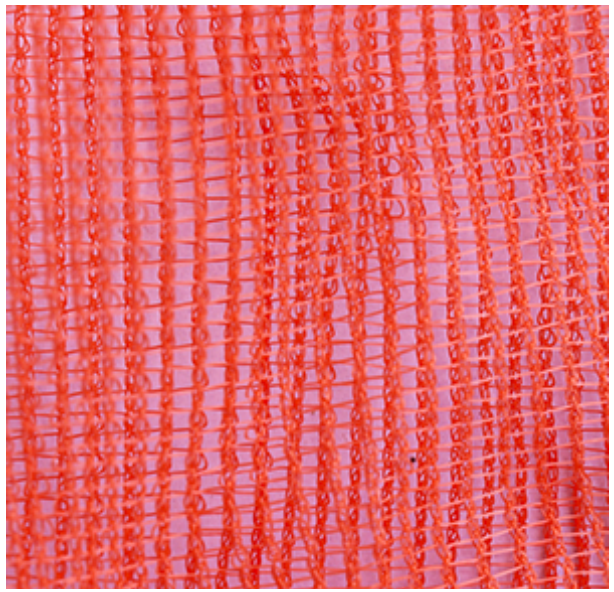
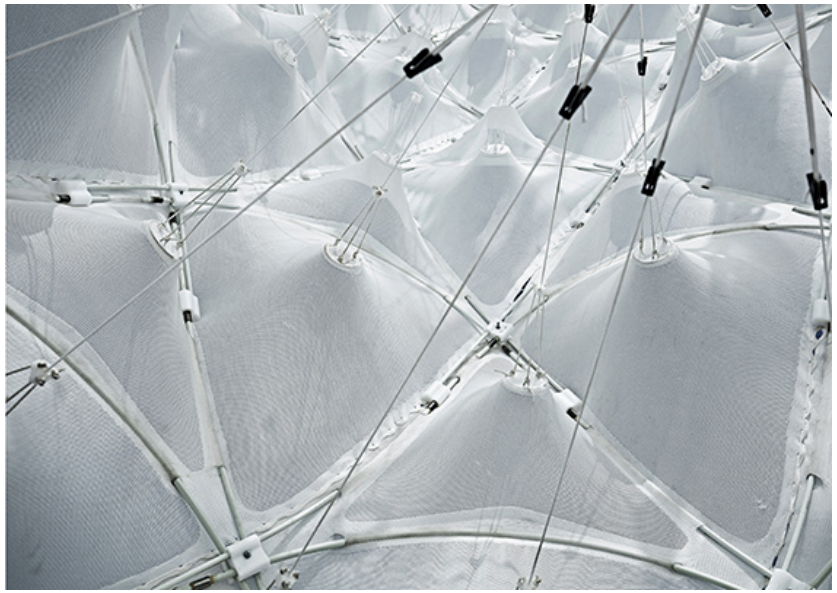




BIOMIMICRY & PARAMETRIC DESIGN

CHRISTINE'S PORTFOLIO

ARCH 4/510 - PROFESSOR NANCY YEN-WEN CHENG SPRING 2017

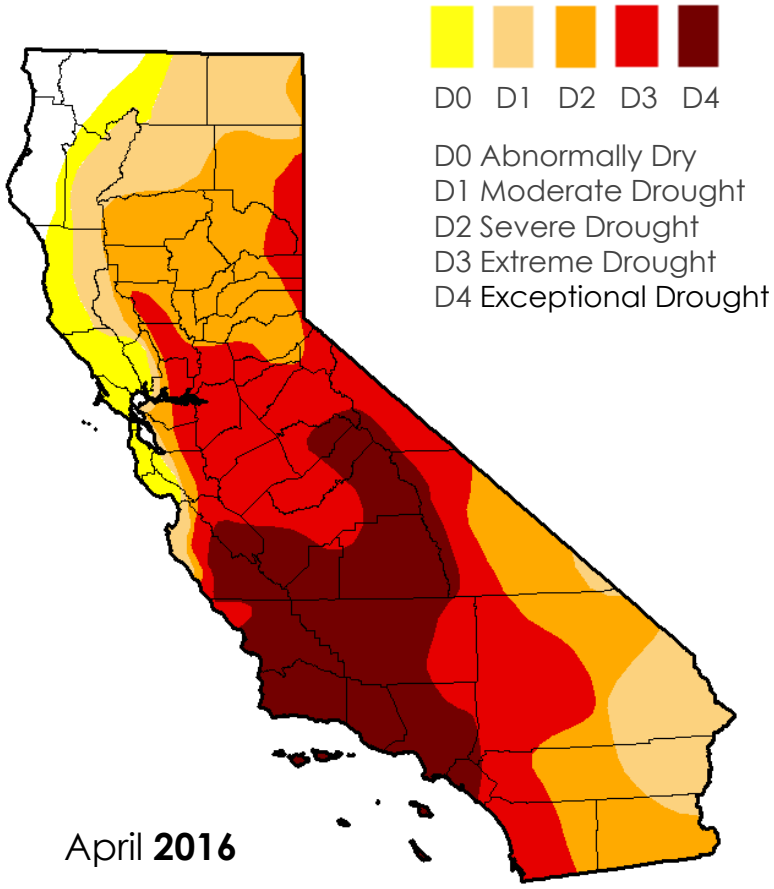
PROBLEM OF CLIMATE CHANGE:

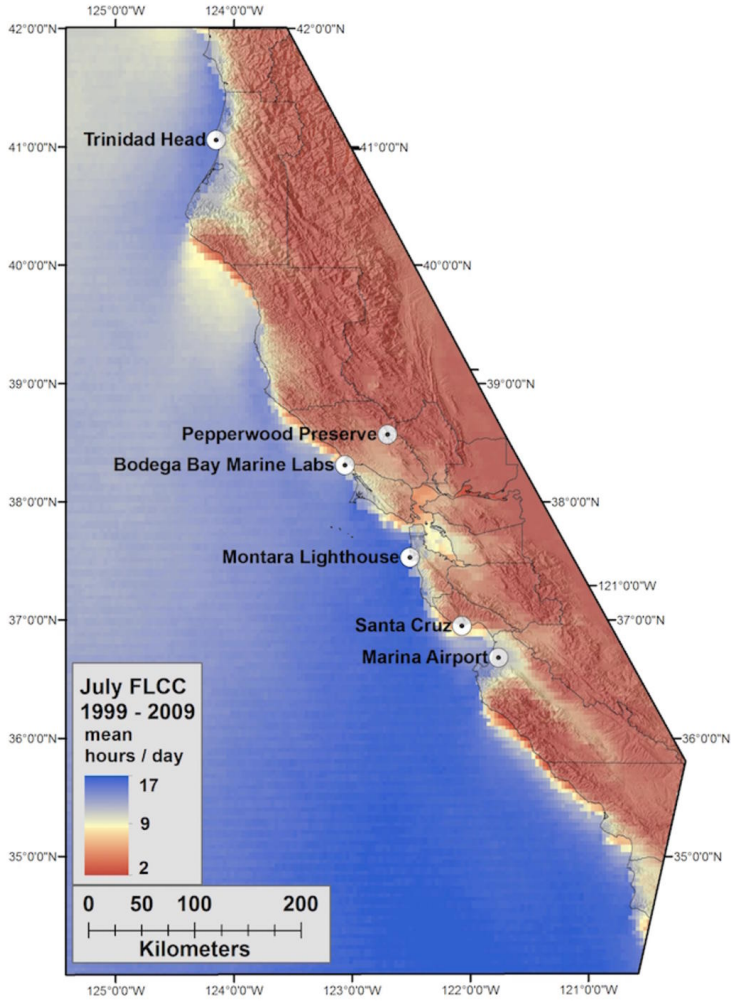
DROUGHT IN CALIFORNIA

- Even if this year the state of california has no problem of drought the recent years have been dangours dry (see drought map at the left)
- The trend for the future predicts unseen changes of the climate and we should be prepared for different scenarios

Approach: Fog Collection

- Map of central California coast (at the right) showing the average amount of fog and low clouds present during the month of July over a period of 10 years





>> *Drought-Map:* Eric Luebehusen, U.S. Department of Agriculture; The National Drought Mitigation Center, University of Nebraska-Lincoln 2017

>> Fog-Map: Torregrosa, A., C. Combs, and J. Peters (2016), GOES-derived fog and low cloud indices for coastal north and central California ecological analyses, Earth and Space Science, 3

BIOMIMICRY & PARAMETRIC DESIGN

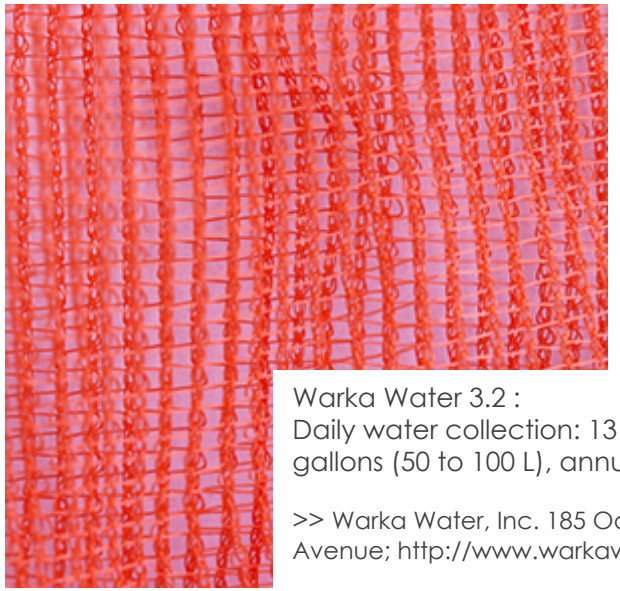
CHRISTINE VON RAVEN

SOLUTION APPROACH:

FOG COLLECTION

- *See natural systems in 1C*
- 0.05 to 0.5 grams of liquid water in a cubic meter of fog
- 40 m2 collecting surface produce an average of 200 L per day throughout the year
- fog collectors are also efficient rainfall collectors: a 40 m2 fog collector will collect much more rain or drizzle than falls on a 40 m2 area on the ground.
- Reforestation is an example of how fog collection can benefit an ecosystem

>> Information provided by: Fogquest, not-for-profit organization; Mailing address: 448 Monarch Place, Kamloops BC, V2E 2B2 Canada; website: http://www.fogquest.org



Warka Water 3.2 :
Daily water collection: 13 to 26 gallons (50 to 100 L), annual average

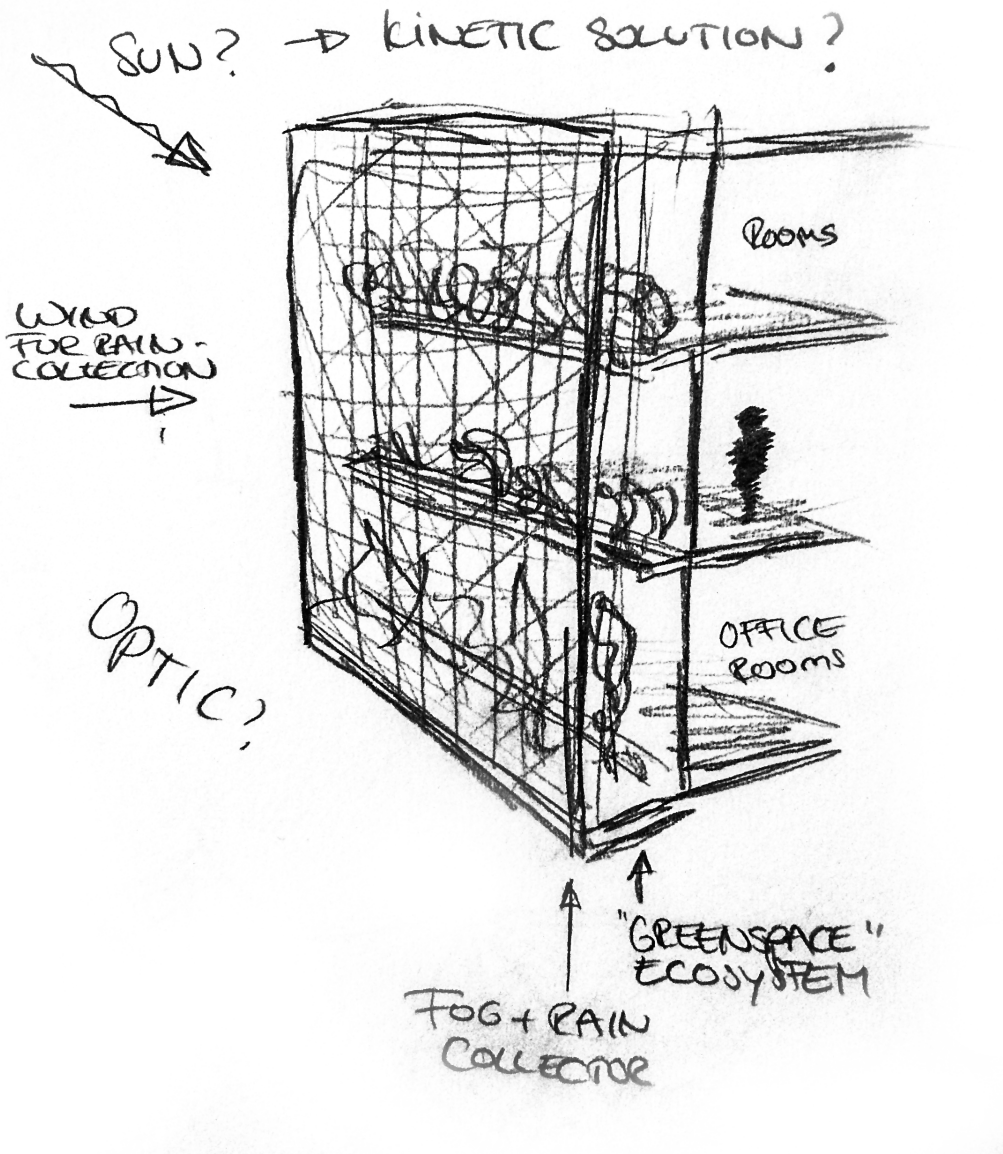
>> Warka Water, Inc. 185 Oakridge Avenue; http://www.warkawater.org/

BIOMIMICRY & PARAMETRIC DESIGN

CHRISTINE VON RAVEN

FOG HARVESTING IN THE CITY

- Using fog collecting nets as tool against the drought-problems in the city of San Francisco
- Integrate the nets into facades, to
  - Collect water used to maintain an ecosystem
  - That regulates the climate within the building
- Factors:
  - Foggy/rainy time-periodes?
  - Wind for Rainwater collection
  - Integration of sunshading?
- Observed natural role model to create an adoptable/kinetic facade net: **Dragline silk**

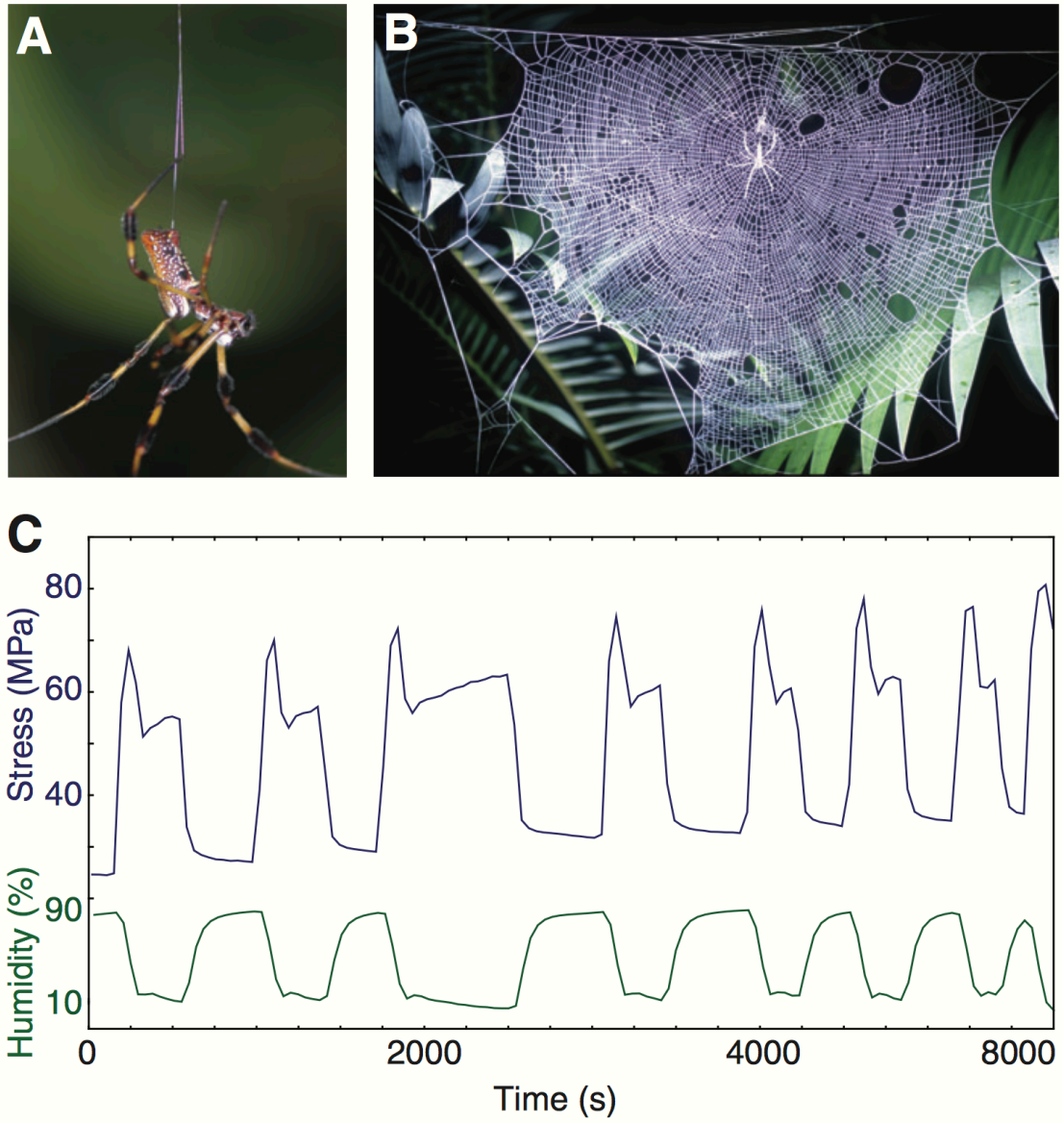


SPIDER DRAGLINE SILK MUSCLES

Mimic of high performance biological muscles by using wet or dry air to drive silk muscle fibers:

- Cyclic stress response of spider dragline silk to humidity
- Contracts up to 50% of its original length
- Already operates at the level of single silk fibers
- Silkworm fibers are already available in commercial quantities

>> Ingi Agnarsson, Ali Dhinojwala, Vasav Sahni,Todd A. Blackledge; Spider silk as a novel high performance biomimetic muscle driven by humidity; Company of Biologists 2009



Spiders use dragline silk as
(A) lifelines
(B) the supporting framework of their webs

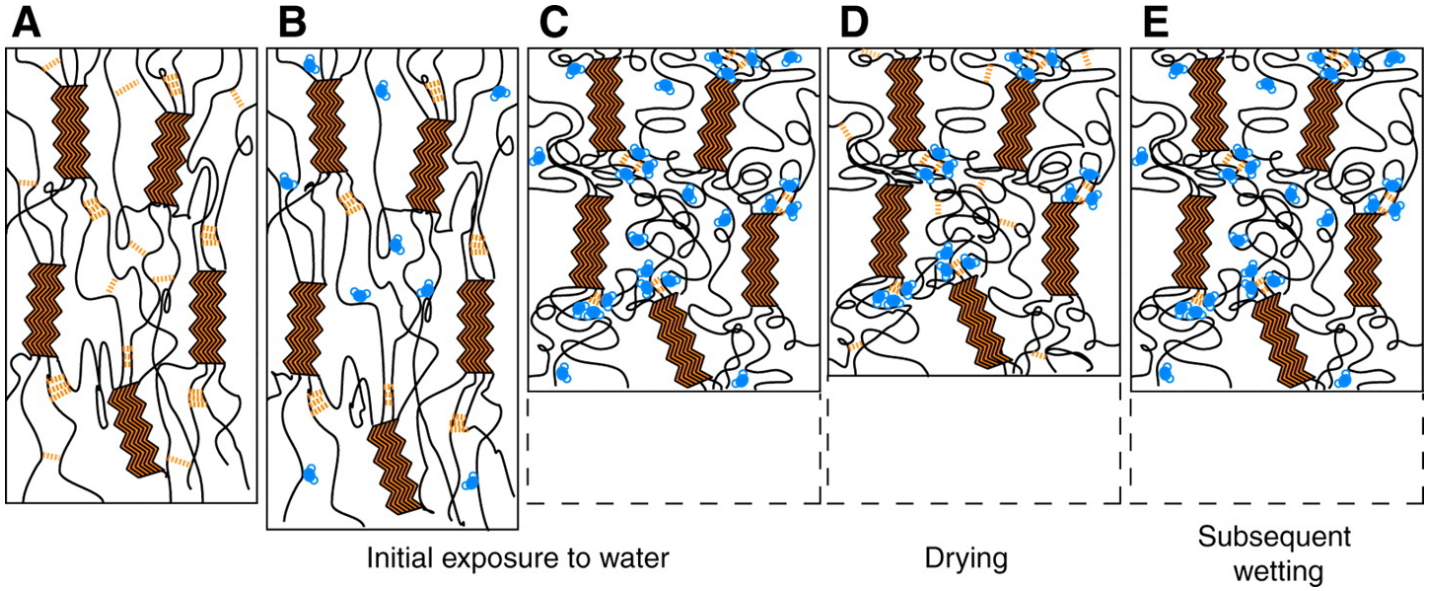
(C)
- Silk repeatedly **contracts upon drying** and then **relaxes upon subsequent wetting**
- nearly instantaneous and produces large stresses
- The spikes in stress at the beginning of each drying cycle are caused by brief puffs of dry N2 in the environmental chamber before the introduction of small amounts of moisture to control humidity (i.e. the chamber is briefly much drier than can be maintained long term)

KINETIC NET STRUCTURE

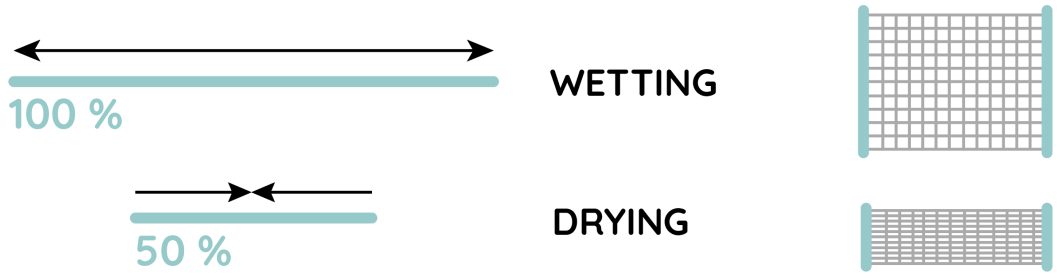
- With the possibility to create fibres with the strucutral behaviour of the silk the possibility of extrem humidity-adobtable facades becomes possible

Plan

- Investigation of net structures implementing such a fibre that behave according to the needs for the facade-approach mentioned bevore:
  - Max surface at high humidty
  - Max transparenz for view
  - Integrated sunshading to the extend possible
  - Stunning optic



Hypothesized model of interaction of water molecules with spider silk proteins
>> *Model-image:* Todd A. Blackledge, Cecilia Boutry, Shing-Chung Wong, Avinash Baji, Ali Dhinojwala, Vasav Sahni, Ingi Agnarsson; How super is supercontraction? Persistent *versus* cyclic responses to humidity in spider dragline silk; Journal of Experimental Biology 2009



TENSILE STRUCTURES

Searching for adobptable net-structures

HYBRID TOWER RESEARCH-PROJECT

- an integrated hybrid structure
- design for and with material performance
- combination of compression and tension elements
- relationship between skin and structure is a central question
- Further Research CITA-Projects (bottom right): Slow Furl, 2008
- https://kadk.dk/en/CITA-research-projects

>> Mette Ramsgaard Thomsen, Martin Tamke, Yuliya Sinke Baranovskaya, Anders Holden Deleuran; Hybrid Tower Researchproject, CITA, The Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation, 2016