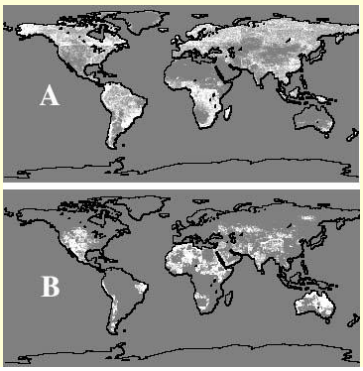
Physiography of streams

The fun starts here

Lecture outline

- Classifying streams
- Streamflow and geomorphology
- Export of material

Where do you find streams?

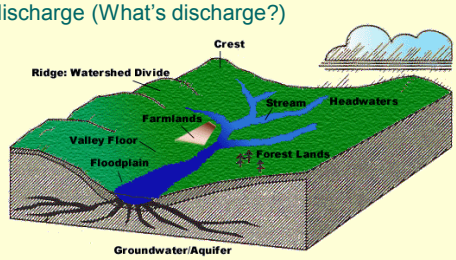


Permanent

Intermittent

What's a watershed?

- Streams are often classified by the size of their watersheds
- "Watersheds" vs. "catchments"
- Larger watersheds usually have streams with more discharge (What's discharge?)



Stream **order**

- Another way to classify by stream size
- **Strahler** classification system—widely used
- Caveats:
  - Smallest streams
  - Streams as 'blue lines'
  - Lack of agreement with some physical factors

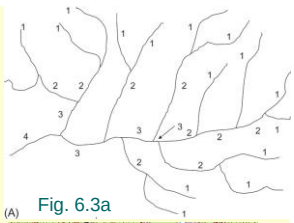
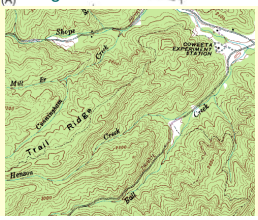


Fig. 6.3a



Stream order vs. length

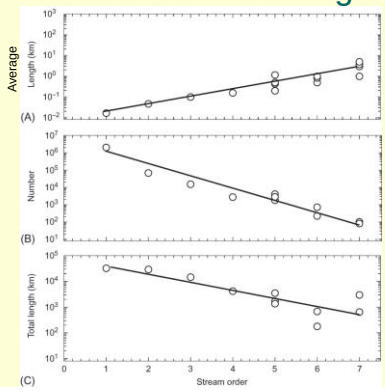
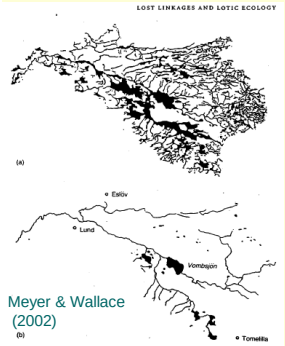


Fig. 6.4

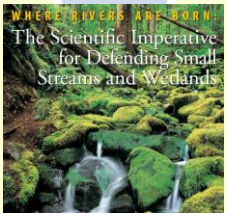
Do the little ones matter?



Meyer & Wallace (2002)

Figure 14.3 Loss of small streams from the Kävlinge River catchment in Sweden. The top panel (a) is a map from 1812 to 1820, whereas the bottom panel (b) shows the same area in 1950–53 after extensive diking and channelization. (Reproduced with permission from Wolf 1956.)

"THE PHYSICAL, CHEMICAL, AND BIOTIC INTEGRITY OF OUR NATION'S WATERS IS SUSTAINED BY SERVICES PROVIDED BY WETLANDS AND HEADWATER STREAMS."



Hydrographs and streams

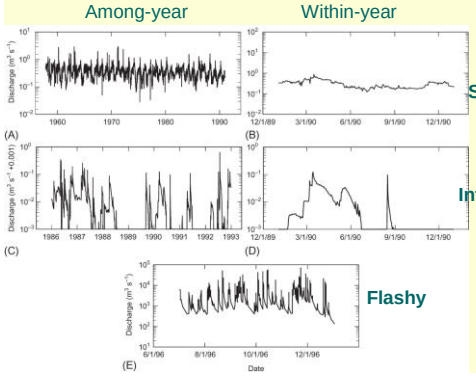


Fig. 6.6

Stream classification and discharge

Table 6.2 A Method of Classifying Streams by Discharge Patterns and Relationship to Aquatic Communities

Drying Frequency	Flood and Discharge Frequency/Predictability	Stream Type	Effect on Biota
Often	Rare–frequent	Harsh intermittent	Strong
Low	Frequent	Intermittent flashy	Strong
Low	Infrequent	Intermittent runoff	Strong
Rare	Frequent unpredictable floods, low discharge predictability	Perennial flashy	Strong
Rare	Frequent predictable floods, low discharge predictability	Snow and rain	Strong–intermediate
Rare	Infrequent floods, low discharge predictability	Perennial runoff	Strong–intermediate
Rare	Infrequent floods, high discharge predictability	Mesic groundwater	Weak
Rare	Infrequent predictable floods, high discharge predictability	Winter rain	Seasonally strong
Rare	Infrequent predictable floods, high discharge predictability	Snowmelt	Seasonally strong

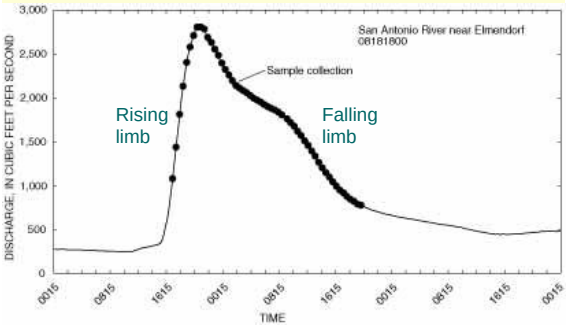
(After Poff and Ward, 1989)

Lecture outline

- Classifying streams
- **Streamflow and geomorphology**
- Export of material

Storm hydrograph (1)

- Where does **baseflow** come from?



Storm hydrograph (2)

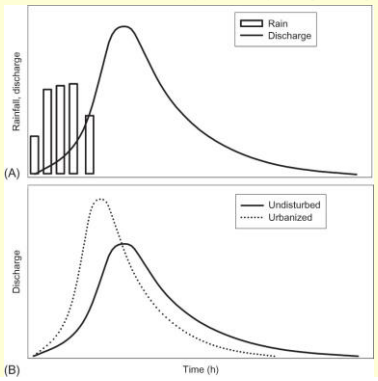


Fig. 6.8

Flood frequency

- RI = 10 yr; 1 in ? chance in any year (P = ?%)
- So, what's a 100-yr flood?

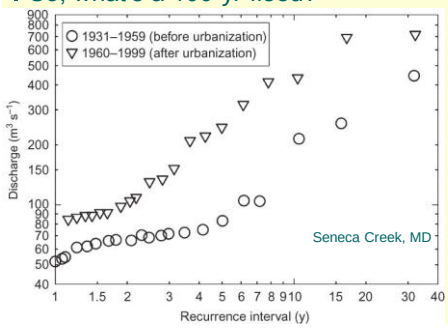


Fig. 6.9

Stream geomorphology (1)

Stream geomorphology (2)

- Riffles, pools, runs; **reach**; **hyporheic zone**
- Riffle-pool sequences often repeat every 5 – 7 channel widths; Locally?

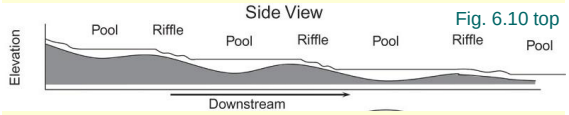


Fig. 6.10 top

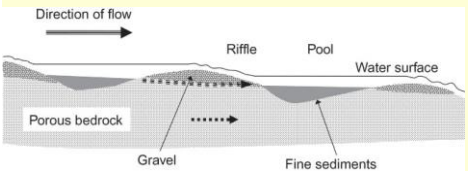


Fig. 6.11

Stream geomorphology (3)

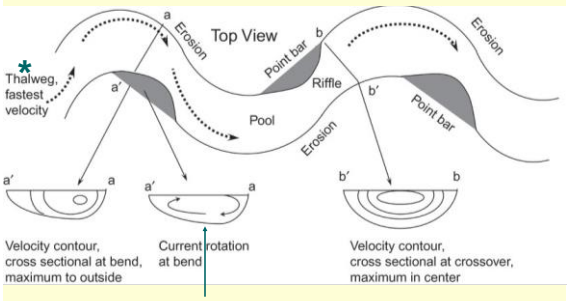
- Meanders

Iowa River

1964 Alaskan earthquake

Stream geomorphology (4)

- Meandering stream—close-up



'Spiral flow'

Fig. 6.10 bottom

Floodplains

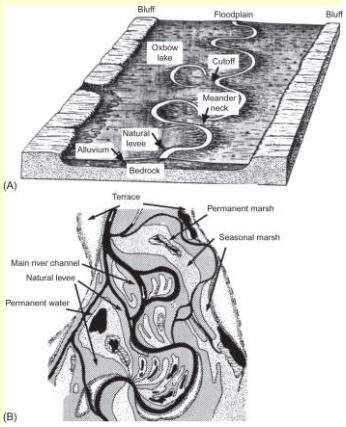
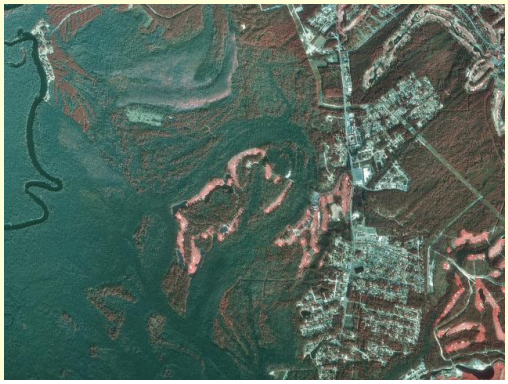


Fig. 6.13

Local floodplains (1)



Local floodplains (2)

Humans, geomorphology, and time

- Willamette River; Over 25 km: 250 km of shoreline to 64 km

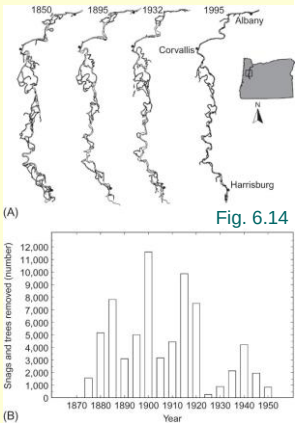


Fig. 6.14

Lecture outline

- Classifying streams
- Streamflow and geomorphology
- **Export of material**

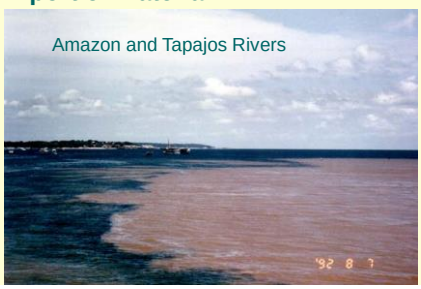
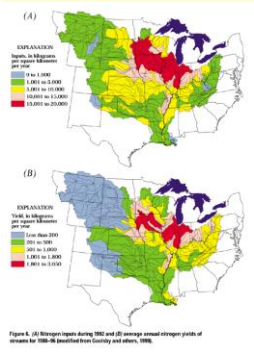


Table 6.4 Average Chemical Composition of River Water Throughout the World

Attribute	Current Concentration	Natural Concentration	Pollution	% Increase
Ca^{21}	14.7	13.4	1.3	9%
Mg^{21}	3.7	3.4	0.3	8%
Na^{1}	7.2	5.2	1.3	28%
K^{1}	1.4	1.3	0.1	7%
Cl^{2}	8.3	5.8	2.5	30%
SO_4^{22}	11.5	6.6	4.9	43%
HCO_3^{2}	53.0	52.0	1.0	2%
SiO_2	10.4	10.4	0.0	0%
Total dissolved solids	110.1	99.6	10.5	11%
Dissolved nitrogen	21.5	14.5	7.0	32%
Dissolved phosphorus	2.0	1.0	1.0	50%

(From Berner and Berner, 1987, and Meybeck, 1982). Concentrations in mg L^{21}

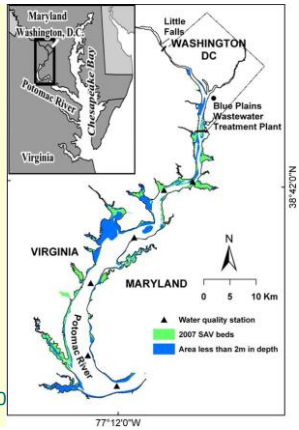
The start…to the finish line



Making a recent difference

- Reducing dissolved nitrates by 2/3 at Blue Plains led to a 10X increase in SAV in the Potomac River
- Plant upgrades cost $1 billion over a decade

Ruhl & Rybicki 2010



How do dissolved materials move downstream?

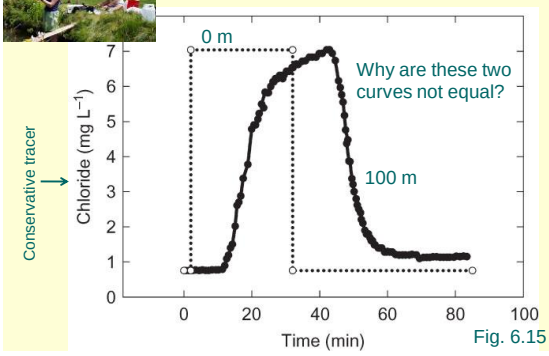
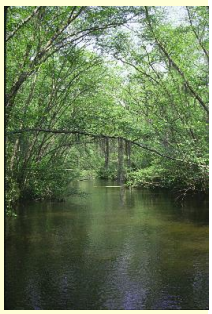


Fig. 6.15

What's the difference between dissolved and particulate matter?

- Not much…
  - DOM vs. POM: 0.5 μm
- Suspended load vs. bed load

Platte R—sand western R—gravel



Movement of particulate matter

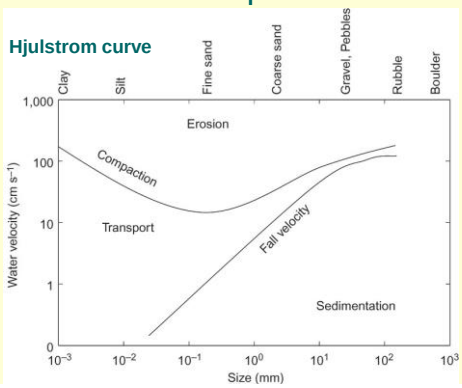


Fig. 6.17