and mining raw data, how do we store, mine, and synthesize our knowledge about, and understanding of, ecological systems? A key challenge is that the pace and volume of ecological research has outstripped the capacity for many of us to understand, remember, and synthesize through traditional means (e.g., research papers, reviews, meta-analyses). Perhaps more than any other field of science, ecology suffers from a hyperdiversity of case studies and only limited first-principles frameworks for organizing and synthesizing information. For ecology to advance, and efficiently use its existing knowledge to improve decision making and target new research, this will require that we augment our understanding with new cyberinfrastructure, models, databases, and artificial intelligence. Nowhere is this more pressing than in the synthesis across global data networks and observatories. Discussion will focus on barriers and opportunities for moving beyond data networks.
2) **Ecological Forecasting:** Beyond tallying understanding and knowledge, there is growing interest in making ecology more predictive. This is motivated both by the desire to accelerate research and make ecology more rigorous, and by the imperative

for decision making to be informed by the best available information about what will happen to systems in the future. Many important forecasting problems (e.g., climate change, invasive species/migration, globalization of resource extraction, emergent infectious disease) invoke transnational processes, even when the goal is simply local understanding. Discussion will focus on identifying key opportunities to advance both research-focused and decision-focused ecological forecasts in terms of specific problems and overarching broad concepts (e.g., teleconnections, scaling, trend detection, quantifying function).

3) **Training, Education, and Outreach:** Across all Earth and Environmental Science disciplines, data are accumulating faster than our capacity to synthesize them. Urgently needed are scientists with both an extensive formal background in a specific discipline and extensive experience in applying informatics, statistical, and forecasting methods to create knowledge, develop novel hypotheses, and improve predictive capacity. It is necessary to train "multilingual" scientists who can communicate across disciplines and who have a solid foundation in experimental design, statistical theory, and data mining. These scientists will fill a niche that will develop and define the research agenda for decades to come. Focusing at an international scale, this workshop will address the following questions: How can we prepare the next generation of ecologists to tackle global ecological questions and challenges? How can we scale-up and collaborate on current educational approaches to ensure international perspectives and access and to foster collaboration and cross-fertilization? Likewise, how do we reach out to the public both as citizen science participants in, and consumers of, global ecological research?

B. Workshop Organization and Agenda

The format of the meeting is designed to focus on communication and discussion. Specifically, we will employ a combination of rapid, engaging, and focused presentations with discussions in break-out groups. **Lightning talks** (5 min for researchers, 10 min in Day 1 for observatories) increase the attention of participants and maintain an engaging pace to the meeting that discourages distractions. Short talks also force speakers to be organized and focused on the most relevant issues.

While only a subset of participants will present lightning talks, following these talks all participants will be invited to present one individual '**lightning slide**," with a 60 sec time limit, for each of the focal areas. The preparation of these slides encourages all participants to organize their thoughts about each topic ahead of time, while also ensuring that everyone at the meeting gets a chance to share their prior ideas without interruption. Finally, within each focal area we will organize into break-out groups according to different subtopics. This will ensure that the majority of the time at the meeting is spent on active small-group discussion and brainstorming.

Monday, February 19th

9:00	Greeting/Introductions	
9:45	Where are we now: Observatories (10 min each)	
	NEON	- Rommel Zulueta
	TERN	- Beryl Morris
	SAEON	- Bob Scholes
	MexLTER / ILTER	- Manuel Maass

10:30 Coffee break

10:45 Where are we now: Networks (5 min each)

CZO	- Rachel Gallery
ForestGeo	- Krista Teixeira
NPN	- Jake Weltzin
GLEON	- Kathleen Weathers
CarboNA	- Catherine Ste-Marie

Lightning Slides (1 min each)

11:30 Group Discussion: Synergies and opportunities across networks and observatories

12:00 Lunch

1:00 From data to knowledge: Presentations (5 min each)

Ben Sparrow	- TERN Ecoinformatics & AEKOS
Belinda Medlyn	- "Assumption-centred" model-data synthesis
Rodrigo Vargas	- Barriers for interoperability
Marie-Josée Fortin	- Spatial Ecology across Scales
Brian Enquist	- Global biodiversity data integration via BIEN and SPARC

Lightning Slides (1 min each)

2:00 From data to knowledge: Break-out groups I (S215, S225, N375)

3:00 Coffee Break

3:15 From data to knowledge: Break-out groups II (S215, S225, N375)

4:15 Group Discussion - Groups Report

5:00 Adjourn

6:30 Group Dinner

El Charro Cafe
311 N Court Ave, Tucson, AZ 85705

To get to dinner at El Charro on Monday night, we recommend three options:

- take the Sun Link streetcar, which you can pickup just outside of the hotel at the University/Tyndall stop (this is the route: about 20 mins)
- share a Lyft or Uber; we can help with arrangements.
- walk; it's about 1.5 miles and a 30 min walk.

Tuesday, February 20th

9:00 Ecological Forecasting: Presentations (5 min)

Julie Pulliam	Epidemiological forecasting
Andy Fox	Ecological Forecasting with Earth System Models
Hao Ye	How much process is needed to forecast ecosystems?
Michael Dietze	Near-term Ecological Forecasting Initiative

Lightning Slides (1 min)

9:45 Ecological Forecasting: Break-out groups I (S215, S225, N375)

10:30 Coffee Break

10:45 Ecological Forecasting: Break-out groups II (S215, S225, N375)

11:45 Group Discussion

12:15 Grab bag lunches

12:30 Santa Rita NEON Field Trip: depart campus. People can snack in van on the way or eat lunch once we arrive at SRER.

1:15 Arrive NEON tower parking lot. Introduction and overview from Abe Karam.

2:00 Split into groups to tour:
-- tower
-- soil plot
-- instrument hut
-- phenology trail & botany plots

4pm - depart SRER - can take people direct to hotel

The NEON Botanist will lead the phenology tour. One of the domain scientists will be there for general questions and Abe can also field many questions.

Wednesday, February 21st

9:00 Training, education, and engagement: Presentations (5 min each)

Jason McLachlan	- Can coordination of short courses multiply impact?
Matt McCandless	- IISD & Experimental Lakes Area
Jackie Matthes	- An Inclusive Framework for Teaching Novices to Build a Forecasting Foundation
Dave Moore	- All singing, all dancing: How should we train empirical, theoretical and mathematical ecologists?
Shipherd Reed	- CZO

	Lightning Slides (1 min each)
9:45	Training, education, and engagement: Break-out groups I (S215, S225, N375) Flandrau CZO Education/Outreach Exhibit - led by Shipherd Reed
10:30	Coffee Break
10:45	Training, education, and engagement: Break-out groups II (S215, S225)
11:30	Group Discussion
12:00	Synthesis and conclusions
12:30	Adjourn

C. Meeting Location and Accomodations

Workshop attendees will be staying at:

Tucson University Park Hotel
880 E 2nd St
Tucson, AZ 85719
http://www.tucsonuniversityhotel.com/
(520) 792-4100

Travel to/from Tucson International Airport:

The hotel is approximately 10 miles (20 mins) from the airport. Lyft and Uber are available from Tucson International Airport. Estimated fares range from $15-40 depending on ride sharing options. A taxi stand is located just outside of baggage claim. There are also many shuttle and limo service options.

The workshop itself will be located at:

Environment and Natural Resources 2 Building (ENR2)
Room located on second floor: S215
University of Arizona
1064 E Lowell St
Tucson, AZ 85719
The walk to ENR2 from the hotel is only 8 min / 0.4 mi (see map below)

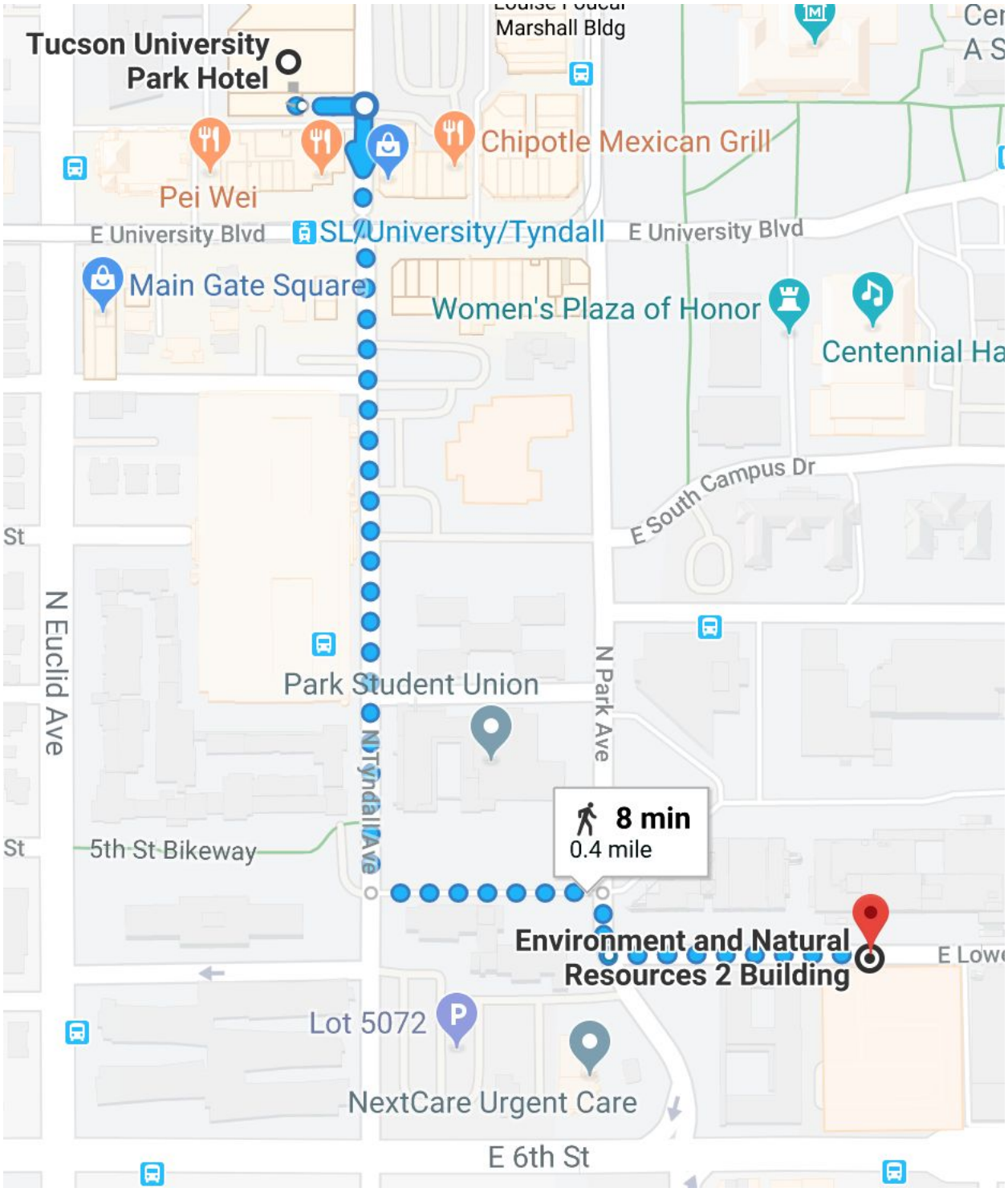
Getting around Tucson:

The Sun Link streetcar takes you from campus to downtown - including the Mercado san Agustin. A day pass is $4.50; you can purchase one-way trips for $1.75.

http://www.sunlinkstreetcar.com/destinations

Tucson has a TuGo bikeshare system with a station located on University Ave just across the street from the hotel and a station at ENR2, where the workshop is being held. An $8 daily pass gets you unlimited short rides (up to 30 mins at a time).

https://tugobikeshare.com/system-map/


Tucson University Park Hotel
Marshall Bldg
Chipotle Mexican Grill
Pei Wei
E University Blvd
SL/University/Tyndall
E University Blvd
Main Gate Square
Women's Plaza of Honor
Centennial Ha
E South Campus Dr
St
N Euclid Ave
Park Student Union
N Park Ave
N Tyndall Ave
8 min
0.4 mile
St
5th St Bikeway
Environment and Natural Resources 2 Building
E Lowe
Lot 5072
NextCare Urgent Care
E 6th St

D. Dining

You do not need to keep receipts for meals. We will be reimbursing based on GSA per diem rates

Breakfast	$13
Lunch	$15 (note: most lunches are provided)
Dinner	$26
Incidental	$5 (note: snacks/coffee provided on most days)

Breakfast: Breakfast is not complementary at the hotel, but the hotel does have both buffet and a la carte options. In addition to the hotel, there are a range of coffee and breakfast options in the immediate vicinity of the hotel (Espresso Art Cafe, Starbucks, Panera, Dunkin Donuts, The Dutch). The Slot Canyon cafe located on the ground floor of Environment and Natural Resources 2 Building (ENR2) opens at 7:30am and serves coffee, breakfast sandwiches, fruit, and snacks.

These excellent, local coffee/tea shops are on the way from the hotel to ENR2:
Espresso/coffee: Cafe Luce, 4205 N Campbell Ave, Tucson, AZ 85719
Tea: Scented Leaf Teahouse, 943 E University Blvd, Tucson, AZ, 85719

Lunch/Snacks/Coffee Lunch is provided all three days at the workshop. For Tuesday's field trip we will be grabbing a bagged lunch to-go. Coffee/tea will be available all day and snacks will be provided during mid-morning and mid-afternoon breaks.

Dinner On Monday night we will be doing a group dinner at the iconic El Charro Cafe established in 1922. Check out its history. The dinner will be a buffet and will be paid for directly by the workshop. Alcoholic drinks are available at a cash bar but participants will not be reimbursed for alcoholic beverages.

Tucson has diverse and delicious food options and has been designated a UNESCO World City of Gastronomy for its creativity and cultural inclusivity in sustainable urban development.
http://ediblebajaarizona.com/tucson-designated-unesco-world-city-of-gastronomy

Participants are on their own for Sunday and Tuesday nights. There are a wide range of options in the **immediate vicinity of the hotel**:

Pasco (try the Father Kino, ceviche, and albondigas soup)
Reds
Gentle Bens
The Dutch

Within 10-20 mins walk or 5-10 min Streetcar ride
Time Market
Mi Nidito

Tall Boys AF
Boca
Cup Cafe
Ermanos

In addition, if you're interested in wandering a bit further afield, we recommend the **following local favorites.** You can take the streetcar to Mercado San Agustin where there are two delicious options:

Agustin Kitchen (reservations recommended)
Sies (casual, try the street tacos.. try all of them!)

Other favorites:
Penca (reservations recommended)
Cafe Poca Cosa (reservations recommended)
Kingfisher (reservations recommended)
Downtown Kitchen (reservations recommended)

Try a Sonoran Hot Dog at any number of locations. Tucson food truck options are spectacular. You can find food truck roundup events here

E. Other Logistics

Reimbursements

- Please keep receipts for flights and other itemized costs (e.g. taxi, public transit).
- We will not be reimbursing rental cars
- By default reimbursements will be by check in US $. Wire transfers are possible but discouraged as this requires tax additional forms (e.g. W-8).

Products

The results of the workshop will primarily be distributed via the meeting webpage, a short 'meeting report' article (e.g. EOS), and social media. The meeting website will include workshop presentations (lightning talks and single slides) and break-out group notes, but all participants will be given an opportunity (three weeks post workshop) to redact slides and comments that they want shared publicly. There is no prior commitment to produce a formal white paper or peer-reviewed review/concepts paper, but this option will be discussed at the workshop.

Presentations

Please deposit your talk and single slides in the meeting Google Drive prior to the start of the meeting.

EKP2018 Presentations: https://goo.gl/5QTPGo

The workshop room has a dedicated PC desktop connected to two overhead screens. Individual slides will be organized by the conveeners ahead of time so it is particularly important that these be submitted by no later than **5PM Sunday, Feb 18th. Please submit in Powerpoint or PDF format or a URL.**

Please note - the presentations and lightning talks will be video recorded and a subset of talks may be released on a public YouTube channel and shared over social media. All speakers will be given the opportunity to preview and redact talks before they are released. The following times will be recorded:

Monday, February 19th
9:00-10:30am; 10:45-11:30am; 1-2pm

Tuesday, February 20th
9:00-9:45am

Wednesday, February 21st
9:00-9:45am

The breakouts and discussions will not be recorded.

Wi-Fi

Participants can access the UA Wi-Fi through Eduroam or the UAGuest wireless network:

Eduroam

Visitors from participating institutions visiting the University of Arizona campus can use UA's eduroam secure wireless network, which provides the same speed and security as UAWiFi.

- Choose **eduroam** from the wireless networks detected by your computer or device.
- Enter your institution's login for the **Username**.
- Enter your institution's login password for the **Password**.
- Click **Join.** You will be connected to the UA's eduroam secure wireless network.

Note: We encourage visitors without UA credentials to use eduroam if they are from a participating institution.

UAGuest is a wireless network available to visitors of the University of Arizona. After visitors select the UAGuest network on their devices, they can establish UAGuest accounts by entering a username and phone number. The account will be valid for five days. After that time, visitors will need to establish a new account. UAGuest is an **unsecured network**. Do not send private information such as credit card numbers over this network. UA students, faculty, and staff should use UAWiFi.

Establishing A UAGuest Account

- Select **UAGuest** from your wireless options.
- Open a web browser if one does not automatically open for you.
- The Welcome UAGuest webpage will appear.
- Click on **Create Account** at the bottom of the webpage.
- Enter your **name** and **cell phone number** (enter hyphens, e.g., XXX-XXX-XXXX).
- Enter 6 digit code.
- You will receive a text message containing your assigned username and password.
- Enter your **username** and **password** on the Welcome UAGuest webpage.
- Read the Acceptable Use Policy and click **Accept**.
- This login remains valid for 5 days.

F. Attendees

Name	Institution	email
Michael Dietze Chairperson	Boston University	dietze@bu.edu
Rachel Gallery Local Host	University of Arizona	rgallery@email.arizona.edu
Rodrigo Vargas Co-organizer	University of Delaware	rvargas@udel.edu
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Bob Scholes	SAEON	Bob.Scholes@wits.ac.za
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Bill Smith	University of Arizona	wksmith@email.arizona.edu
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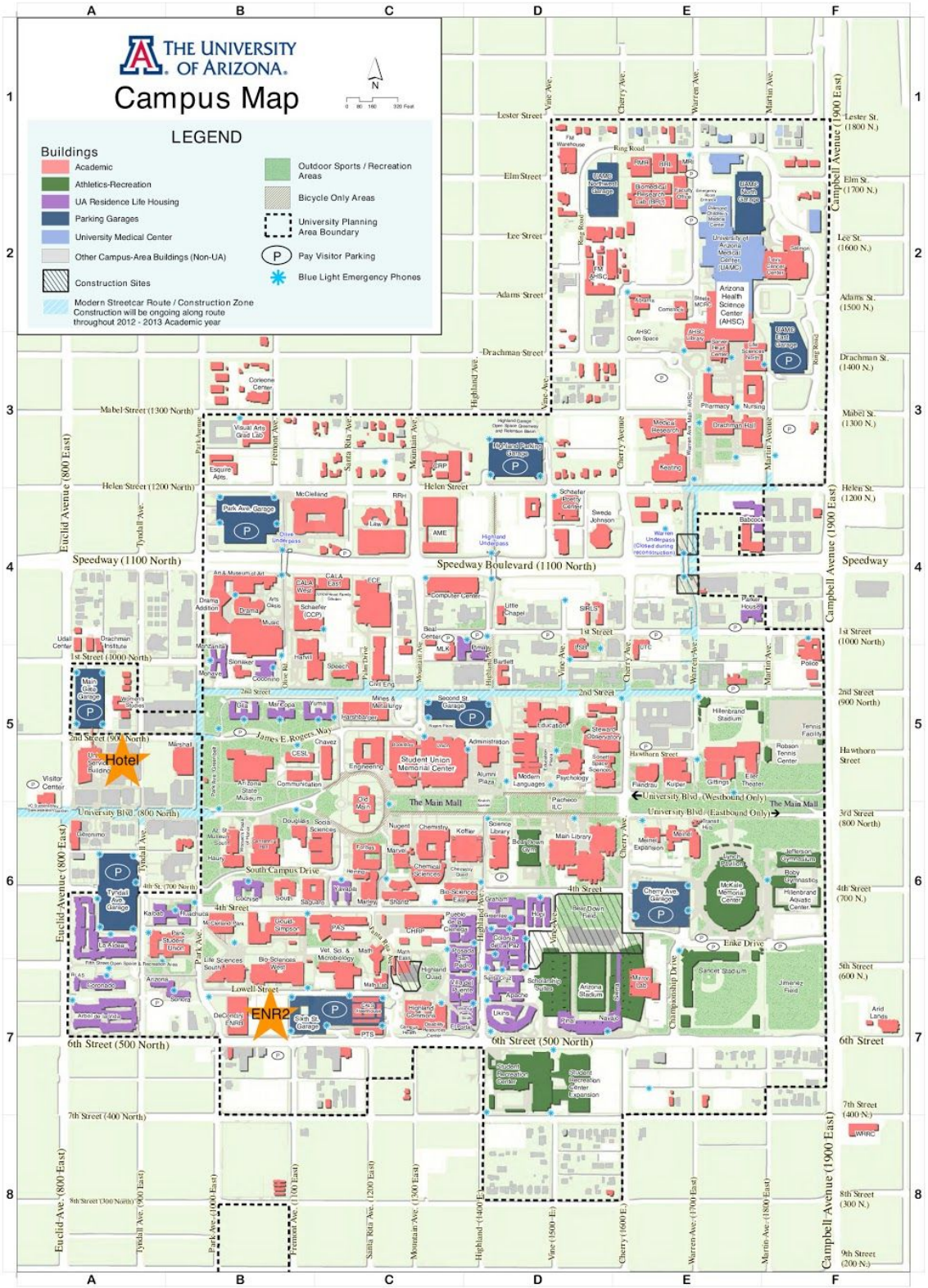
Kathleen Weathers	Cary Institute	weathersk@caryinstitute.org
Jake Weltzin	U.S. Geological Survey	jweltzin@usgs.gov
Hao Ye	University of Florida	hao.ye@weecology.org
Rommel C. Zulueta	NEON	rzulueta@battelleecology.org



Most Frequently Requested Locations

Name	Location
Administration	D5
Arizona Health Sciences Center	E2
Arizona Stadium	D7
Arizona State Museum	B5
Bus Stop (Transit Hub)	E6
Campus Health (Highland Commons)	C7
Centennial Hall	B6
Crowder Hall (Music Building)	B4
Drama (Marroney Theater)	B4
Eller Dance Theater	F5

Name	Location
Highland Commons (Campus Health & Disability Resource Center)	C7
Holsclaw Hall (Music Building)	B4
Main Library	D6
Main Mall	C5-F5
Marroney Theater (Drama Building)	B4
McKale Memorial Center	E6
Museum of Art	B4
Nugent	C6
Old Main (Admissions)	C5

Name	Location
Pacheco ILC	D5
Police	F4
Schaefer (Center for Creative Photography)	B4
Student Recreation Center	D7
Student Union Memorial Center	C5
Swede Johnson (Alumni)	D4
University Services Building	A5
Visitor's Center	A5

University Information

Information: 520-621-2211
Parking Information: 520-626-PARK (7275)

Main UA Website: www.arizona.edu

Emergencies: dial 9-1-1
(Call University Police for non-emergencies: 621-8273)

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