NOAA National Marine Fisheries Service

Response of *O. mykiss* to removal of San Clemente Dam on the Carmel River, California: results to date and managing expectations

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Overview of presentation:

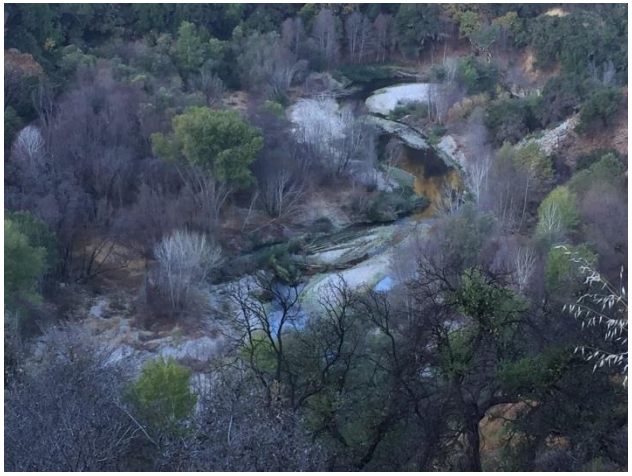
- What, when, where, how – San Clemente Dam removal
- Stream response and fish response
- Restoration of dynamic processes
- Expectations

Collaborators:

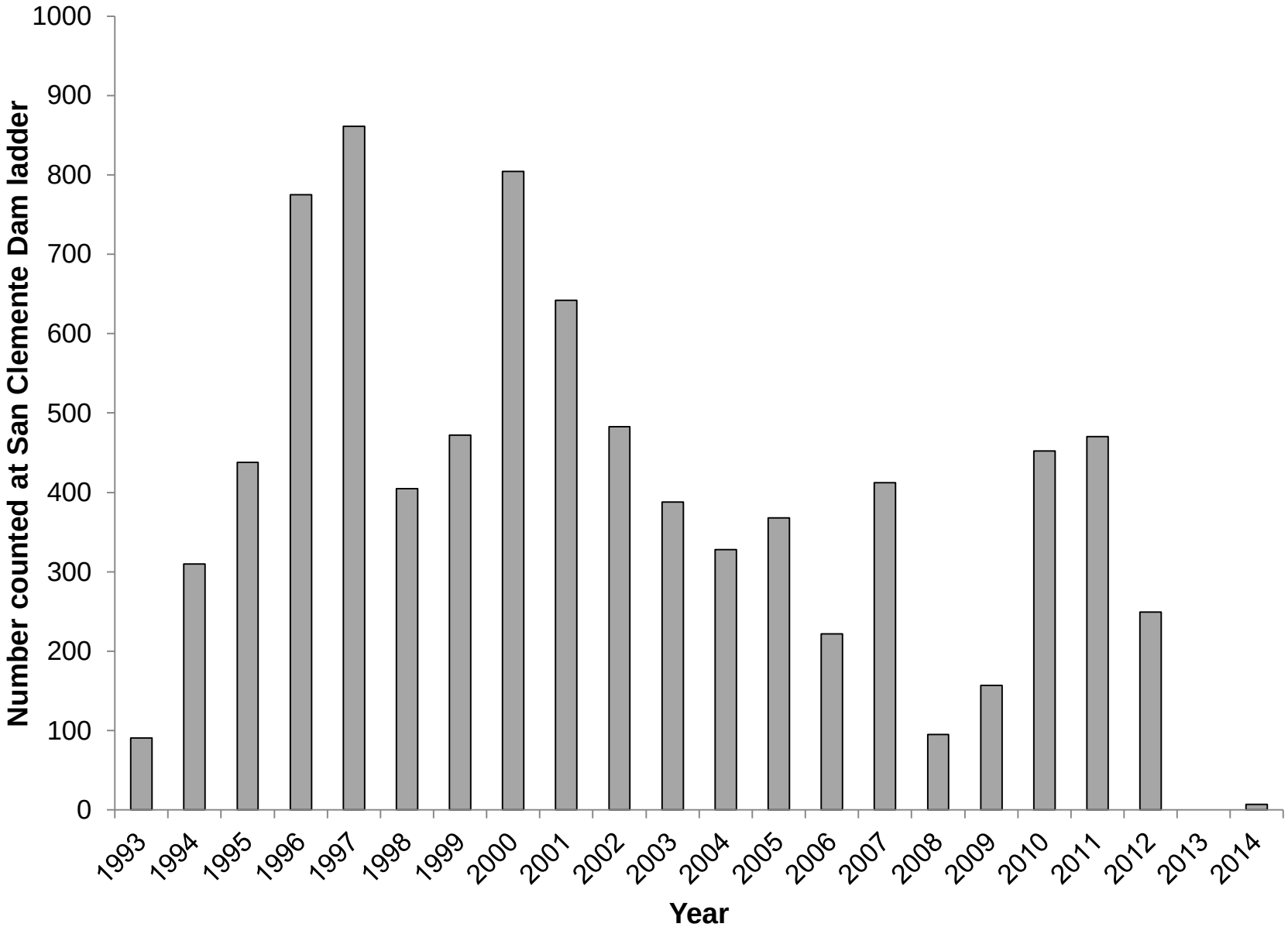
- Amy East (USGS)
- David Boughton (NMFS-SWFSC)
- Dave Rundio (NMFS-SWFSC)
- Nate Mantua (NMFS-SWFSC)
- Lee Harrison (NMFS-SWFSC)
- Doug Smith (CSU – Monterey Bay)
- Lots of others assisting with fieldwork, access, etc
- Assistance from Kevan Urquhart and staff (Monterey Peninsula Water Mgt. District)

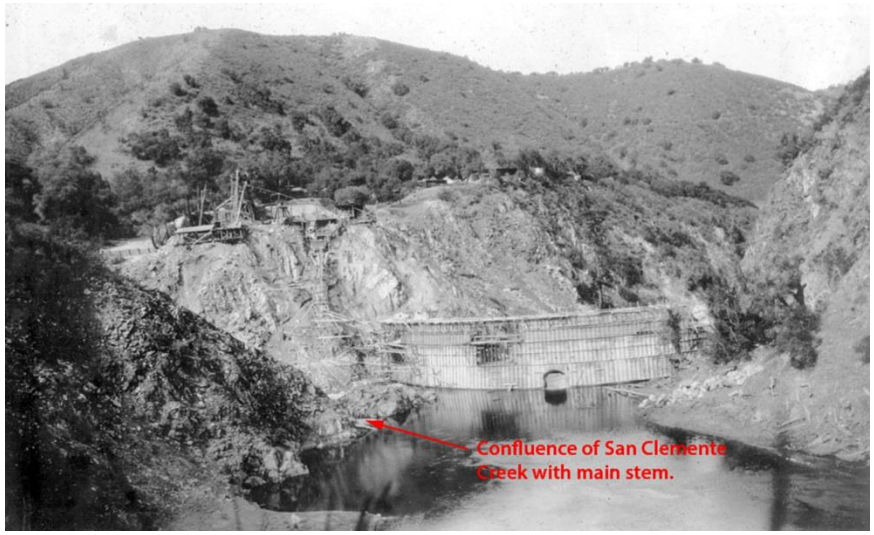
" *The Carmel is a lovely little river. It isn't very long but in its course it has everything a river should have.* "

John Steinbeck, Cannery Row, 1945



- **Steelhead ESA-listed as threatened (1997)**
- **South-Central California Coast DPS**
- **DPS extends from Pajaro River south to Santa Maria River**
- **From 1960s and early 1970s estimates of over 1,300 adult steelhead**
- **Counts at SCD ladder from 1993 to 2014 averaged ~ 380 adults**


Number counted at San Clemente Dam ladder
1000
900
800
700
600
500
400
300
200
100
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



- 650 km2 watershed
- Maximum elevation 1,540 m
- Most of watershed steep, fractured slopes, weathered granitic substrate and talus, chaparral vegetation
- Mediterranean climate

- San Clemente Dam built in early 1920s (rkm 31)
- 32 m high
- One of three dams that existed, Los Padres Dam remains (rkm 42), built in 1948
- SCD removed Fall 2015
- Involved re-route channel

Images from CalAM

- **95% water storage capacity lost**
- **~ 1.7 million m^3 of sand and gravel**
- **Little to no water storage**
- **Mediterranean climate, flow varies more than three orders of magnitude seasonally**

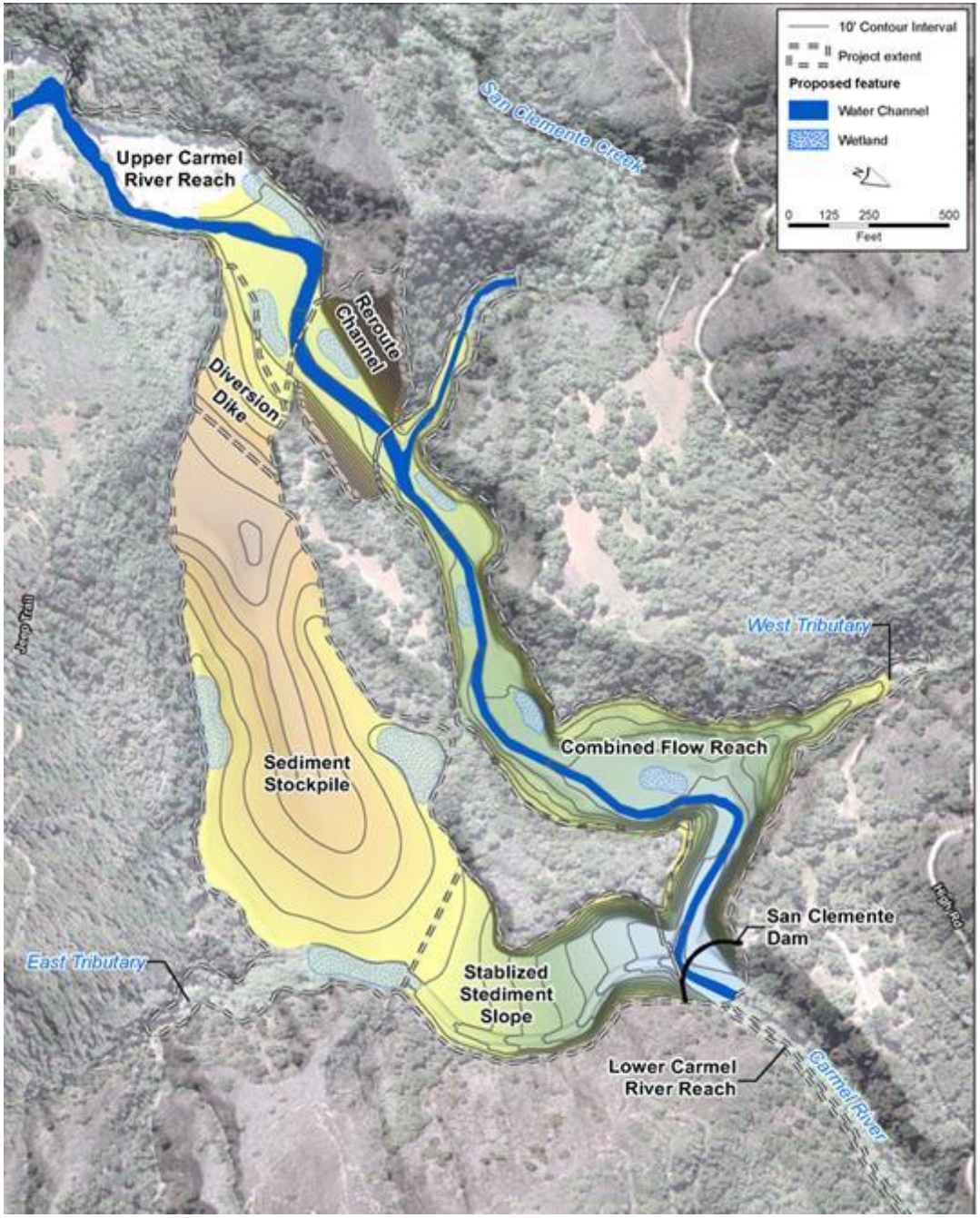
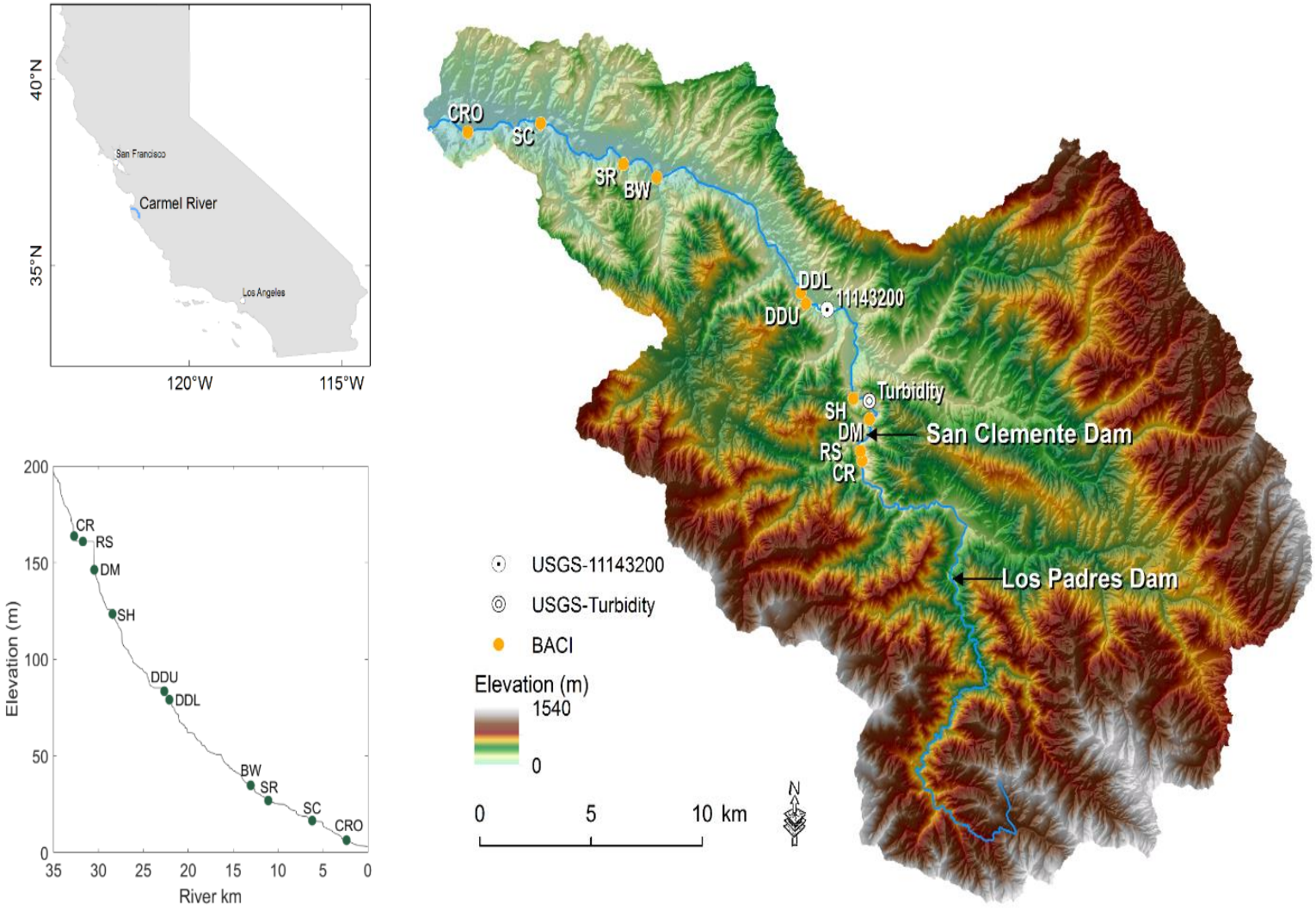
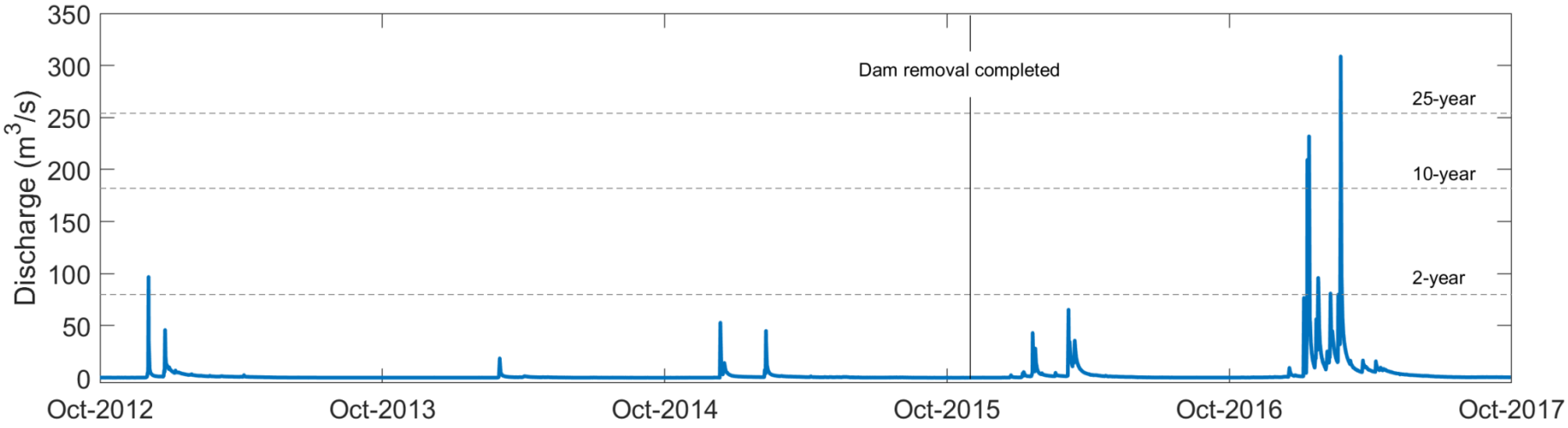


Image used with permission - CalAm

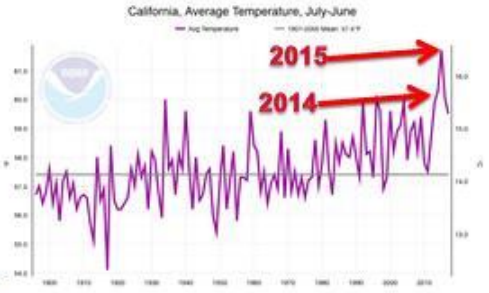


Harrison et al. (in review)

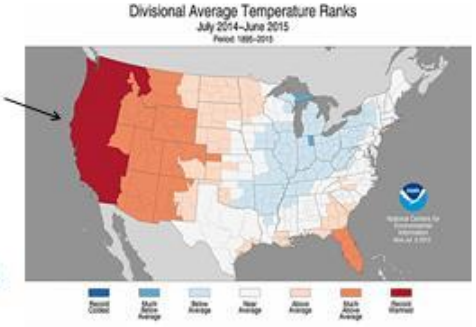


USGS data, L. Harrison figure

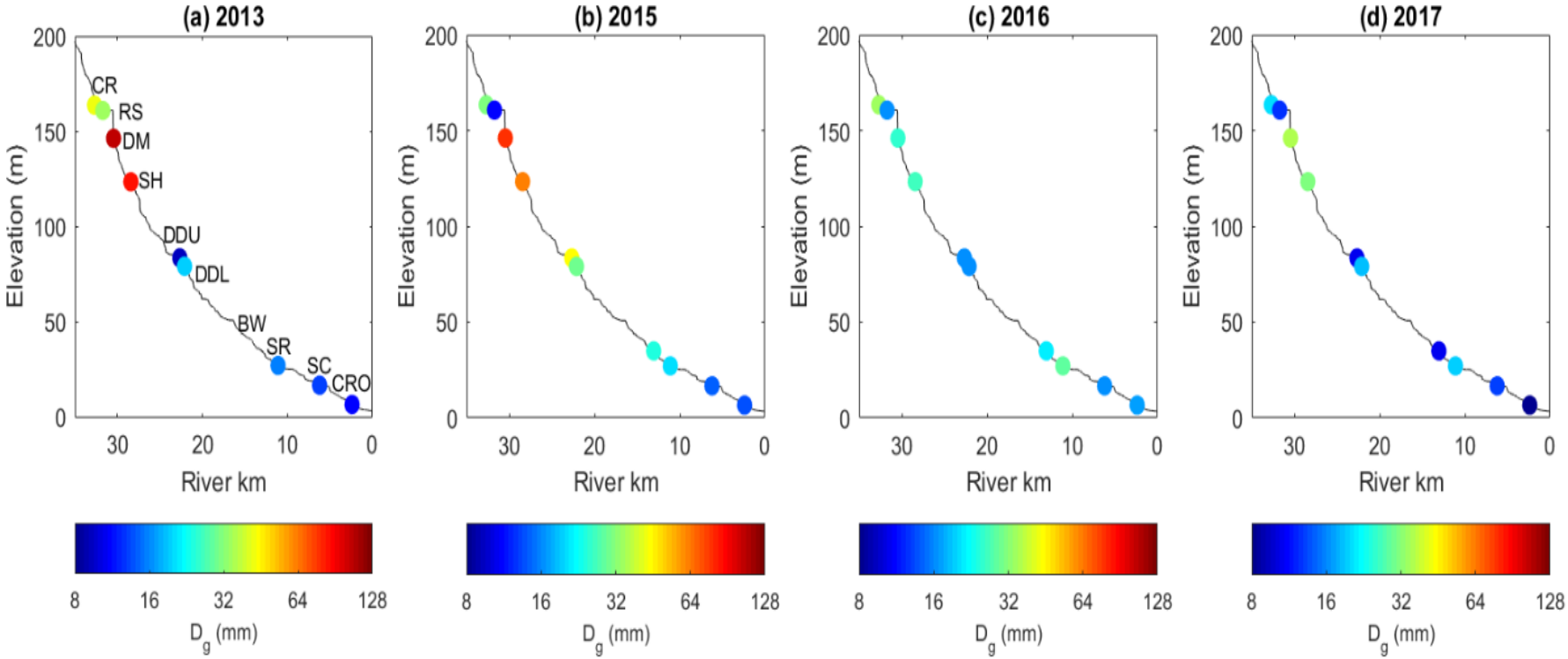
2014-17: exceptionally warm years for California

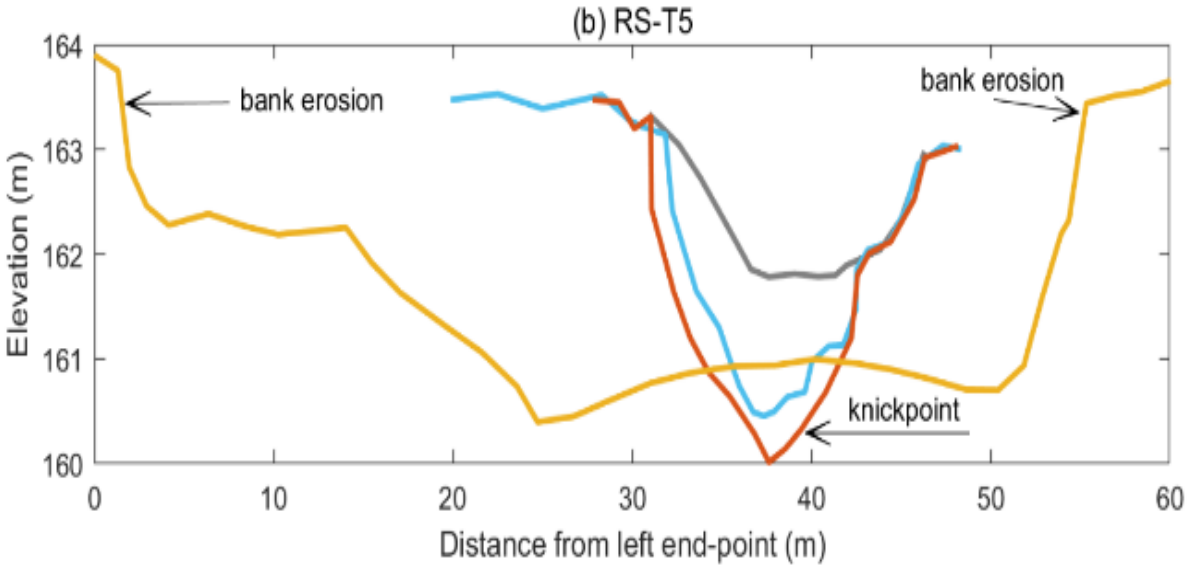


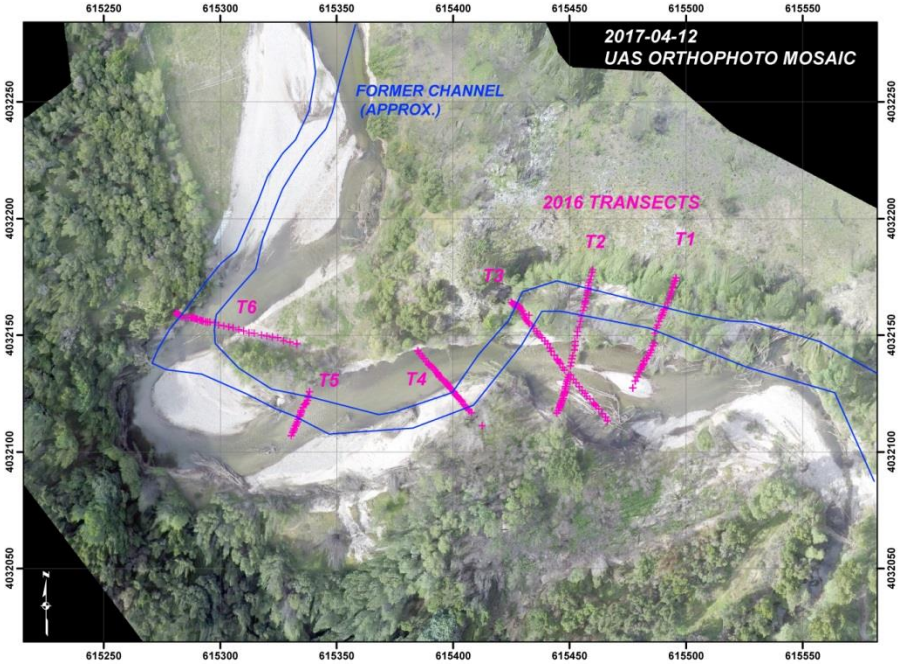
- Surface air temperature record for July 2014-June 2015 was almost off the charts, ~ 1 °C warmer than the previous record
- 2015 Western Snow Drought came with record high temperatures for the entire west coast
- The "hot drought" was amplified ~30% by high temperatures
- 2016 and 2017 a bit cooler than 2014

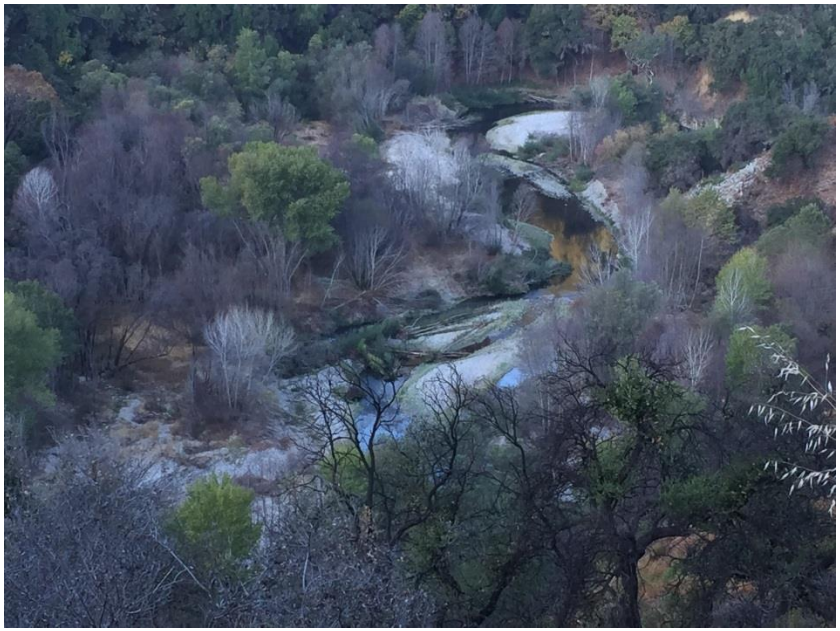


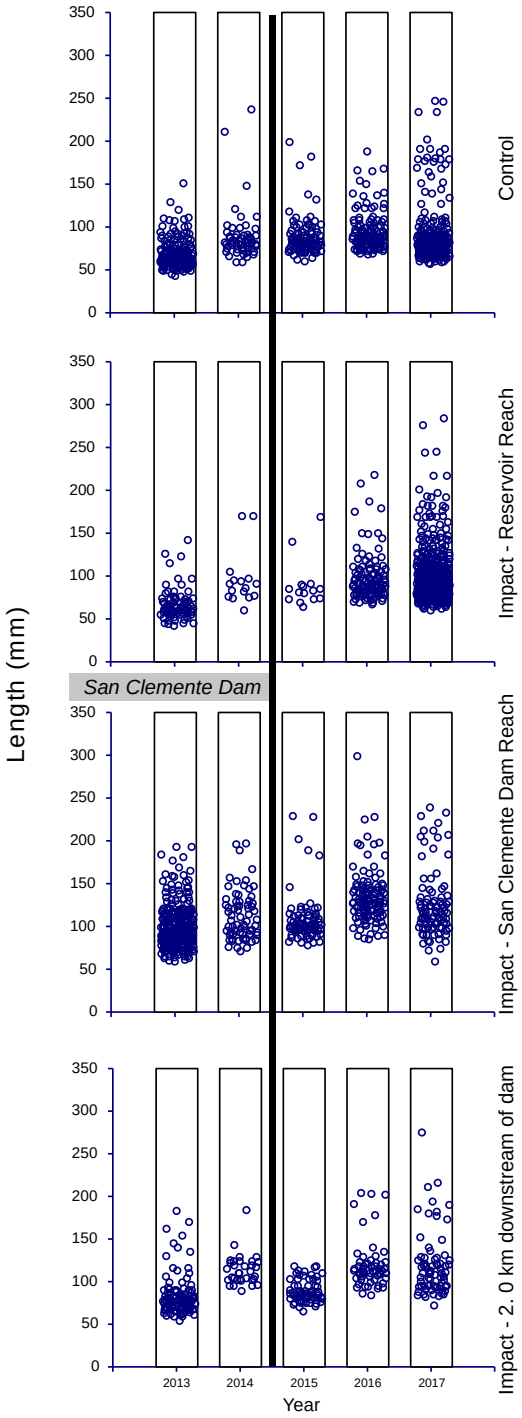
N. Mantua

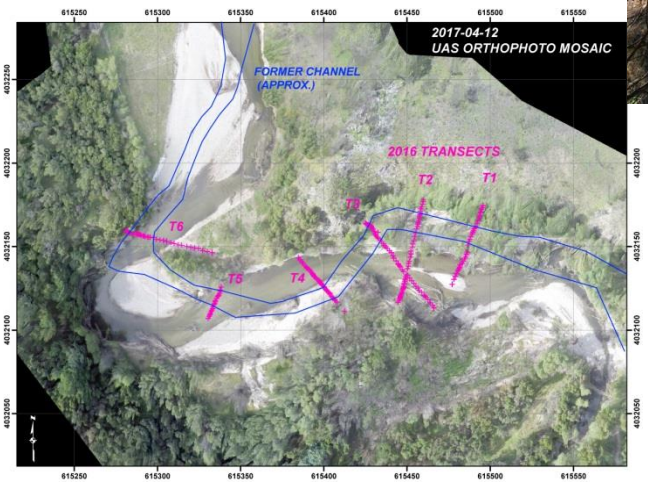

(a) 2013
(b) 2015
(c) 2016
(d) 2017
Elevation (m)
River km
CR
RS
DM
SH
DDU
DDL
BW
SR
SC
CRO
8
16
32
64
128
D_g (mm)

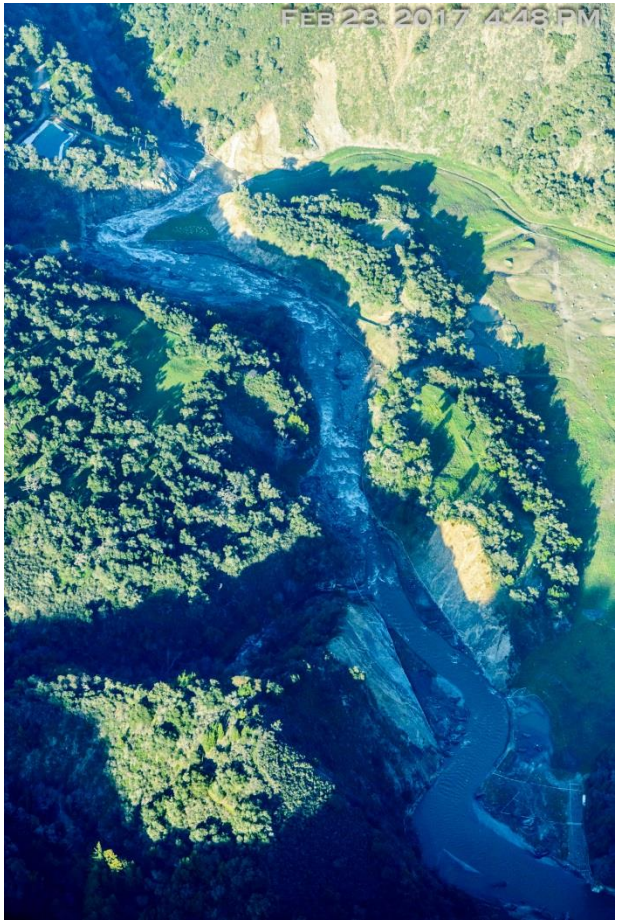

(b) RS-T5
bank erosion
bank erosion
knickpoint
Elevation (m)
Distance from left end-point (m)
164
163
162
161
160
0
10
20
30
40
50
60


2017-04-12
UAS ORTHOPHOTO MOSAIC
FORMER CHANNEL
(APPROX.)
2016 TRANSECTS
T1
T2
T3
T4
T5
T6
615250
615300
615350
615400
615450
615500
615550
4032250
4032200
4032150
4032100
4032050




Length (mm)
Control
Impact - Reservoir Reach
San Clemente Dam
Impact - San Clemente Dam Reach
Impact - 2. 0 km downstream of dam
Year
2013
2014
2015
2016
2017
Flow


2017-04-12
UAS ORTHOPHOTO MOSAIC
FORMER CHANNEL
(APPROX.)
2016 TRANSECTS
T1
T2
T3
T4
T5
T6



Images by Brian Cluer

Doug Smith (CSUMB)

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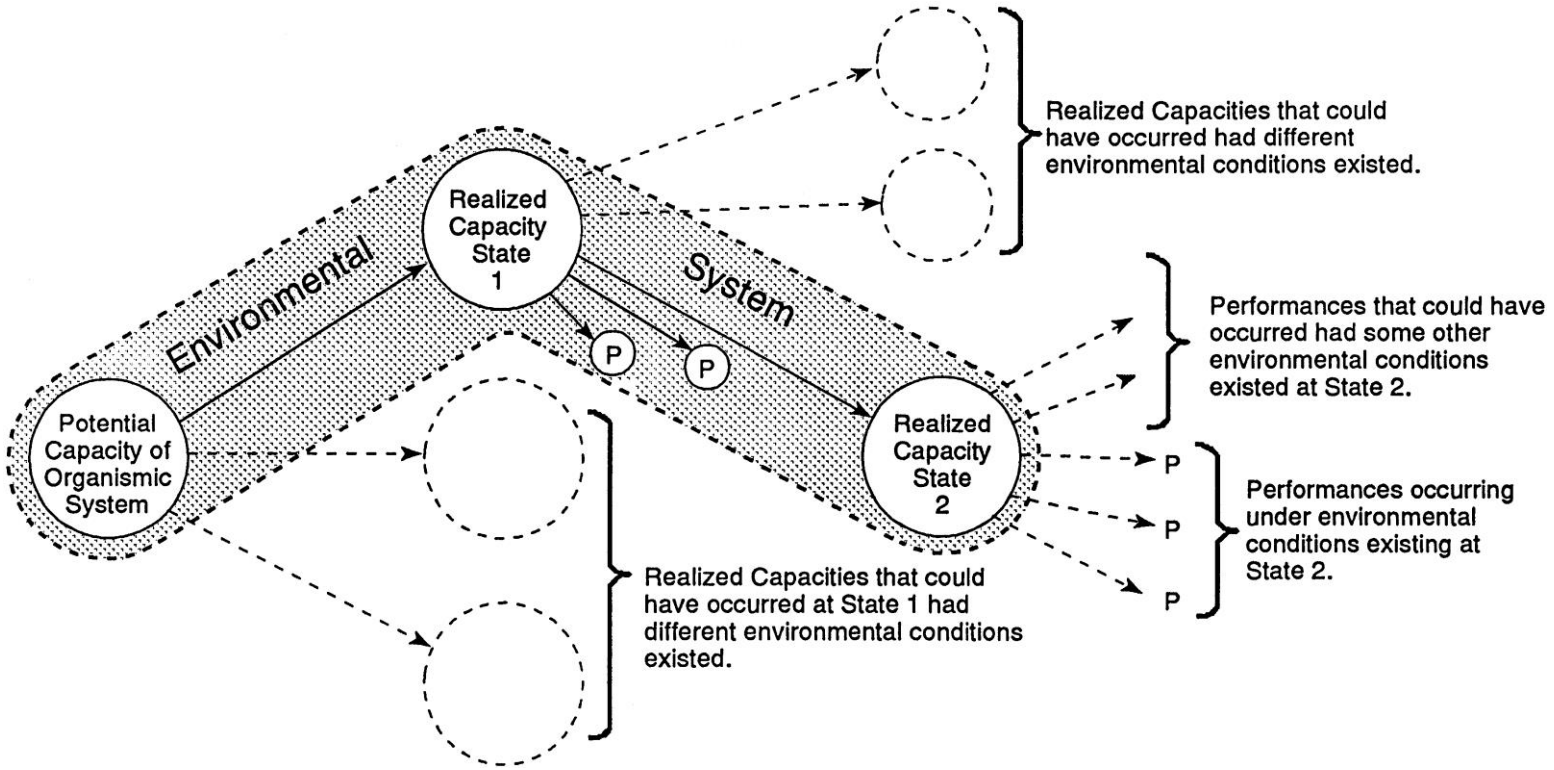
Expectations – time and events

To be viable (i.e., persist) – fish need to be able to track changes in the environment

- **Individuals**
- **Populations**
- **Biogeographic groups**
- **Species**

Photo: M. Capelli



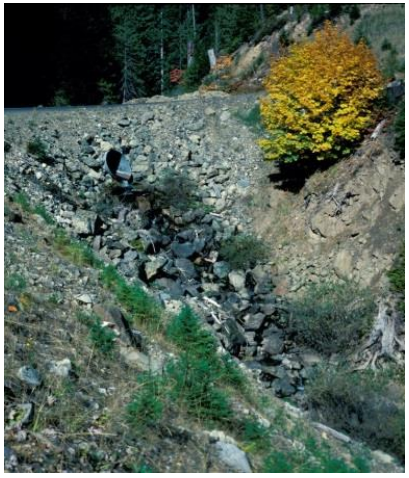
From Ebersole et al. 1997. Envir. Mgt. 21:1-14.

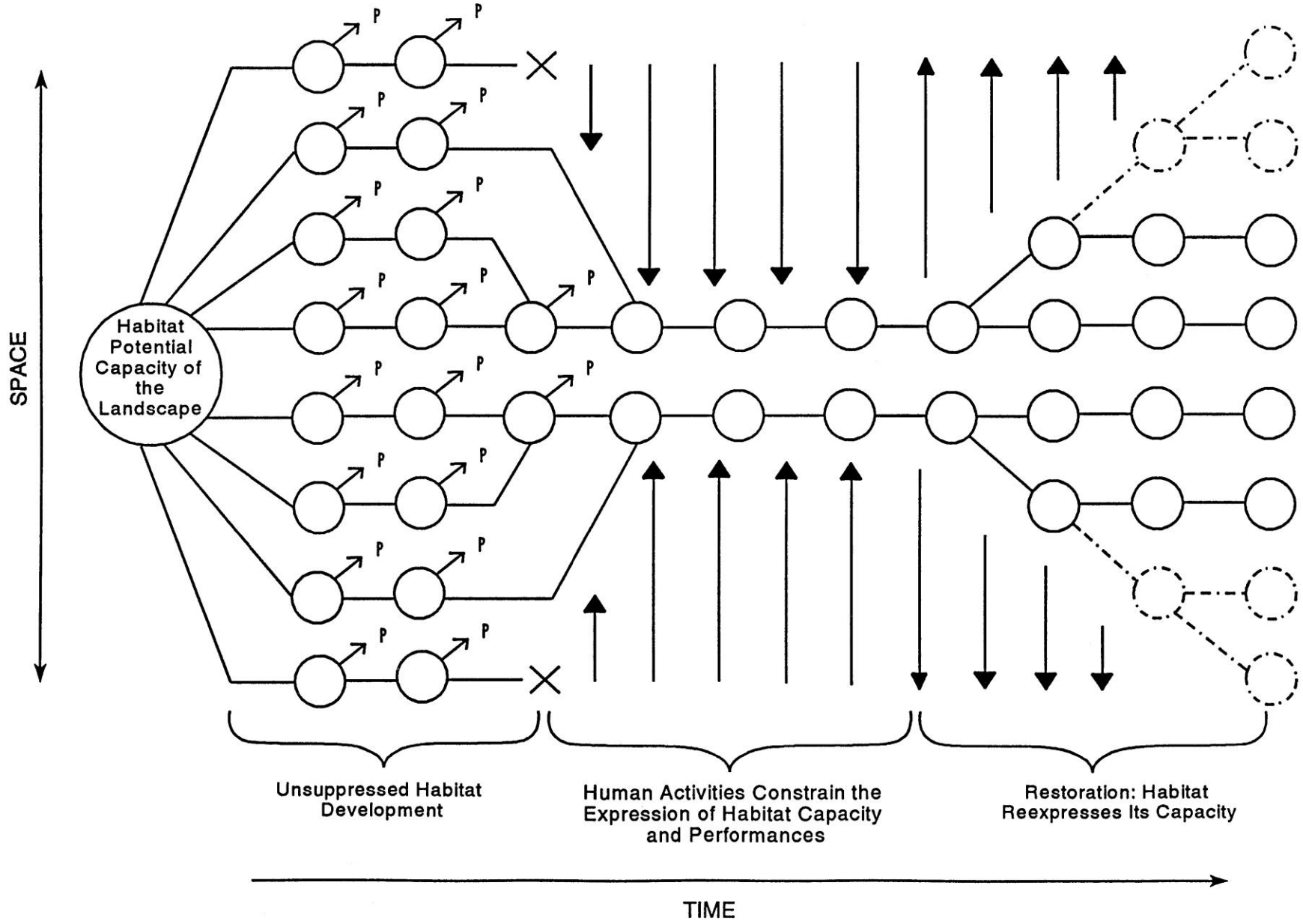
Natural disturbance events that influence salmonid populations throughout their range include:

- **fires**
- **landslides**
- **glaciers**
- **earthquakes**
- **volcanic eruptions**
- **floods**

Anthropogenic constraints that can influence the ability of salmonid populations to track changes in environmental conditions include:

- **urbanization**
- **land management activities (e.g., timber, agriculture)**
- **fire (magnitude, frequency)**
- **flooding (magnitude, frequency)**
- **barriers**





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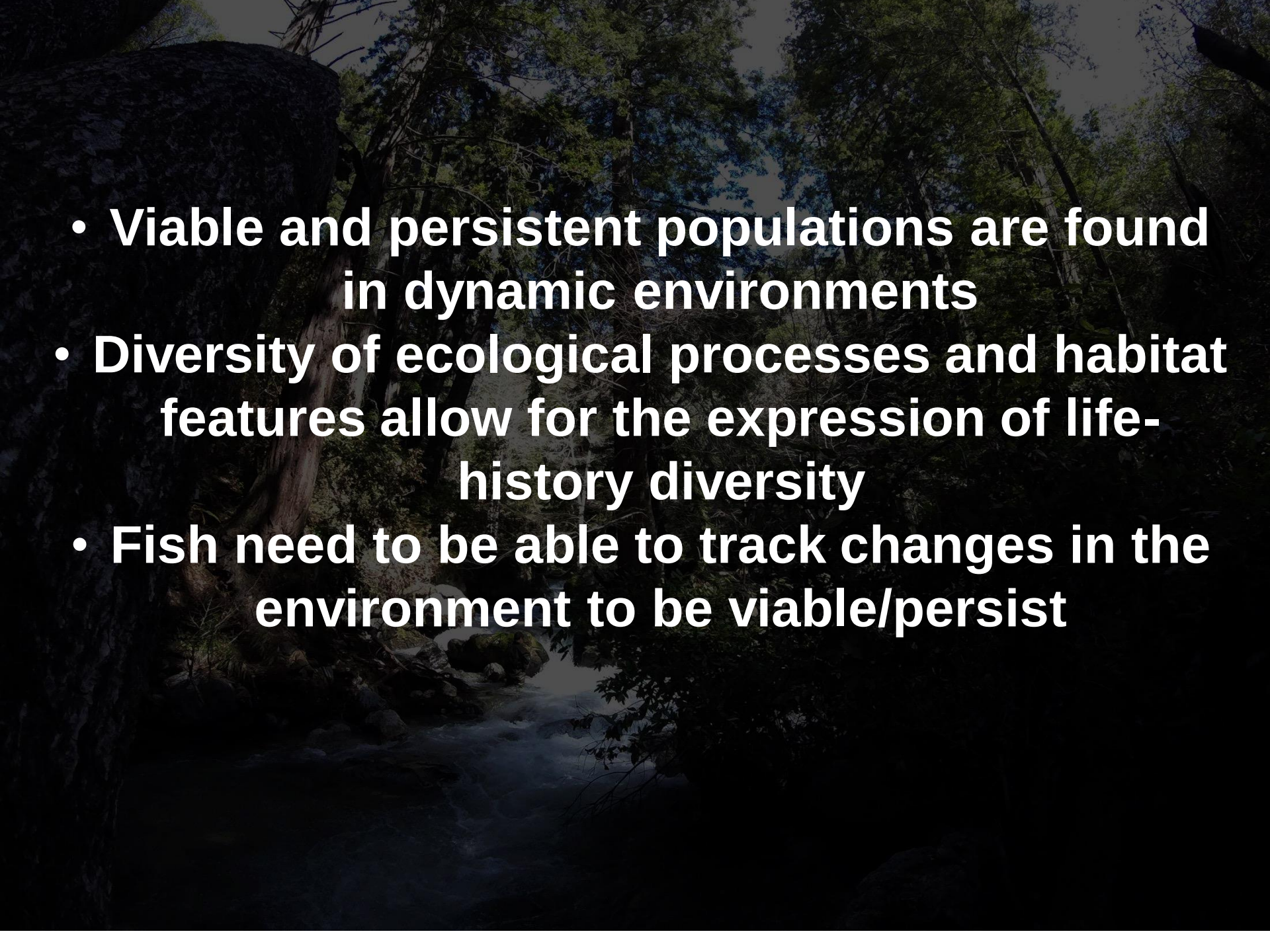
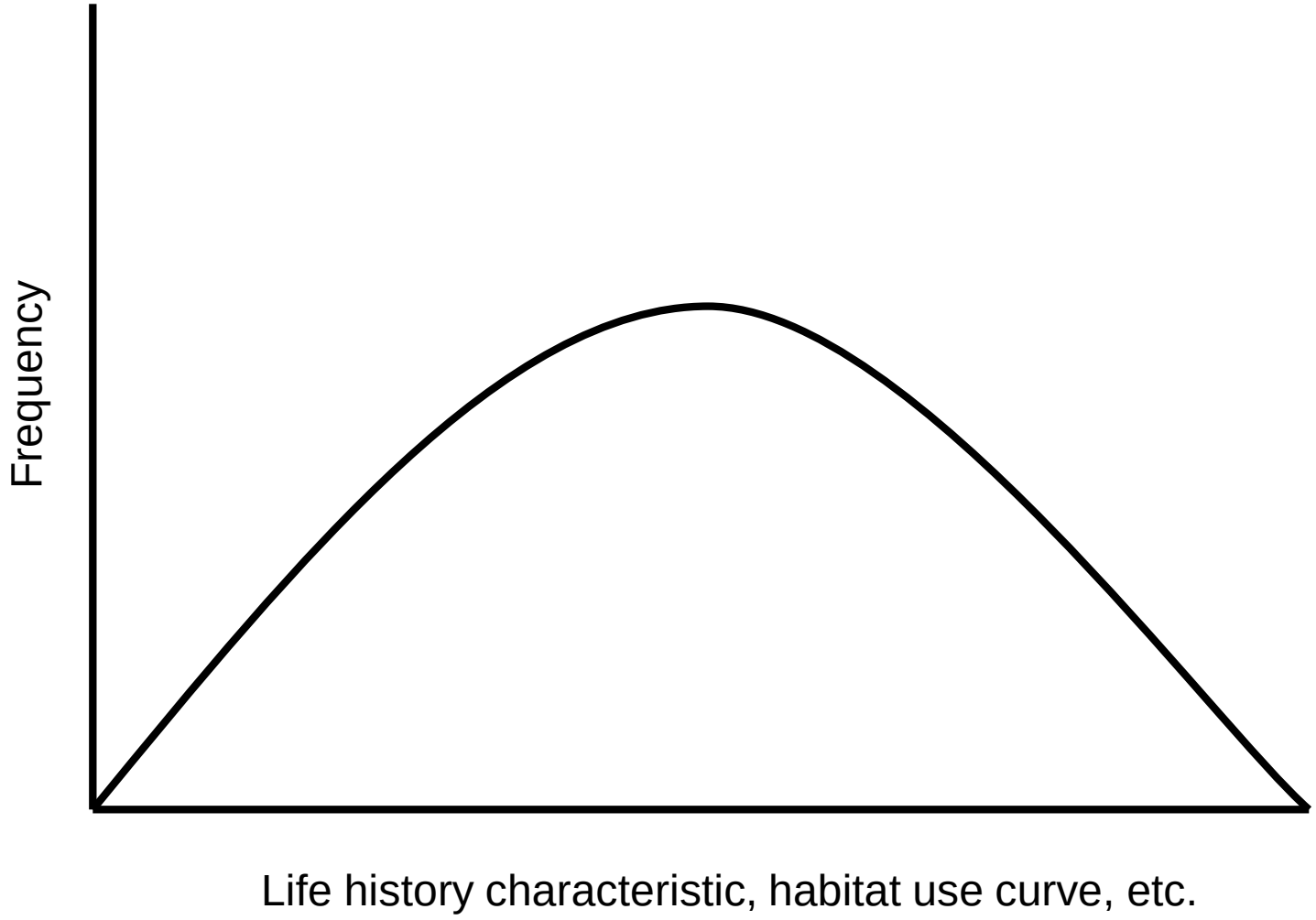
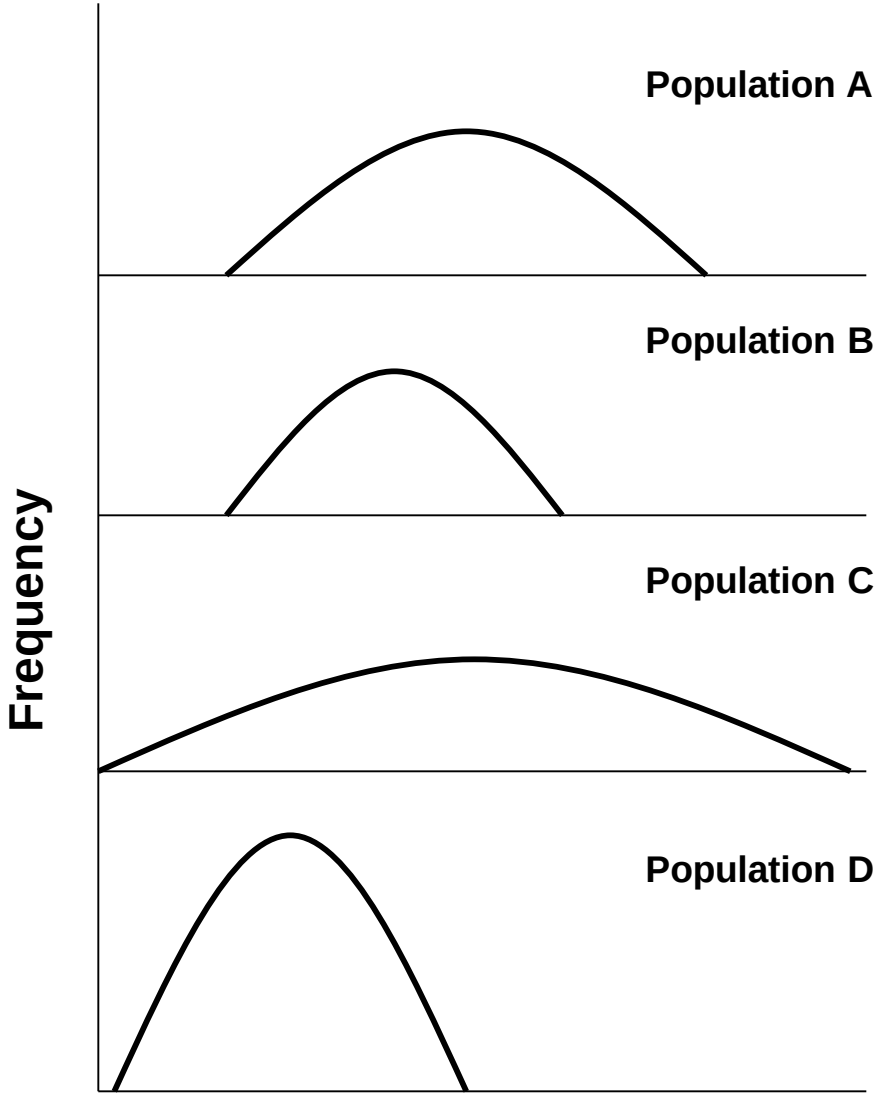
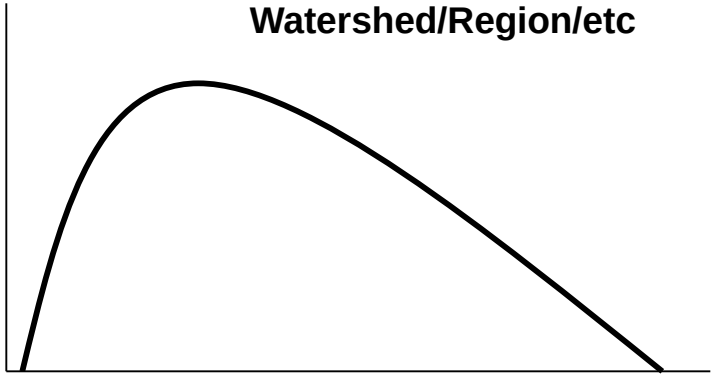


- Viable and persistent populations are found in dynamic environments
- Diversity of ecological processes and habitat features allow for the expression of life-history diversity
- Fish need to be able to track changes in the environment to be viable/persist


Frequency
Life history characteristic, habitat use curve, etc.





Williams et al. In Preparation