Geomorphic impacts of tributary fans on mainstem fluvial system in Shukushubetsu River Catchment, northern Japan

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Introduction

Tributary fan dynamics:
- Major impact on geomorphic changes and sediment transport processes along mainstem river

Key for comprehensive understanding:
- Sediment budgets in catchment scale
- Diversity and heterogeneity of riparian and riverine ecosystems

Primary objectives:
1. Classify the pattern of tributary fan dynamics
2. Examine whether the occurrence of tributary fans is correlated with geomorphic characteristics of tributaries and bedrock points

Methods

Site selection

Physiognomnic classification
1. Initial: No trees (unvegetated or sparsely covered with herbs)
2. Developing: Saplings of pioneer species below 5m height
3. Established: Pioneer species forming flat canopy layer
4. Transitional: Adult tree patch mainly composed of late successional species
5. Mature: Large-size adult trees with relatively sparse condition

Field measurement
- Classifying into 5 patch types
- Mapping & Measuring patch distribution
- Recording vegetation structure
- Sampling tree ring disks & cores

Results

Cross dating of establishment periods of vegetation patches
- Range of establishment periods were quite different among the 5 patch types

Distribution of age class of patches by tributary fan
- Identified 4 patterns of distribution of age class among 12 tributary fans

Study site

Shukushubetsu River
- Headwater catchment of Saru River
- Altitude: 145-1,317 m a.s.l.
- Catchment area: 64 km²
- Channel length: 18 km
- Channel gradient: 0.02 m/m

Climate
- Annual precipitation 1,142 mm

Vegetation cover & Land use
- Hillslope:
  - Cool-temperate mixed forests
  - Partly altered to forested or pastures

Riparian zone:
- Various developmental stages established on fluvial deposits

Next challenge
Examine whether these patterns of tributary fan dynamics are associated with sediment yield patterns

Conclusion

Channel network structure should be considered to elucidate sediment delivery processes in headwater catchments

Relationship with geomorphic characteristics
- Fan size clearly correlated with catchment size and range of tree ages by patch types

Fig. 2 Location of selected tributaries
- 38 of 51 confluences have tributary fans
- 12 tributary fans were selected

Fig. 3 Major flood events for the past 120 years and range of tree ages by patch types
1. 1931 (1930 flood): Fluvial and alluvial fans
4. 2006 – present

Fig. 4 Characteristics of distribution pattern of age class
- Identified 4 patterns of distribution of age class among 12 tributary fans

Fig. 5 Relationship of fan features with catchment size and valley floor width
- Fan size clearly correlated with catchment size of tributaries except fans of #IV
- Fans of #IV located on relatively narrow reach

The field observation revealed:
1. Variability in size and age features among the tributaries
2. Indicating difference in fan dynamics (sediment supply and transport)
3. Catchment size of tributary is suggested to be one of the major factors to control tributary fan size
4. Narrow valley can erode this control
5. Age feature (i.e., longevity of sediment storage) may reflect other geomorphic factors