

**Channel forming discharge and historical sediment
transport analysis in arid southwestern streams:
Implications for jurisdiction**

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Introduction: Semi-arid Southwestern streams

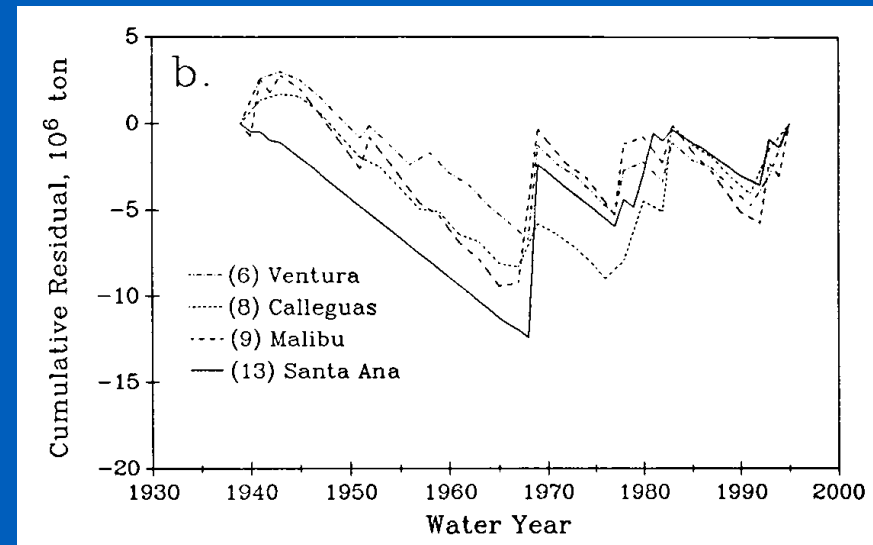
- Streams in semi-arid Southwestern US are frequently ephemeral or intermittent (>66% in CA)
- The high flow events that shape these systems are not typically “ordinary”
- Variability in flood magnitudes in dryland streams is much greater, and the discharge of their larger floods tends to be significantly greater than the mean annual flow



CDFG (2010) Dryland Stream Processes and Forms

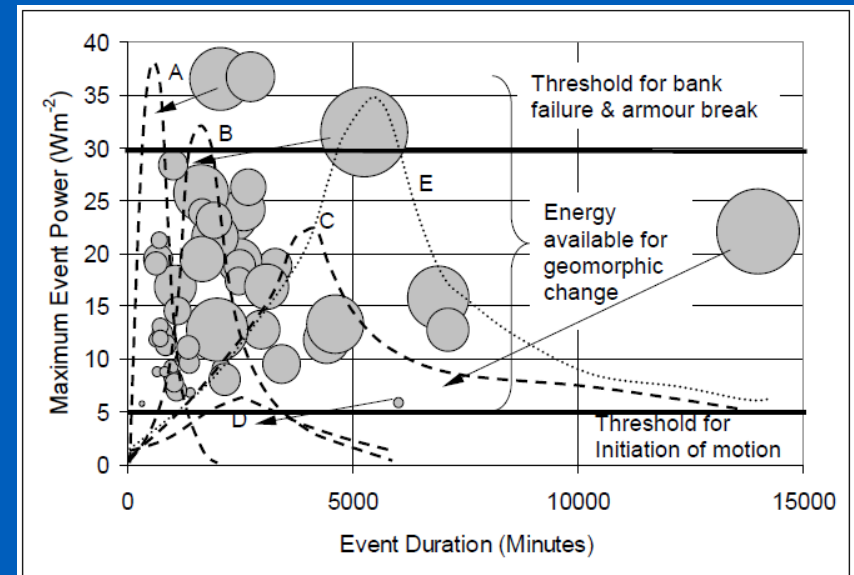
Concepts: Inman and Jenkins (1999)

- The authors examined alternating wet and dry periods and the differential in sediment transport between these periods
- Mean sediment flux of rivers during wet periods exceeds that during the dry periods by a factor of about five
- Sediment flux caused by the three largest wet period events is 27 times greater than that during the preceding dry period
- Takeaway: Larger events or periods of events produce more sediment than smaller events or period of events



Concepts: Sear (2002)

- The author studied how important episodes in semi-arid streams locally alter stream morphology
- The dominance of discrete upstream sources of bedload is more closely associated with the **duration** of event above the threshold for transport than event **magnitude**.
- The magnitude of the event is still significant because it determines not only the power available to initiate transport, but also conditions duration, hence access to vertically segregated sediment sources.



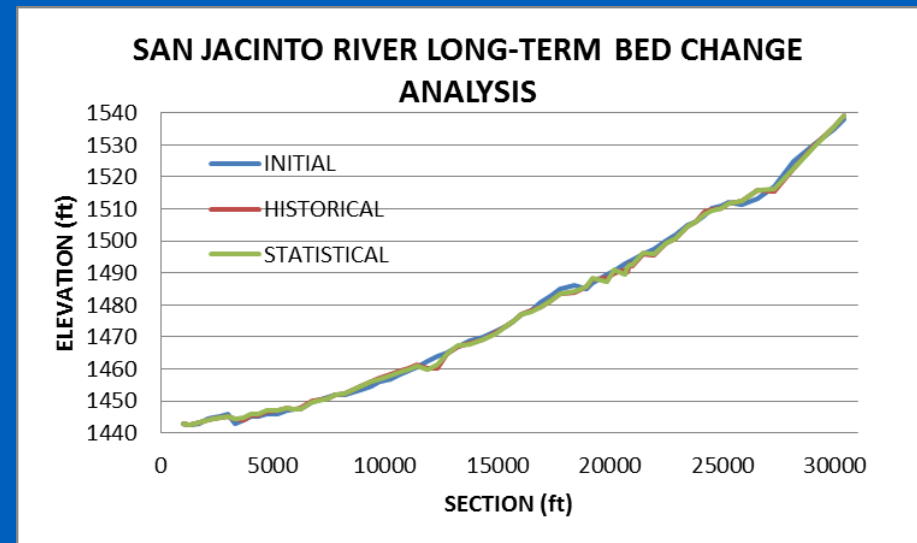
Concepts: Hecht (1993)

- The author considered how decadal-scale events in semi-arid southwestern systems “reset” the geomorphic template for subsequent dry periods
- Reset events cause less-than-complete disruption to local geomorphology and habitat
- Post-event increases in sediment transport help to accelerate habitat reestablishment, particularly in riparian systems



Concepts: Jaffe (2009)

- In investigations considering long-term sediment transport in semi-arid systems, the author found that total water volume discharged during extended periods is the controlling factor with respect to bedload transport and erosion
- A series of flashy events with high hydrograph peaks and short duration resulted in less long-term bed change than longer durations and lower peaks
- When total hydrograph volume was equal long-term bed change was equal



Concepts: ACOE(2008)

- Similarities between the bankfull zone of perennial channels and low-flow features of E/I channels
- Low-flow zone of E/I is transitory during moderate (5-10 yr) events, and low-flow features are dynamic
- Moderate events are capable of carrying the largest proportion of sediment over time, making them dominant or effective discharges
- OHW zone in E/I channel in Arid West is the active floodplain
- The active floodplain functions in same manner as a bankfull channel in perennial systems
- Effective discharges in arid channels align well with the boundary of an active floodplain



CDFG (2010) Dryland Stream Processes and Forms

Implications

- Arid systems with long reset intervals will have greater jurisdictional area than similar systems with short reset intervals.
- As arid systems tend toward perennial behavior, the jurisdictional area should approach that defined by the Channel Forming Discharge.
- The reset event is expected to occur at intervals greater than the initiation of significant sediment transport.
- The variability in reset event interval as a function of watershed or stream size is presently not well understood.



CDFG (2010) Dryland Stream Processes and Forms

References

- **ACOE (2008) A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. ERDC/CRREL TR-08-12.**
- **Hecht (1993) South of the spotted owl: Restoration strategies for episodic channels and riparian corridors in Southern California. Soc. Wetland Scientists, Western Regional Conference, paper.**
- **Inman and Jenkins (1999) Climate Change and the Episodicity of Sediment Flux of Small California Rivers. J. of Geo., V. 107, p. 251-270.**
- **Jaffe (2009) A comparison of long-term sediment transport numerical model results using historical and statistical hydrograph data in the arid southwestern United States. Headwaters to Ocean Conference, Long Beach, abstract.**
- **Sear (2002) Bedload transport rates and the stream hydrograph: results from a new type of load cell bedload trap.**