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**Connectivity Project Summary:**  
**San Diego Fairy Shrimp**



# Vernal pools

- Specialized flora and fauna ( $\approx 20$  spp. federally listed).
- Vernal pool losses in southern CA estimated to be  $>95\%$  (e.g., Bauder 1998).
- At this time, regulatory protection in southern California is primarily focused on endangered species and MSCP



# San Diego fairy shrimp:

## *Branchinecta sandiegonensis* (Fugate, 1993)

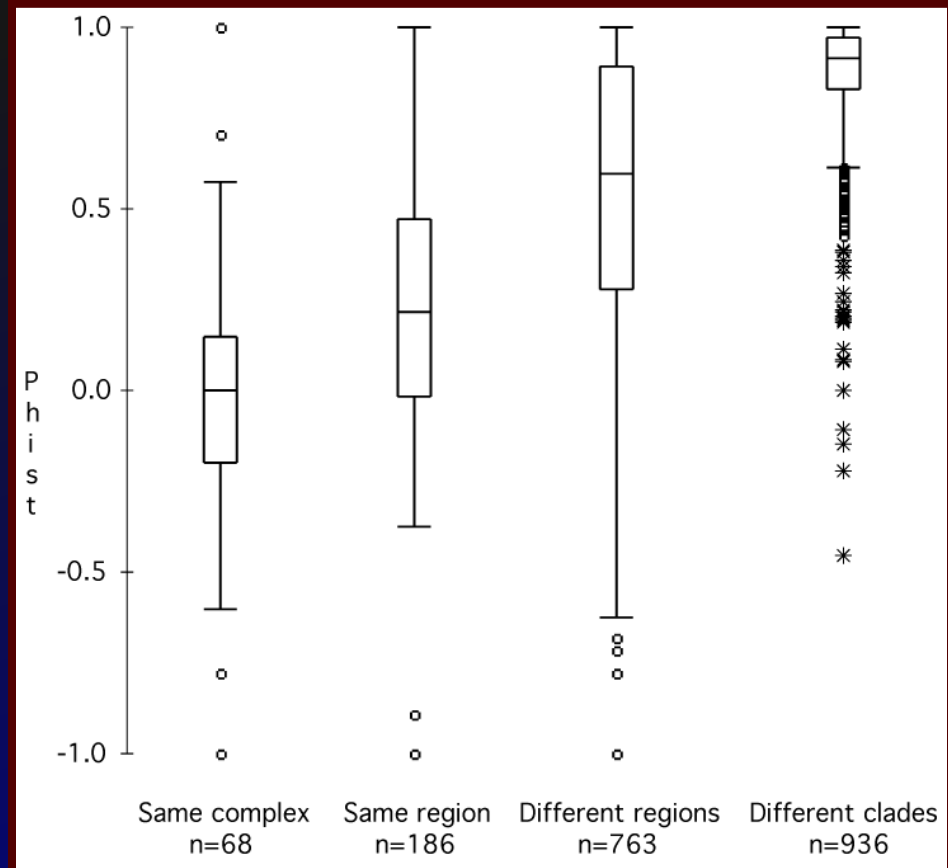
- Federally listed as endangered in 1997
- Narrowly endemic, primarily in San Diego County
- Desiccation resistant cysts (encysted embryos)



# Connectivity and resource

- Genetic differentiation among vernal pools is relatively strong, even over relatively small distances.

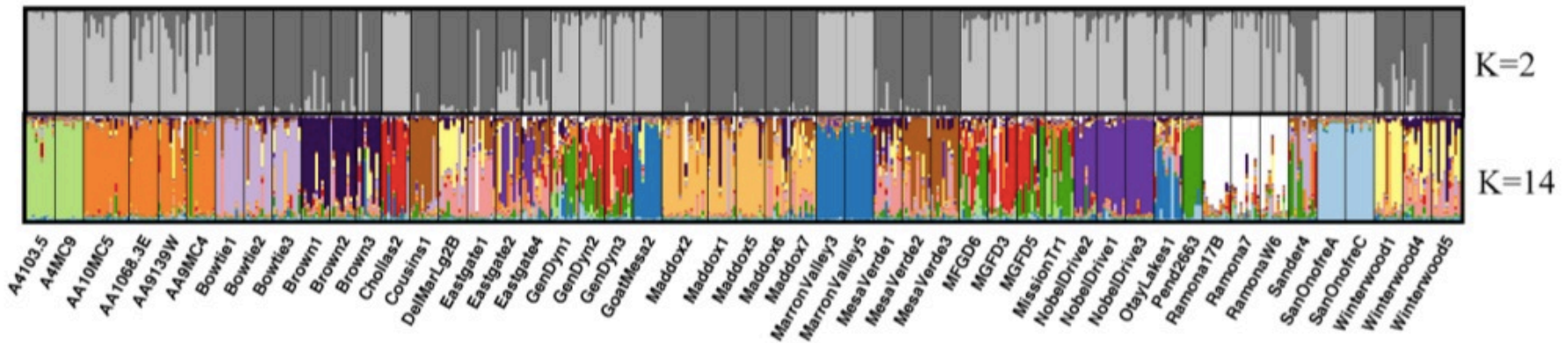
mtDNA divergence  
between pairs of ponds



# Connectivity and resource

- Genetic differentiation among vernal pools is relatively strong, even over relatively small distances.

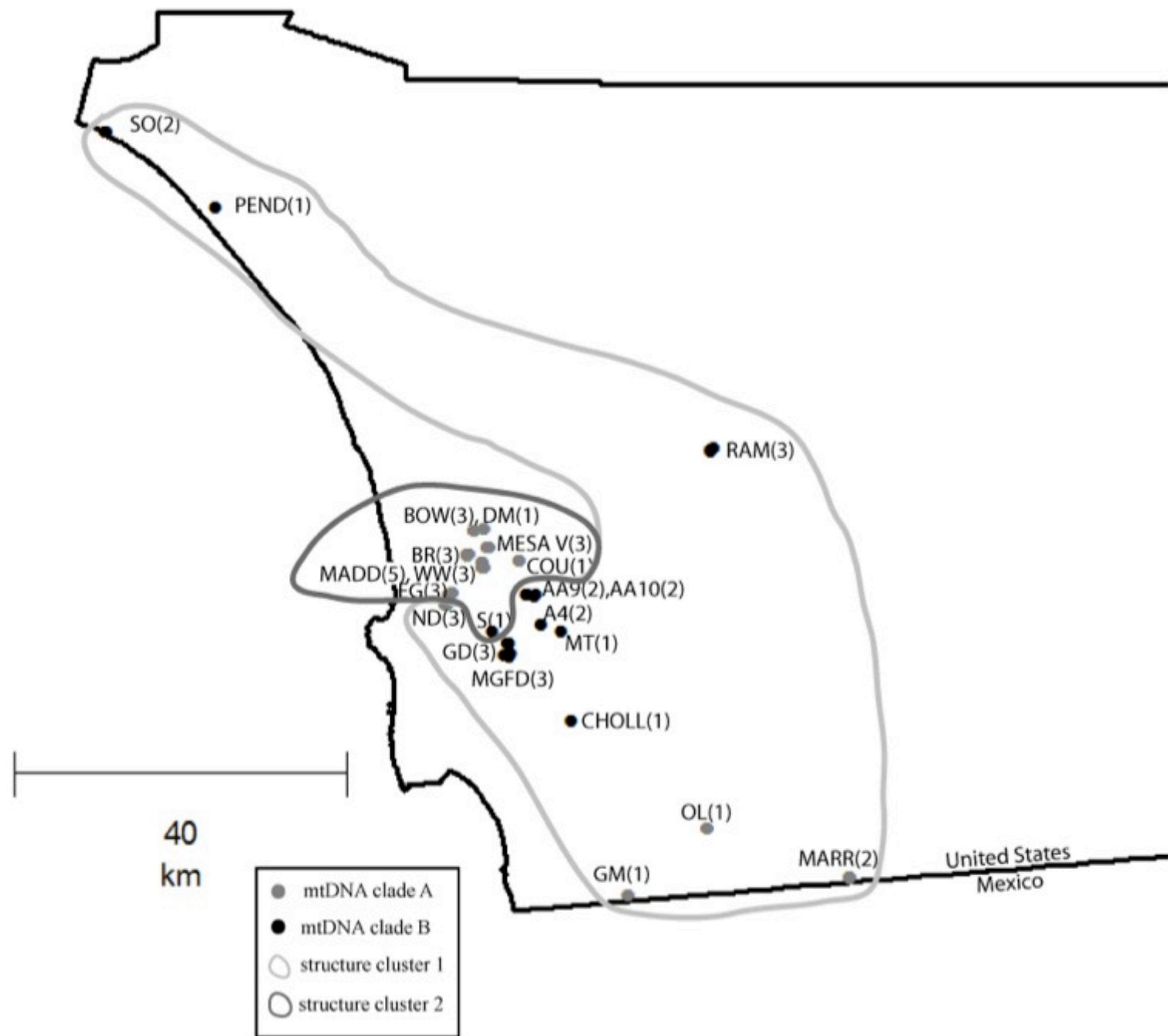
Number of gene pools inferred from microsatellites



# Connectivity and resource

- Preliminary sampling of MCAS Miramar shows that the A4 complex is unusually divergent. Additional sampling throughout Miramar is needed.
- Mira Mesa and Del Mar Mesa pools show somewhat higher divergence than one would expect.



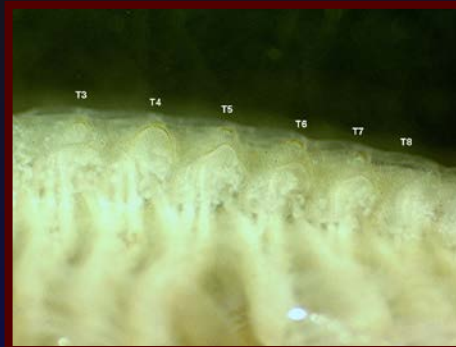


# Connectivity and resource

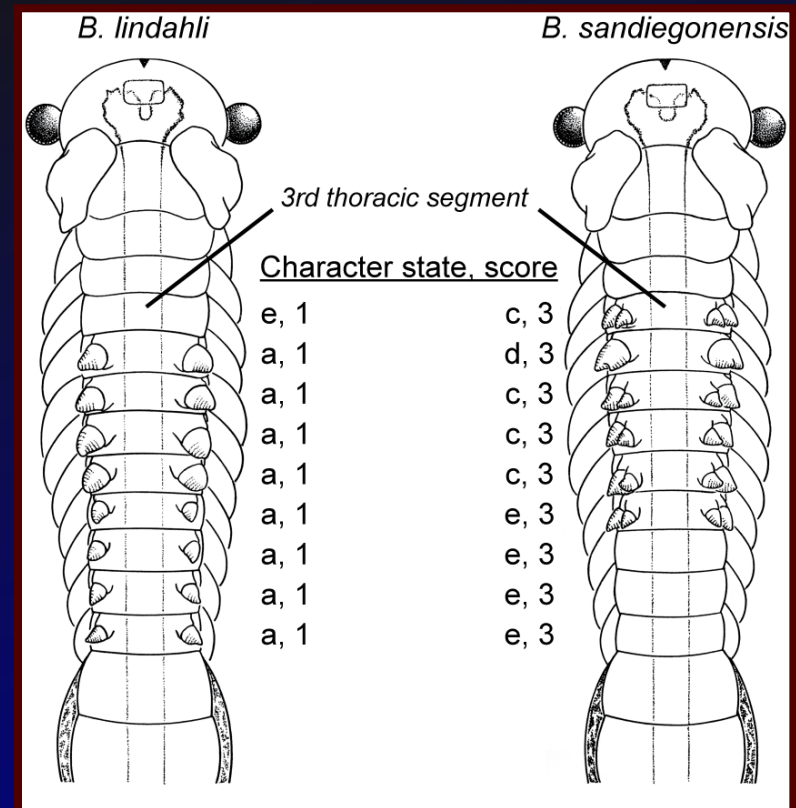
- Hybridization between the versatile fairy shrimp (*B. lindahli*) and San Diego fairy shrimp occurs in disturbed vernal pools.



*B. lindahli* female



*B. sandiegonensis* female





# Hypothesized mechanism for impacts

- The integrity of remaining pool complexes should be maintained at the broadest possible spatial scale.



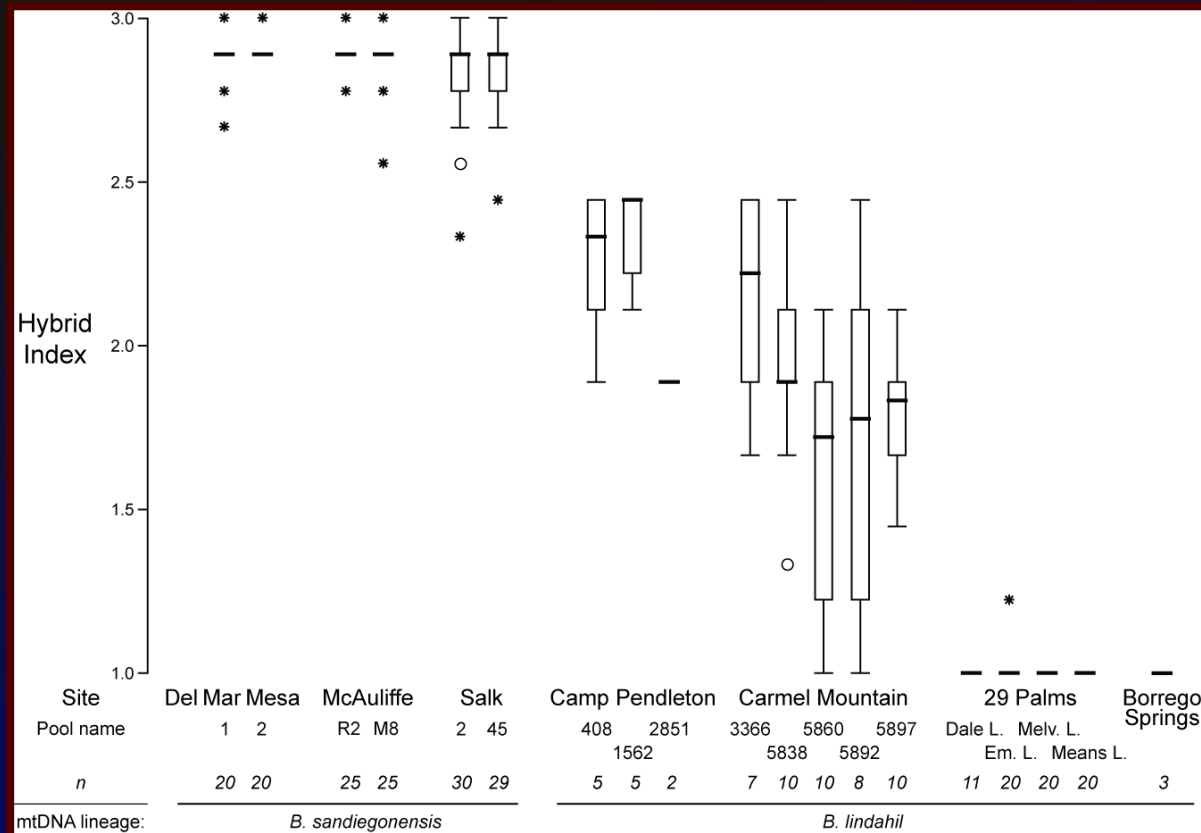
# Hypothesized mechanism for impacts

- Our overall assessment is significant biotic connectivity is normally restricted to pools within complexes, and pools within 5 km of one another.
- Human activities often homogenize these naturally distinct populations, rather than isolate them.



# Hypothesized mechanism for impacts

- Hybrids are more prevalent in road ruts and other highly disturbed basins than in undisturbed pools.



# Information needs for future adaptive management

- We have published a method for identifying hybrids from mature fairy shrimp females. We are attempting to develop a genetic hybrid index at this time.



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## LANDSCAPE HOMOGENIZATION THREATENS THE GENETIC INTEGRITY OF THE ENDANGERED SAN DIEGO FAIRY SHRIMP *BRANCHINECTA SANDIEGONENSIS* (BRANCHIOPODA: ANOSTRACA)

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# Information needs for future adaptive management

- Movement of cysts among pools should be minimized, and especially outside of pool complexes.



# Information needs for future adaptive management

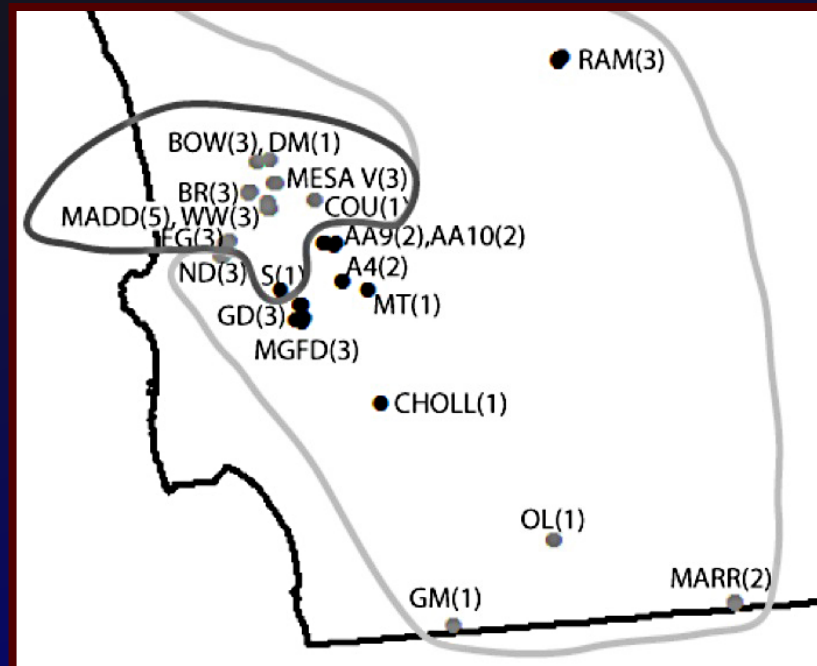
- It follows that newly created pools should be stocked from a single pool complex as close as possible. Stocking single new pools from a single source pool (rather than a multi-pool mixture) is recommended unless logistical or endangered species impacts preclude this.





# Information needs for future adaptive management

- Additional care should be taken to minimize homogenization of {Mira Mesa, Del Mar Mesa} with Miramar and populations south, with Ramona to the east, and with Pendleton to the distant north.



# Information needs for future adaptive management

