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Salish Sea Ecosystem Conference

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Light availability controls in the benthic nearshore ecosystem of the Elwha River

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Glover, Hannah; Ogston, Andrea S.; Eidam, Emily F.; Miller, Ian M.; Rubin, Stephen P.; and Berry, Helen, "Light availability controls in the benthic nearshore ecosystem of the Elwha River" (2018). *Salish Sea Ecosystem Conference*. 53.

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Speaker

Hannah Glover, Andrea S. Ogston, Emily F. Eidam, Ian M. Miller, Stephen P. Rubin, and Helen Berry

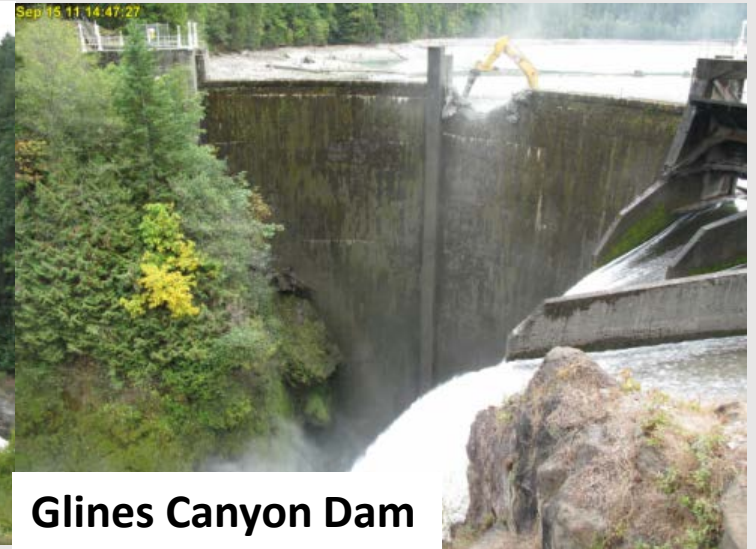
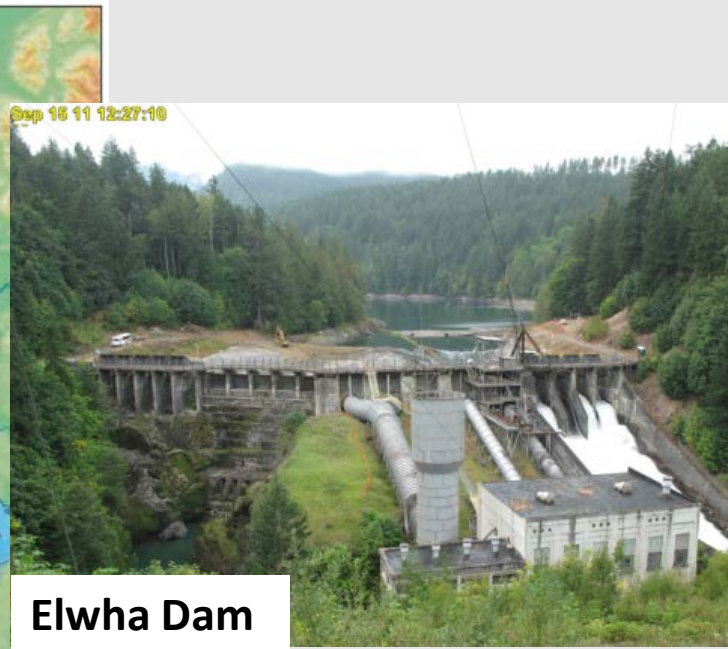
Controls on Light Availability in the Benthic Nearshore Ecosystem of the Elwha River, WA

Hannah Glover

Andrea S. Ogston, Emily Eidam, Ian Miller, Steve Rubin, & Helen Berry

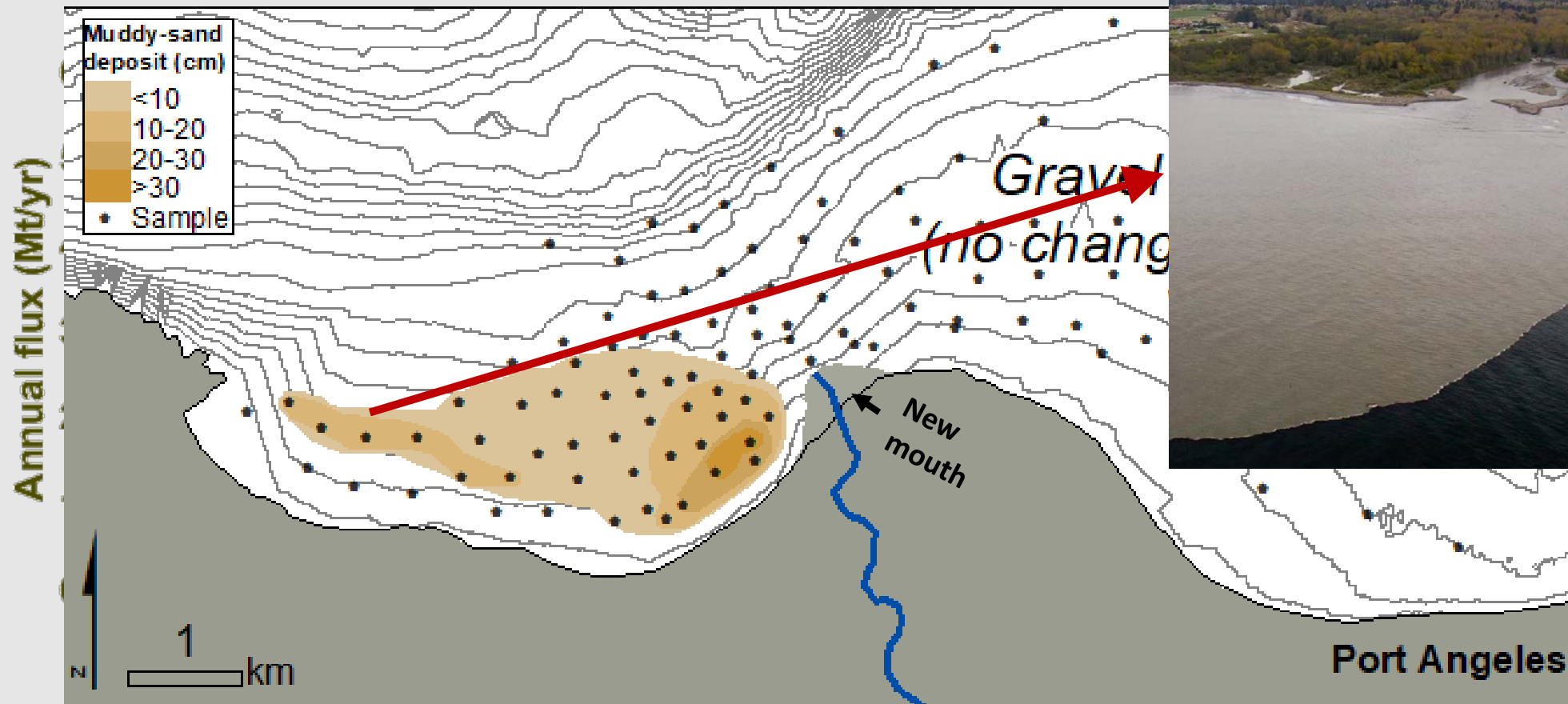


Elwha River Dam Removal Project



Built in early 1900s
30 Mt of sediment in reservoirs
Dam removal in 2011 to 2014

2011-2017 sediment flux and deposition



~15 Mt of sediment have eroded so far
Sandy-mud deposit in Fresh Water Bay
(half of reservoir)

Nearshore ecosystem impacts: macroalgae



- Extensive macroalgae mortality during dam removal (Rubin, et al, 2017)
- Hypotheses for cause of mortality:
 - Changes to substrate
 - Direct scouring
 - Reduced light availability

How does a sediment pulse event and subsequent sediment transport impact benthic light availability?

Lambert-Beers Law and sediment transport

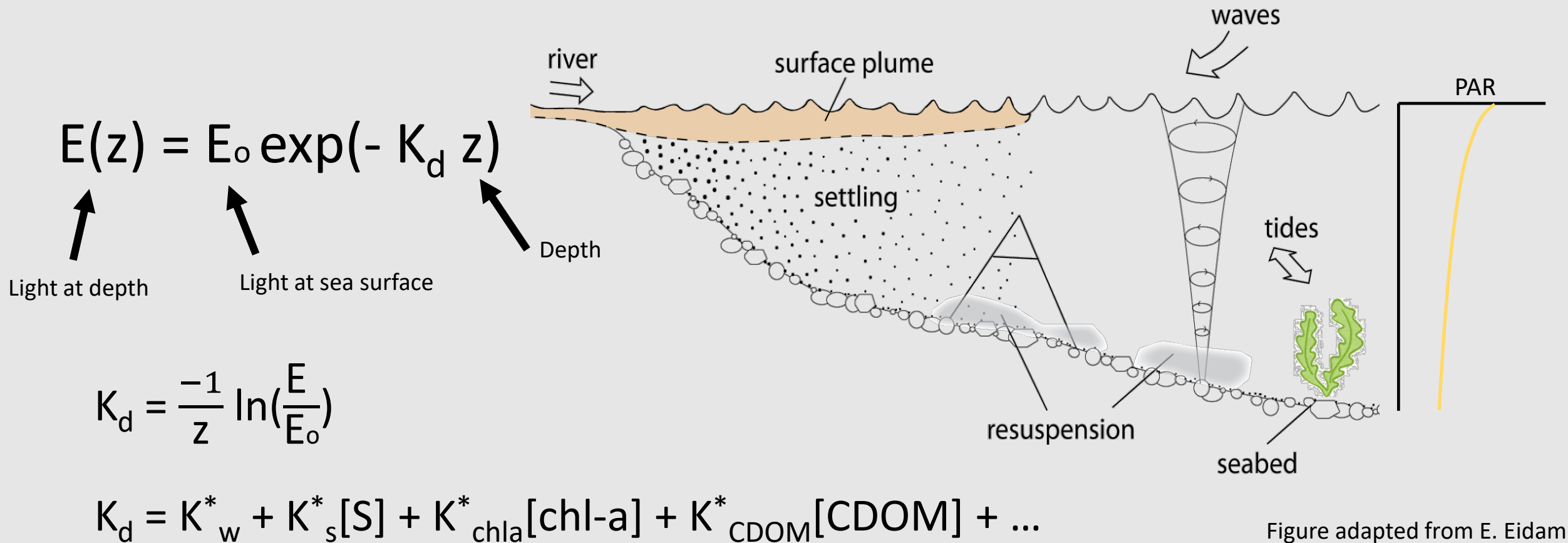
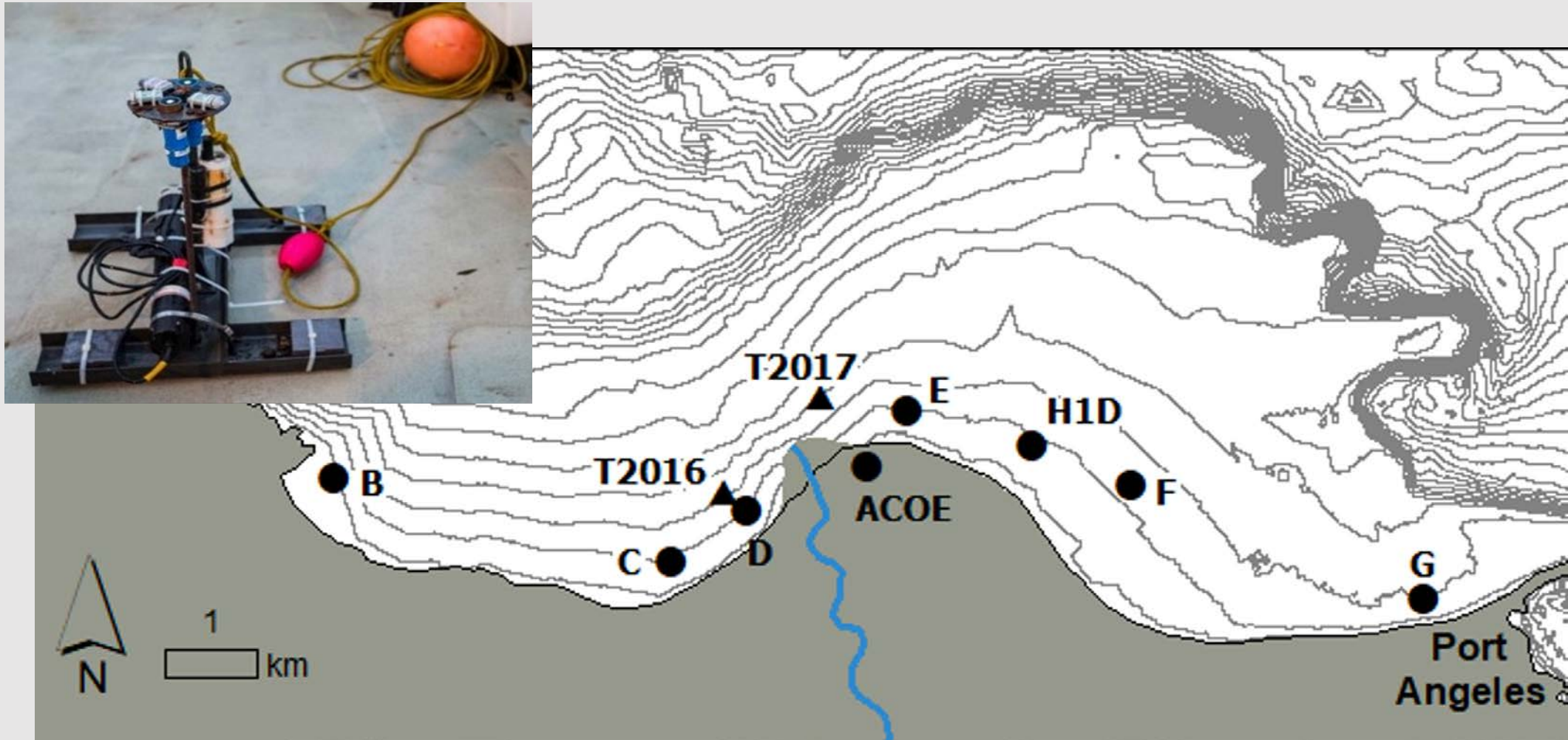
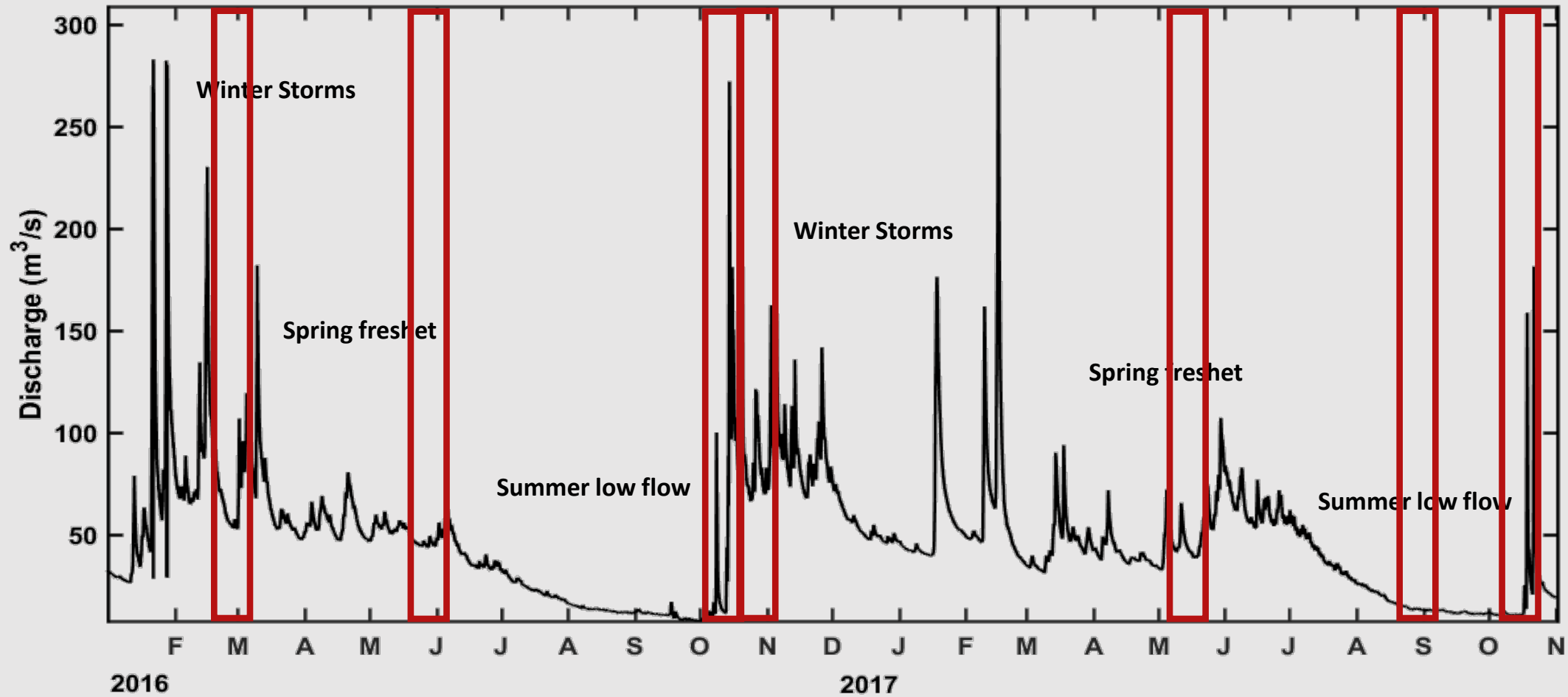


Figure adapted from E. Eidam

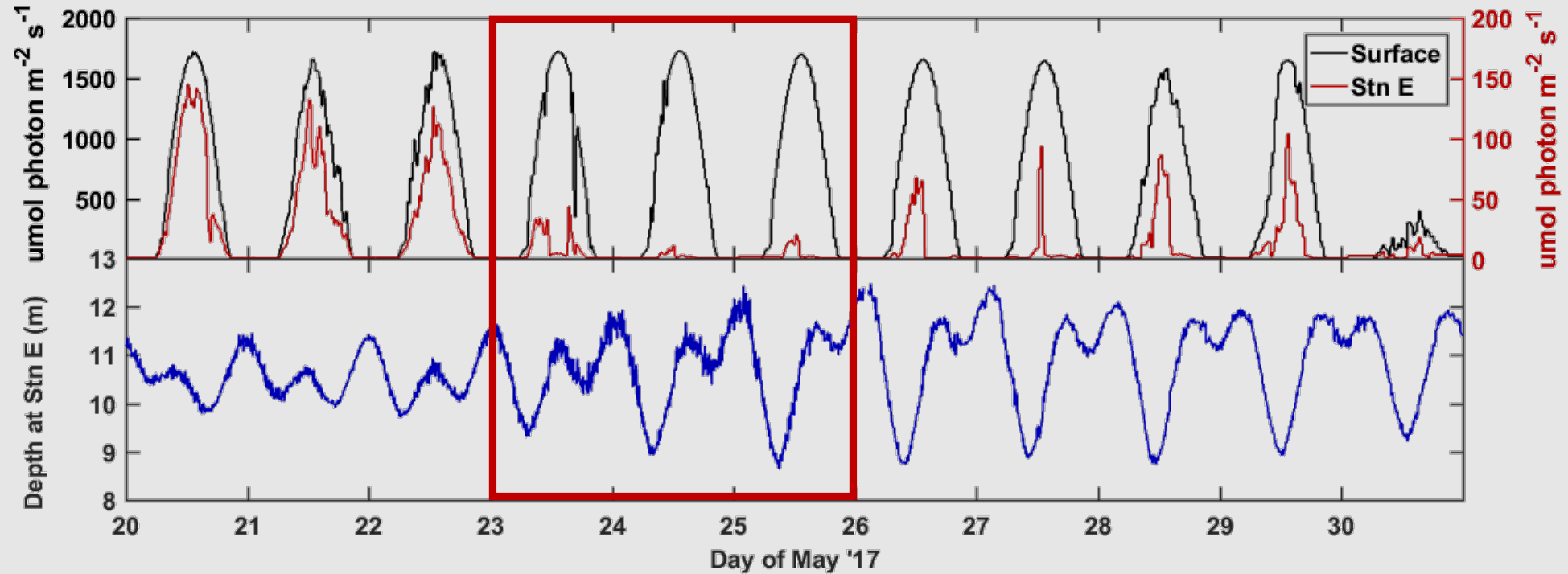
Monitoring light availability in 2016 – 2017



Elwha River Hydrograph 2016 - 2017



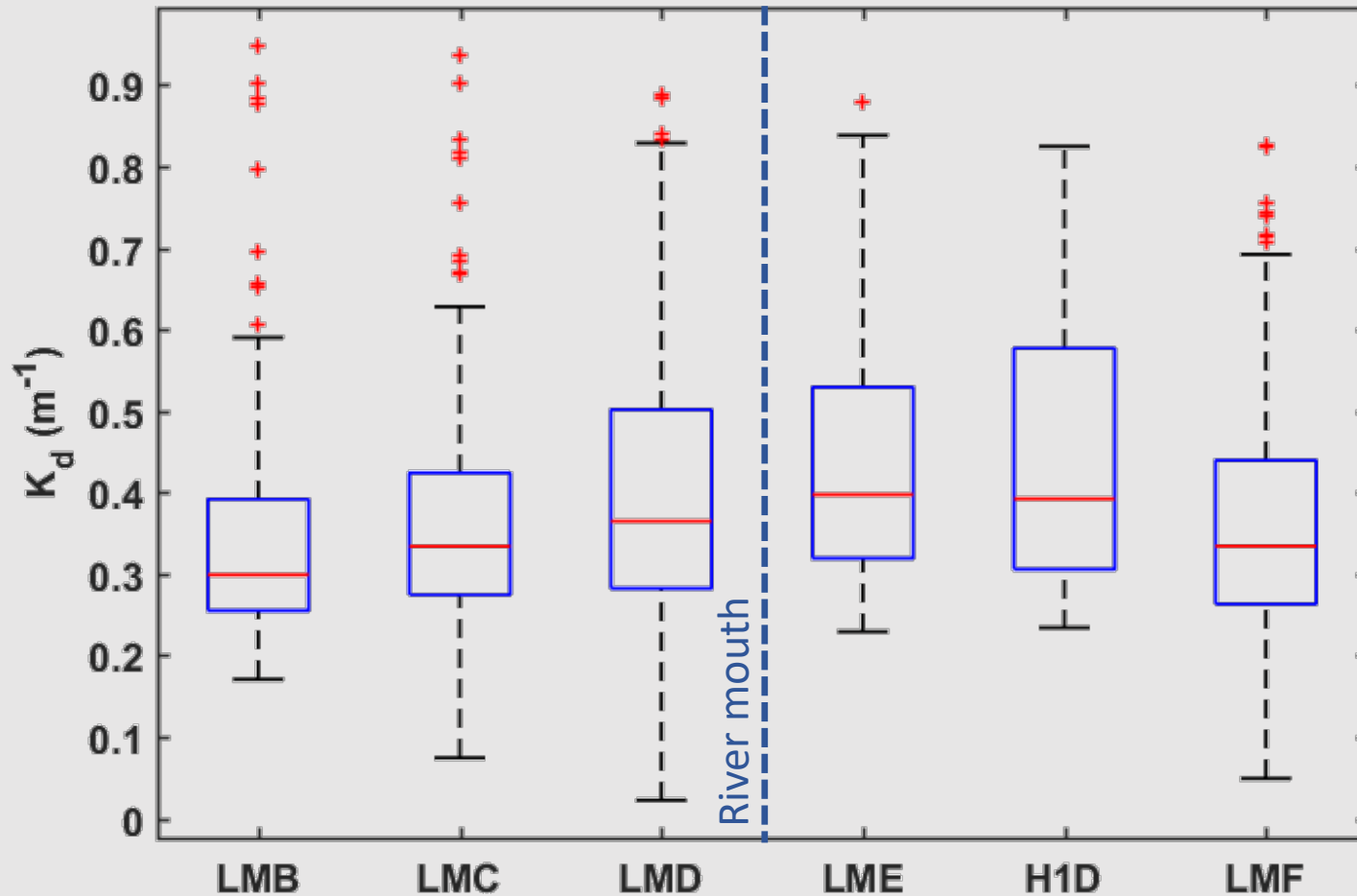
Raw benthic light availability data



Take values between 10:00 – 15:00

$$K_d = \frac{-1}{z} \ln\left(\frac{E}{E_0}\right)$$

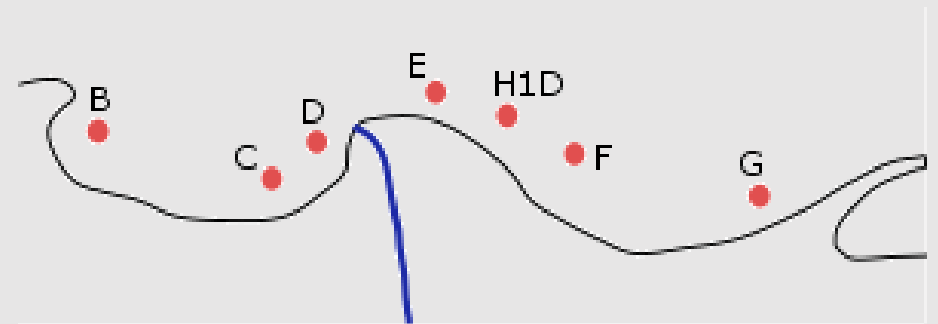
Mean K_d for all deployments



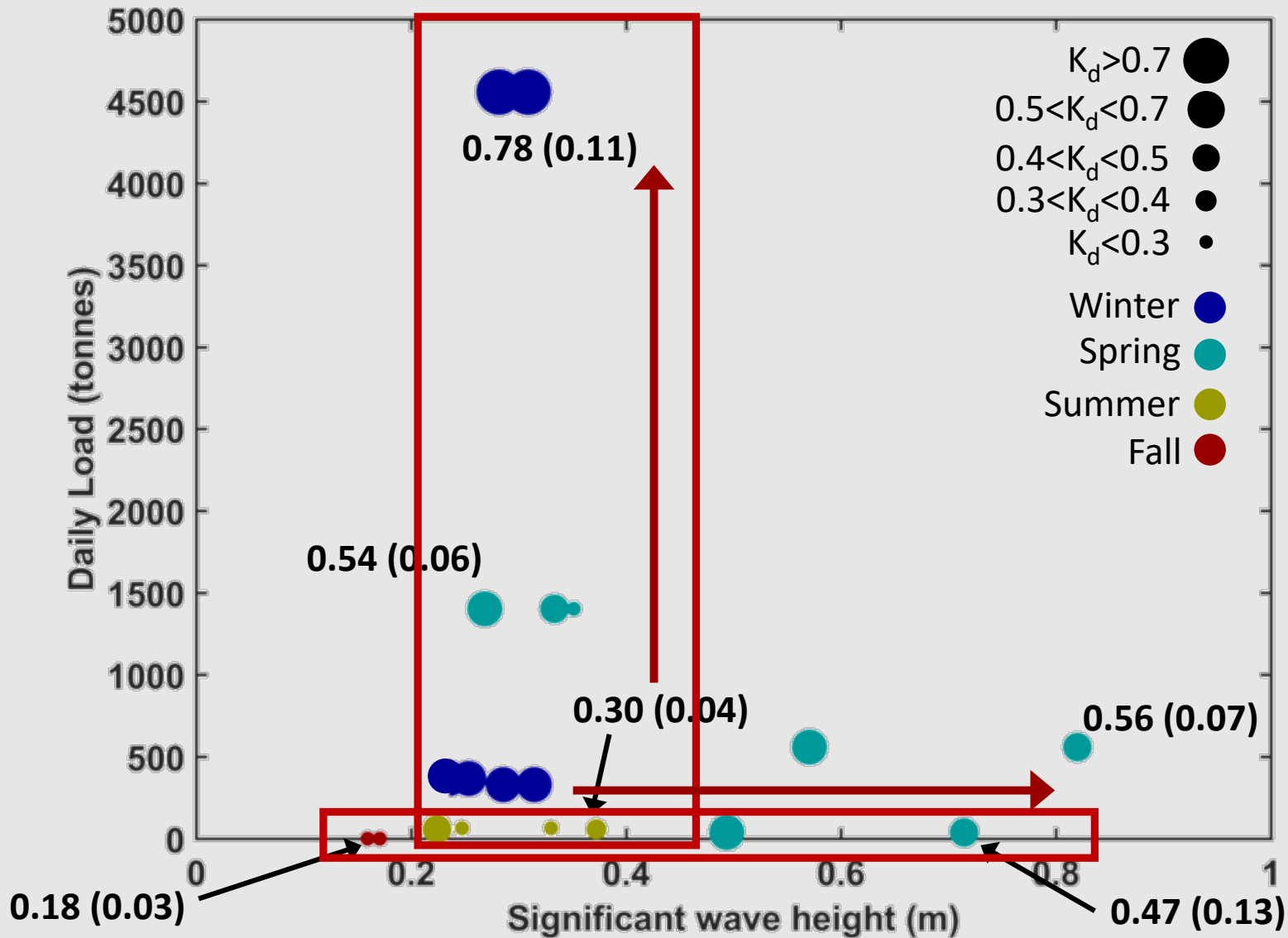
K_d decreases away from the river

Wide range of values observed over the 7 deployments:

- Tides
- River discharge
- Waves



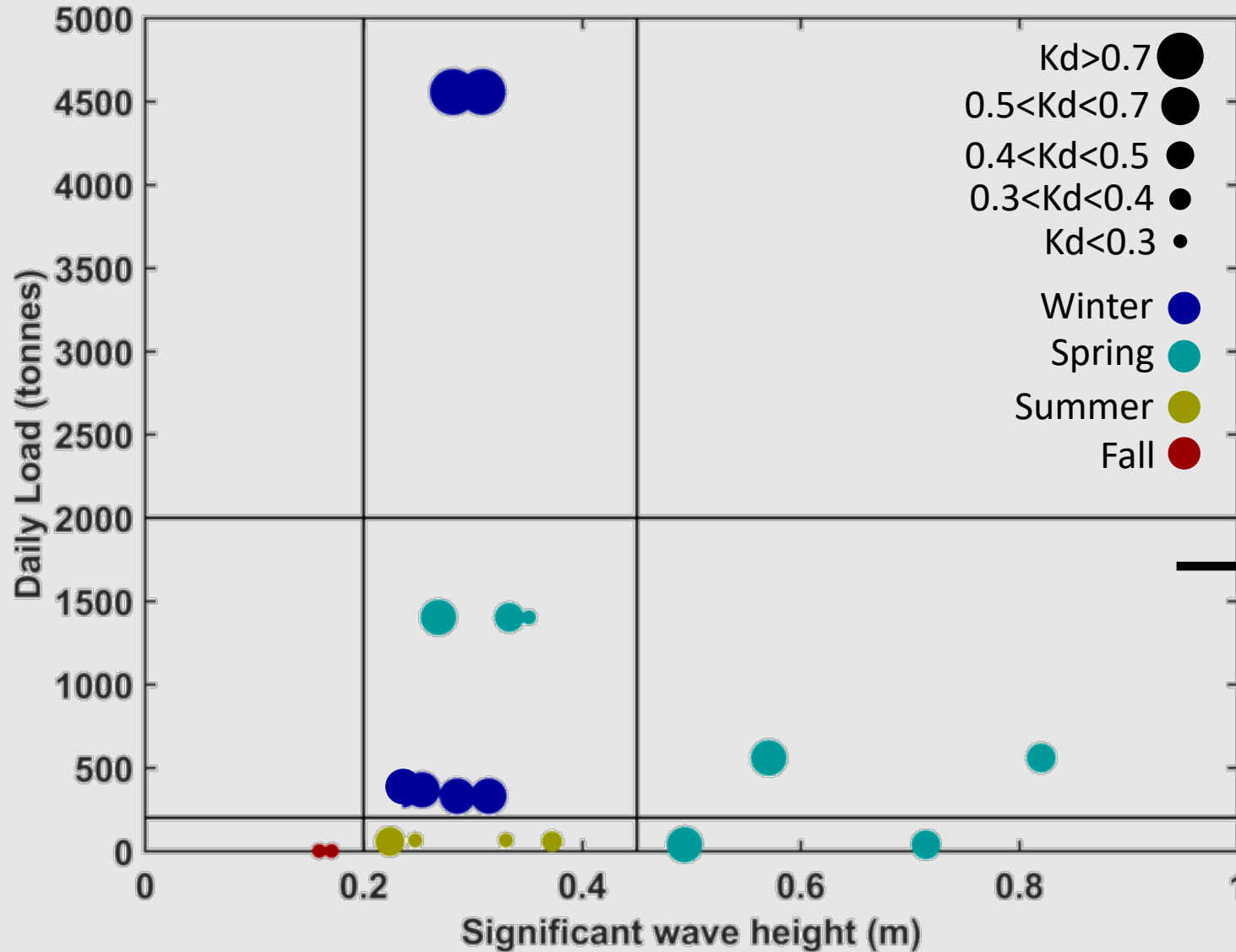
K_d from river discharge and wave climate



K_d increases with discharge

K_d increases with wave height

K_d from river discharge and wave climate



K_d increases with discharge

K_d increases with wave height

→ Hindcast to dam removal

K_d from sediment load during dam removal

Light requirement (mol/m ² /day)*	Maximum K_d (m ⁻¹)
Gametophyte: 0.4	0.54
Adult: 1	0.45
Adult: 2	0.38

*Schiel and Foster, (2015), *The Biology and Ecology of Giant Kelp Forests*

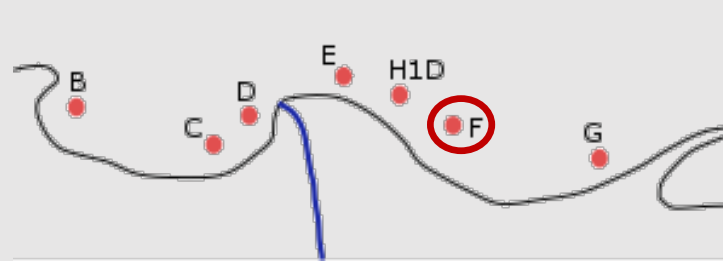
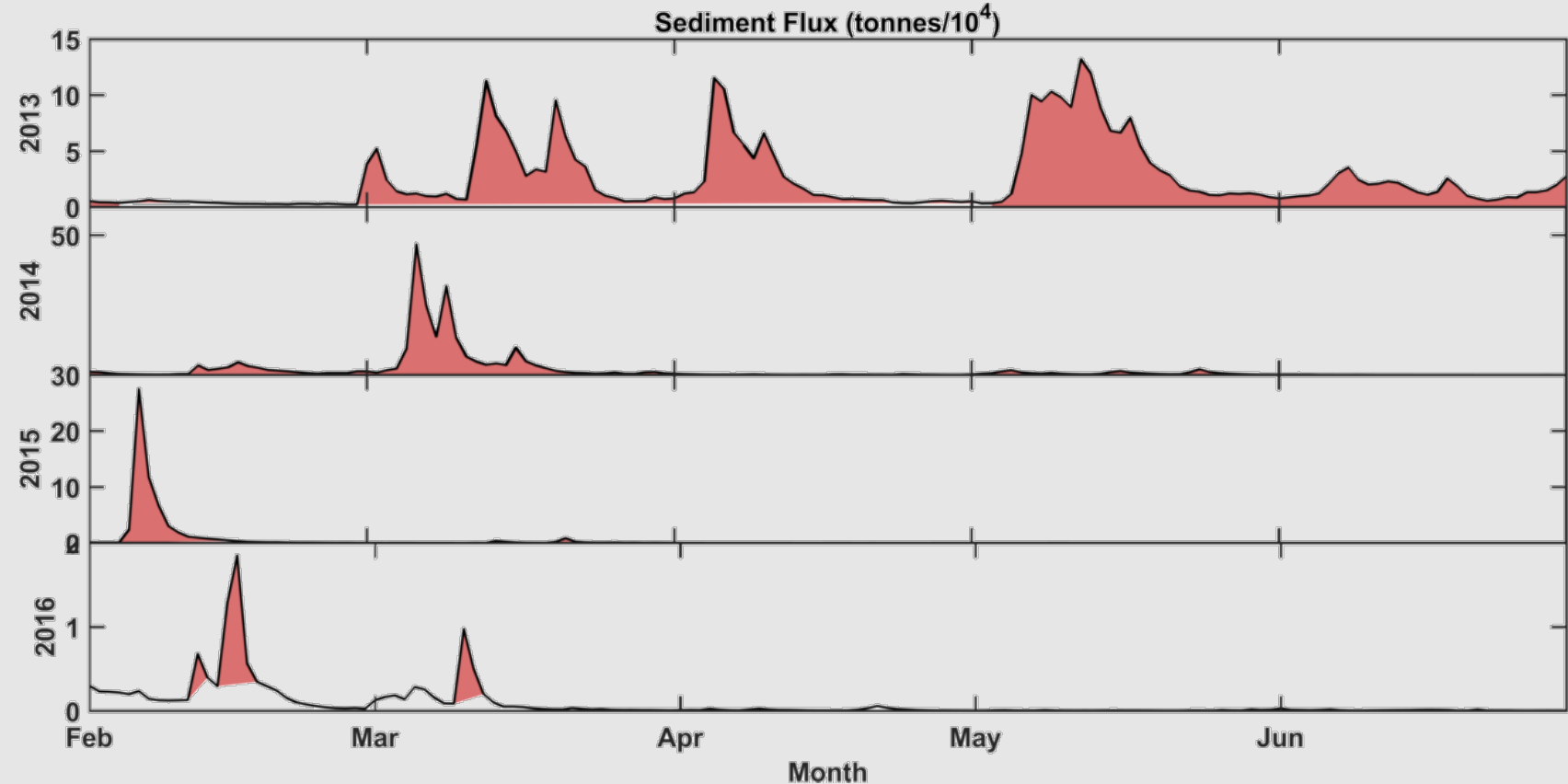
$K_d \sim 0.5$ at station F

Wave height:

0.2 – 0.45 m

Discharge:

200 – 4000 t



Summary and future work

- Sediment discharge has decreased since dam removal
- Benthic light availability has returned to a healthy range for macroalgae.
- Light availability is impacted by:
 - Sediment flux from the river
 - Distance from river mouth
 - Waves
 - Tides
- Data will be used to calibrate a model being developed by Andrew Stevens (USGS)
- PLUGS: Andrea Ogston (Session 3.3), Steve Rubin (Session 3.1)