# Role of Beaver in Riverine Management


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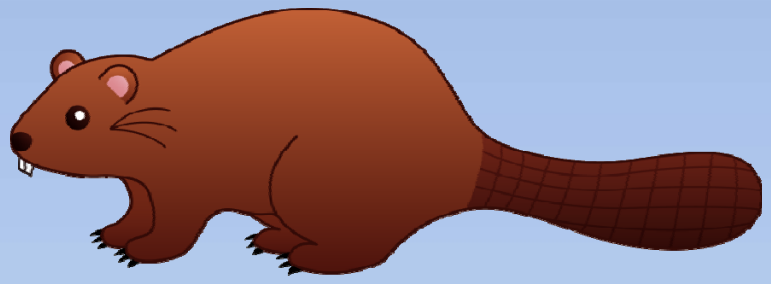
# How do we think of beaver?

As automatons or as individuals (mutes)



**Need to be careful about beaver g*eneralizations***

# Beaver *Generalizations*

- Mean colony size varies depending upon setting and conditions ~ *5.2 individuals ±1.4 standard deviation*[(1)]
- Colony builds 2 to 5 dams per life cycle
- Monogamous / nocturnal
- "Mid-successional species" – prefer aspen, willow, alder, birch….can / do eat and use a multitude of other vegetation

**(1) Rossell & Parker, 1995**

# Beaver *Generalizations*

Beaver Reproduction - population can rebound relatively quickly

- Litter size varies:
  - Midwest and south Canadian prairies ~ 4.7
  - North ~ 3.3
- Pregnancy frequency by age
  - 0% kits
  - 25% yearlings

    *(also reported as 40 to 54%; and only 13% in nuisance colonies)*
  - 33% 2-yr olds
  - 60% 3-yr olds
  - 90% older

***Source: (Payne, Neil. "Population Dynamics and Harvest Response of Beaver". 1989)***

# Beaver *Generalizations*

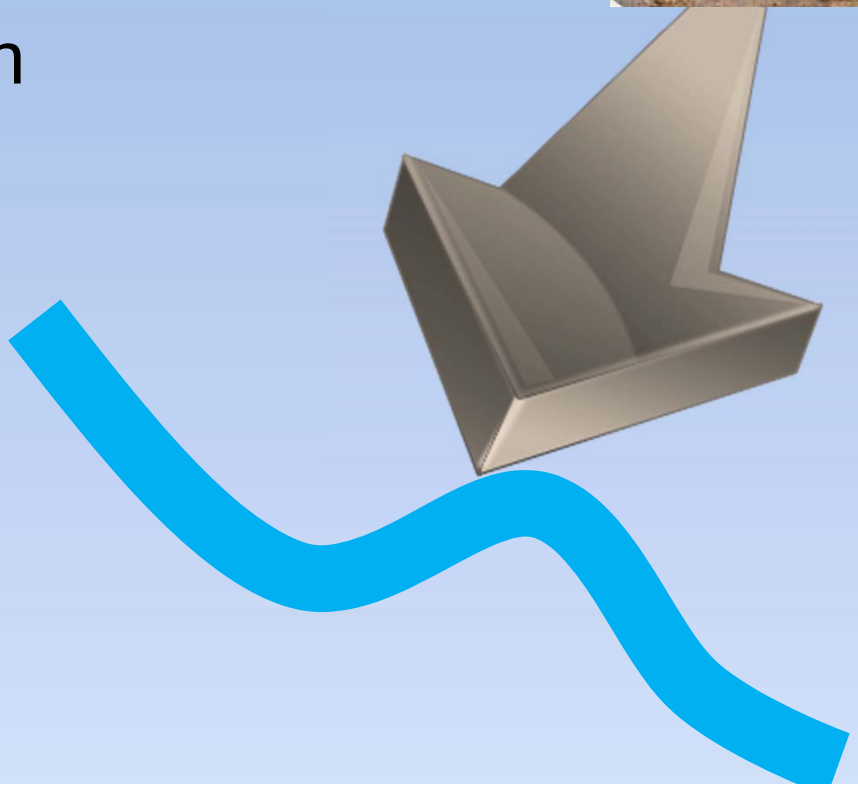
- Kits have a *relatively* low mortality rate (protected by parents)
- Dispersal of young when 2 yrs old
- Can live to 13 yrs +
- Reproduction can replace annual mortality rate of about 30%

***Source: (Payne, Neil. "Population Dynamics and Harvest Response of Beaver". 1989)***

Predators (wolf / coyote / human)…or lack thereof influence it's behavior and population dynamics

# Beaver are an ‘Energy Source’ of Natural Disturbance

- Dam building
- Canal construction
- Browsing



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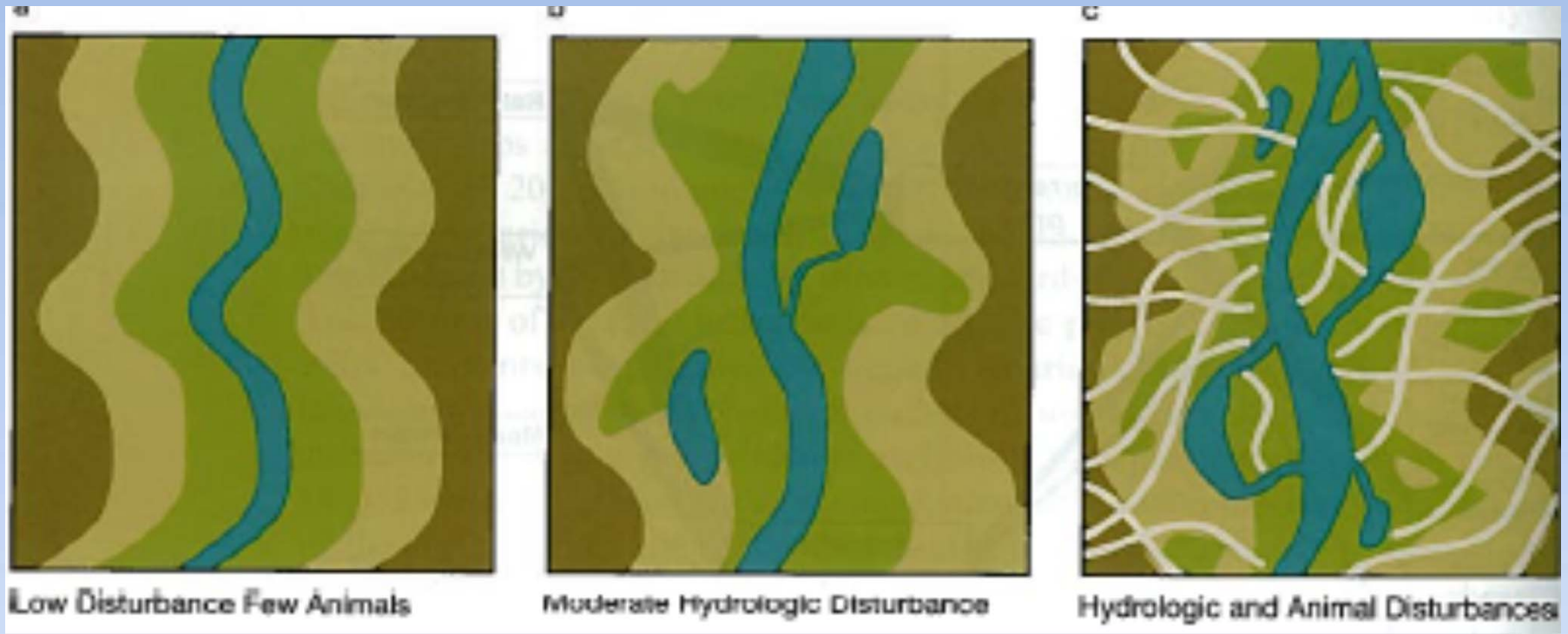
# Beavers Introduce *Hydraulic* Complexity

- Dam Construction Changes Local Slope / Creates Pool
- Direct Coarse / Large Wood Introduction
  - Important in low energy “stable” planform systems
- Dam Failures
  - Perhaps especially important in low energy systems
- Avulsions or channel realignment
- Sediment transport / substrate

# Beavers Directly Introduce Planform Complexity

- *Remnant* dams can have long-lasting impacts on the riverine corridor






***Source: (Naiman, Robert. "Riparia". 2005)***

# Hydrologic Setting Impacts the Effect of Beaver Dams

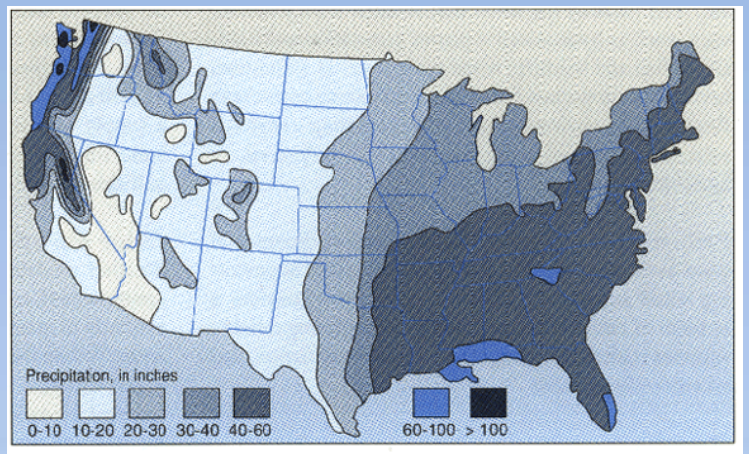
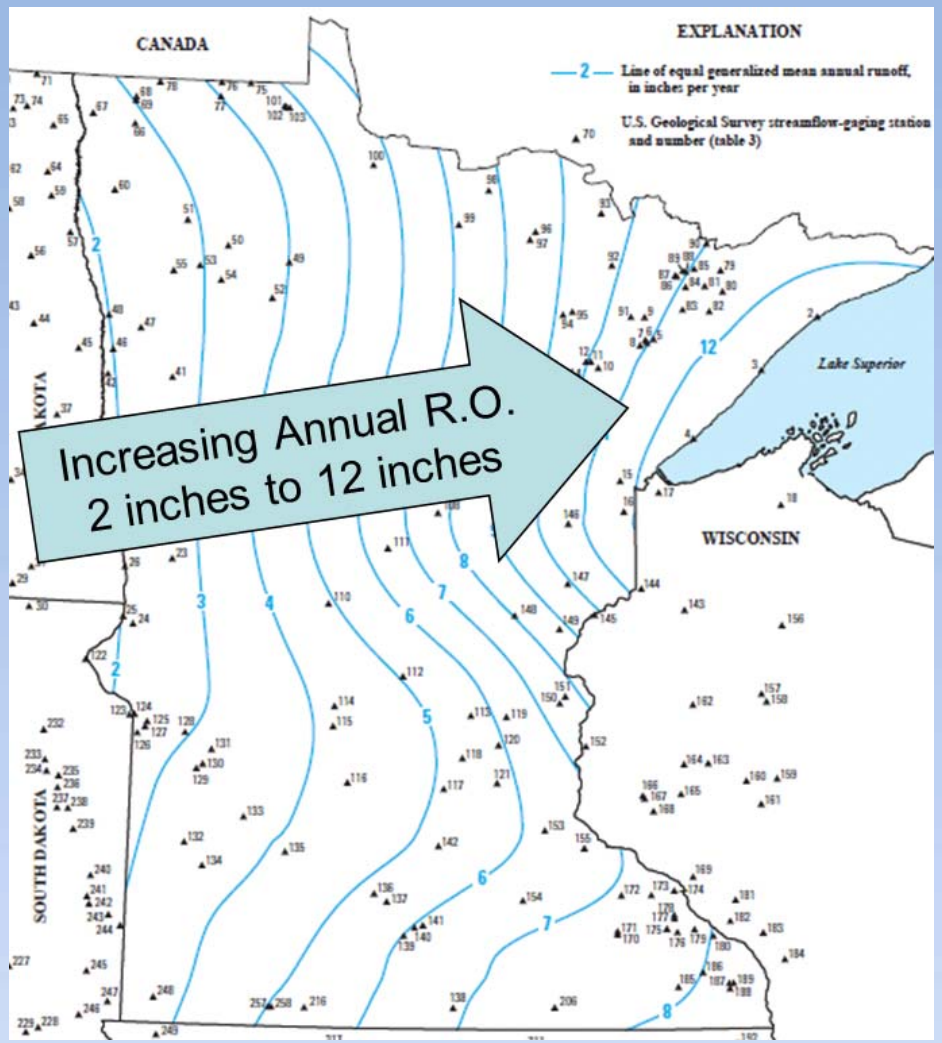



**Figure 2** Average annual precipitation in the conterminous U.S., from U.S. Geological Survey, National Water Summary 1983—Hydrologic Events and Issues: USGS Water-Supply Paper 2250 (1983).




Average Annual Runoff

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# Beaver Dams will Have Larger Impact on Watersheds with Less Storage

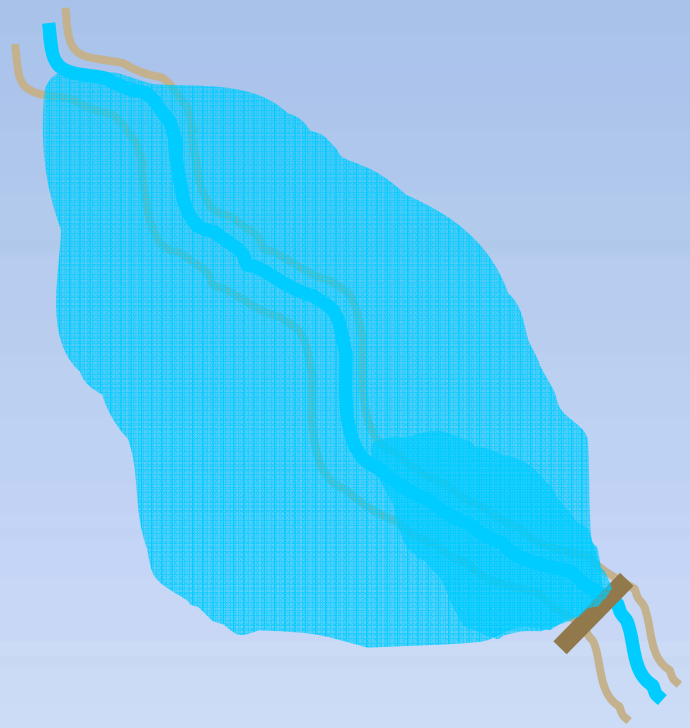
Consider Storage in:

- other Ponds
- Lakes
- Soil

# Hydrologic Impact of Beaver Dams Determined by Volume

Influenced by Dam Height, Valley Width and Slope

*Steep / Narrow < Flat / Wide*



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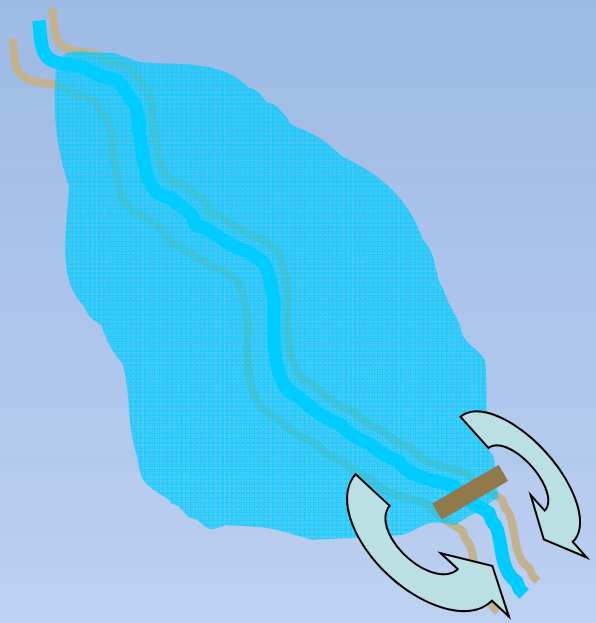
# Storage Volume Based Upon Setting

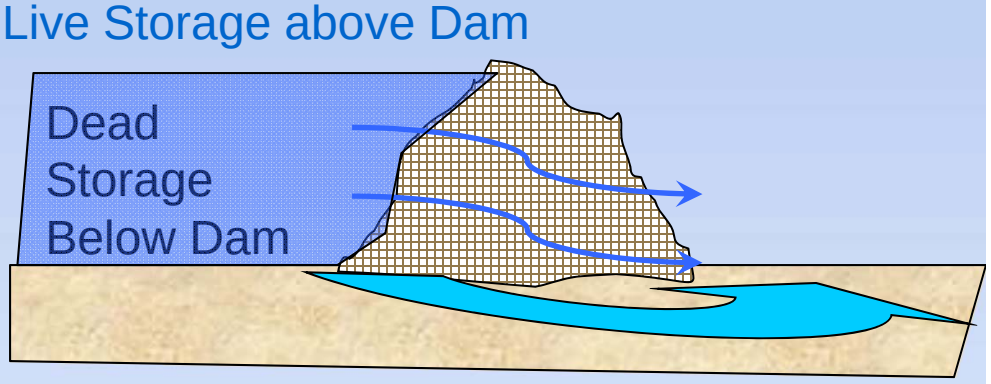
Type of Soil Impacts:

- How Much Bank Storage
- How Much it ‘Leaks’
  - Dead Storage Volume

Precipitation:

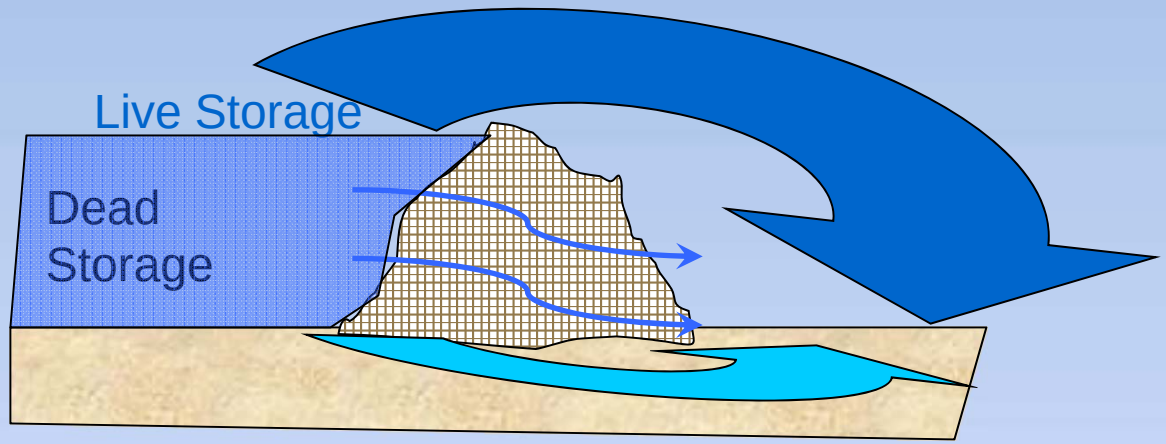
- Time between events (time to leak)





# Dead Storage Important to Hydrologic Impact

Less Impact Once the Dam Overtops – Can Pass a Lot of Water Over Wide Area



# Summary of Hydrologic Influences of Beaver

- Largest impact is on smaller runoff events
- Does not affect snowmelt events as much
- Beaver dams can provide local bank storage, reduce some peak flow rates, and increase base flow

# Beaver at Lake Outlets

Dams can change the:

- Runout elevation
  - Littoral vegetation
  - Riparian vegetation
- Fish migration (impair)
- Outlet rating curve (how much flow at a given elevation)
  - Lake elevation
  - Downstream discharge rates

Impact of failures

# Beaver Impact Water Chemistry (Selected in One Slide)

- Physically trap leaf litter from the fall
- Different (lentic) environment
- Ponds store nutrients – then when dam fails the nutrients become available for vegetation in the new beaver meadow
- Impacts the nitrogen, ammonium, phosphorus, carbon, *etc* cycles

# Beaver / Fish Interaction in One Slide

- Impacts on temperature in marginal coldwater systems may be an important consideration
- Avery study from WiDNR
  - Removal of 219 dams on trout stream and tribs
  - Showed movement across multiple beaver dams (as many as 18 dams over 4 miles)
  - No improvement after 6 years
  - Follow-up showed brook trout population improvement (note some issues with design)

# Beaver / Fish Interaction in One Slide (Continued)

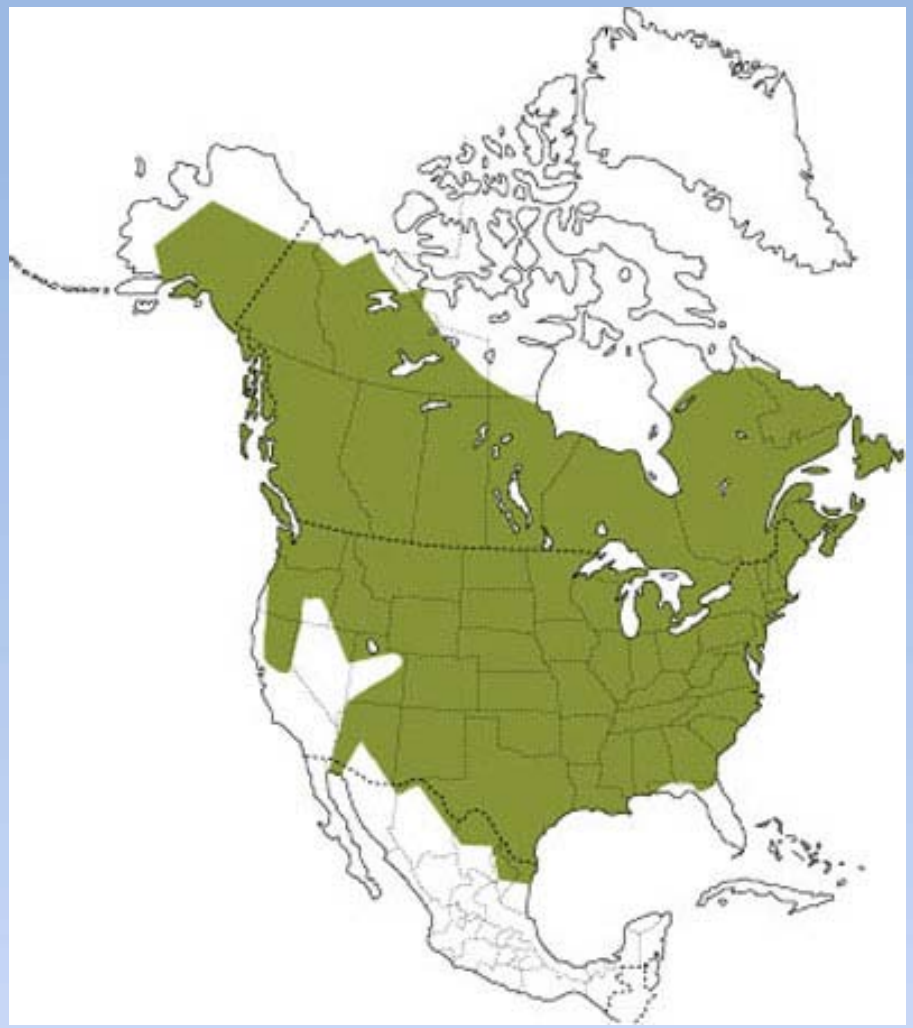
Be careful about transferring conclusions – see discussion regarding hydrologic impacts, etc.

Best to examine information specific to the stream being considered….

# Beaver Impact on Riparian Corridor

- Change local vegetation through browsing and raising the water table
- Create patches (wet meadows) that can be sustained for a very long time

# Beaver and Humans



Pre-settlement Beaver Distribution in North America

Important to many Indians

- Food Supply
- Skins

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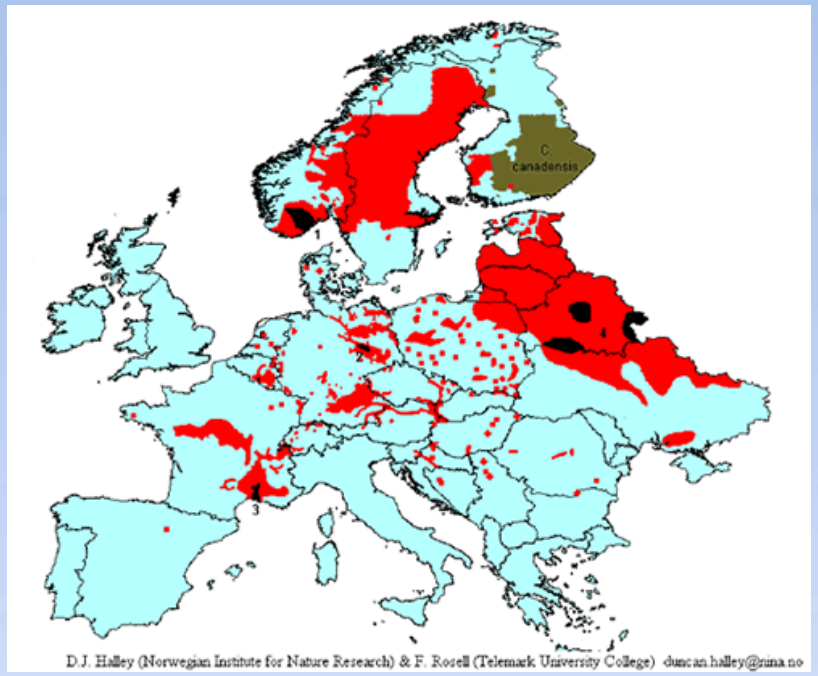
# Europe

- Different species – with different habits
- Being re-introduced as a ‘restoration’ tool




| Country | Date of Extinction | Date when Protection Accorded | Re-introduction and/or Translocation Dates | Present Population Size |
|---|---|---|---|---|
| Albania | unknown | - | - | 0 |
| Austria | 1869 | - | 1970-90 | over 1300 |
| Belarus | remnant | 1922 | - | 24000 |
| Belgium | 1948 | - | 1998-99 | 100-130 |
| Bosnia & Herzegovina | unknown | - | 2005 | 40 |
| Bulgaria | unknown | - | - | 0 |
| Croatia | 1857? | - | 1996-98 | 150 |
| Czech Rep | 17th century | - | 1991-2, 1996 | 300 |
| Denmark | c500BC *2* | - | 1999 | 75 |
| England | pre 12th century | - | (2002 fenced) | (6) |
| Estonia | 1841 | - | 1957 | 10000 |
| Finland | 1868 | 1868 | 1935-37, 1995 | 1500 |
| France | remnant | 1909 | 1959-95 | 7000-10000 |
| Germany | remnant | 1910 | 1936-40, 1966-89 | 8000-10000 |
| Greece | unknown | - | - | 0 |
| Hungary | 1865 | - | 1980-2000 | 70 |
| Italy | 1541 | - | proposed | 0 |
| Kazakhstan | unknown | - | - | 1000 |
| Latvia | 1830s | - | 1927-52, 1975-84 | 50000 |
| Lithuania | 1938 | - | 1947-59 | 32000-50000 |
| Luxembourg | unknown | - | 2000 *3* | less than 10 |
| Macedonia | unknown | - | - | 0 |
| Mongolia & China(Xinjiang) | remnant | - | 1959-85 | 800 |
| Netherlands | 1826 | - | 1988-2000 | over150 |
| Norway | remnant | 1845 | 1925-32, 1952-56 | over 70000 |
| Poland | 1844 | 1923 | 1943-49, 1975-86 | 17000 |
| Portugal | unknown | - | - | 0 |
| Romania | 1824? | - | 1998-99 | over 28 |
| Russia | remnant | 1922 | 1927-33, 1934-41, 1946-64 | 232000-300000 |
| Scotland | 16th century | - | proposed | 0 |
| Serbia | 1903? | - | 2004-2006 | 60 |
| Slovakia | 1851 | - | 1995 | over 500 |
| Slovenia | unknown | - | 2000 *5* | less than 10 |
| Spain | c1600 | - | 2003 | over 30 |
| Sweden | 1871 | 1873 | 1922-39 | over 100000 |
| Switzerland | 1820 | - | 1956-77 | over 350 |
| Ukraine | remnant | 1922 | - | 6000 |
| Wales | 12th century | - | - | 0 |

Source: www.beaverinfo.org

# Beaver Population in MN in One Slide

9 Counties named after fur traders

(Aitkin, Fairbault, Morrison, Olmstead, Renville, Rice, Sibley, McLeod, and Brown)

Some Important Dates

| | |
|---|---|
| 1770's | Fur trade boomed in Mn |
| 1783 | Grand Portage Fort Built by Northwest Fur Co |
| Early 1800's | Steel trap introduced |
| 1803-04 | Large fires in north MN – "continual blaze" |
| 1825-26 | Rainy River Hudson's Bay Report – "nearly extinct" |
| Late 1800's | North Shore logging begins |
| 1901 | Beaver from Canada brought to Itasca Park |
| 1907 | 300+ Beaver in Itasca Park |
| 1939 | Trapping re-instated in 19 Counties |

# Beaver Impact on Humans

Conflict with our service demands


# Beaver Populations Naturally Fluctuate Over Space and Time

Likely > 0 somewhere, sometime

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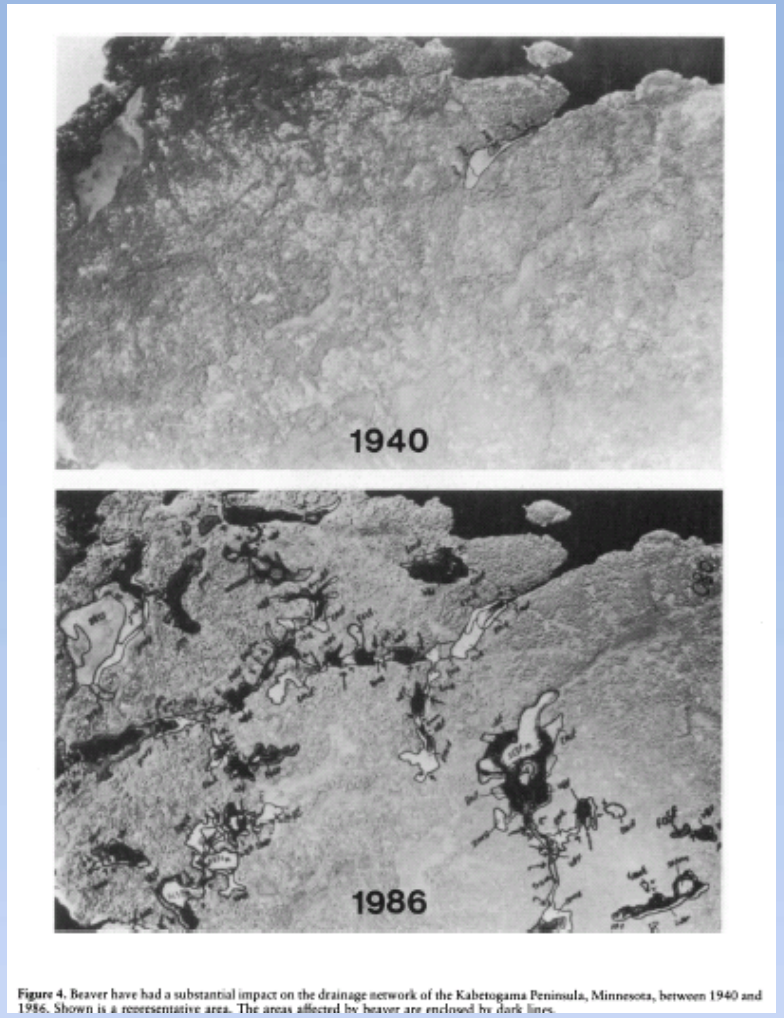


Figure 4. Beaver have had a substantial impact on the drainage network of the Kabetogama Peninsula, Minnesota, between 1940 and 1986. Shown is a representative area. The areas affected by beaver are enclosed by dark lines.

***Source: (Naiman, Johnston, and Kelley. "Alteration of North American Streams by Beaver". 1998)***

# Beaver Research Needs

- Map the prevalence of beaver activity and relate to landscape setting
- Quantify the effects of beaver activity on the riverine environment along the North Shore……need to prioritize
  - Discharge
  - Temperature
  - Physical Habitat
  - Water Chemistry
  - Biota (from mussels to moose….)
  - Riparia

# Beaver Research Needs

Beaver Roadway Crossings

- *Why* do beaver sometimes create a dam upstream of the crossing and other times within the crossing?
- Quantify the benefit of accommodating beaver associated with wider crossings being installed
  - Frequency of failures due to plugging
  - Maintenance costs
  - ‘Actual’ capacity as opposed to design capacity
- Design elements to incorporate?

# Beaver and Watershed / Riverine Management

- Beaver are a **natural** and **important** component of the riverine environment. A truly sustainable or restored ***system*** must include beaver.
- They are an **energy source** to the morphology of the stream and deserve the 'keystone' species
- We need to understand when statements are **technical** and when they are **value-based**

# Beaver and Watershed / Riverine Management

Human management of beaver has always occurred and will continue. It will need to come in the form of:

- ✓ ***Population control***
- ✓ ***Mitigation of Undesirable Effects***
- ✓ ***Modification of our service expectations***

# Beaver and Watershed / Riverine Management

Beaver need to be thoughtfully considered and explicitly discussed in the ***planning and design*** of:

- Watershed Management Plans
- Human Infrastructure
  - Roads
  - Stream restoration structures / projects
  - Utilities
  - Floodplain use
- Resource Management Including Fisheries / Fishing


***Tributary to Fawn Creek Stream Restoration***