RELATION OF GEOMORPHOLOGY TO STREAM HABITAT AND TROUT STANDING STOCK IN SMALL ROCKY MOUNTAIN STREAMS

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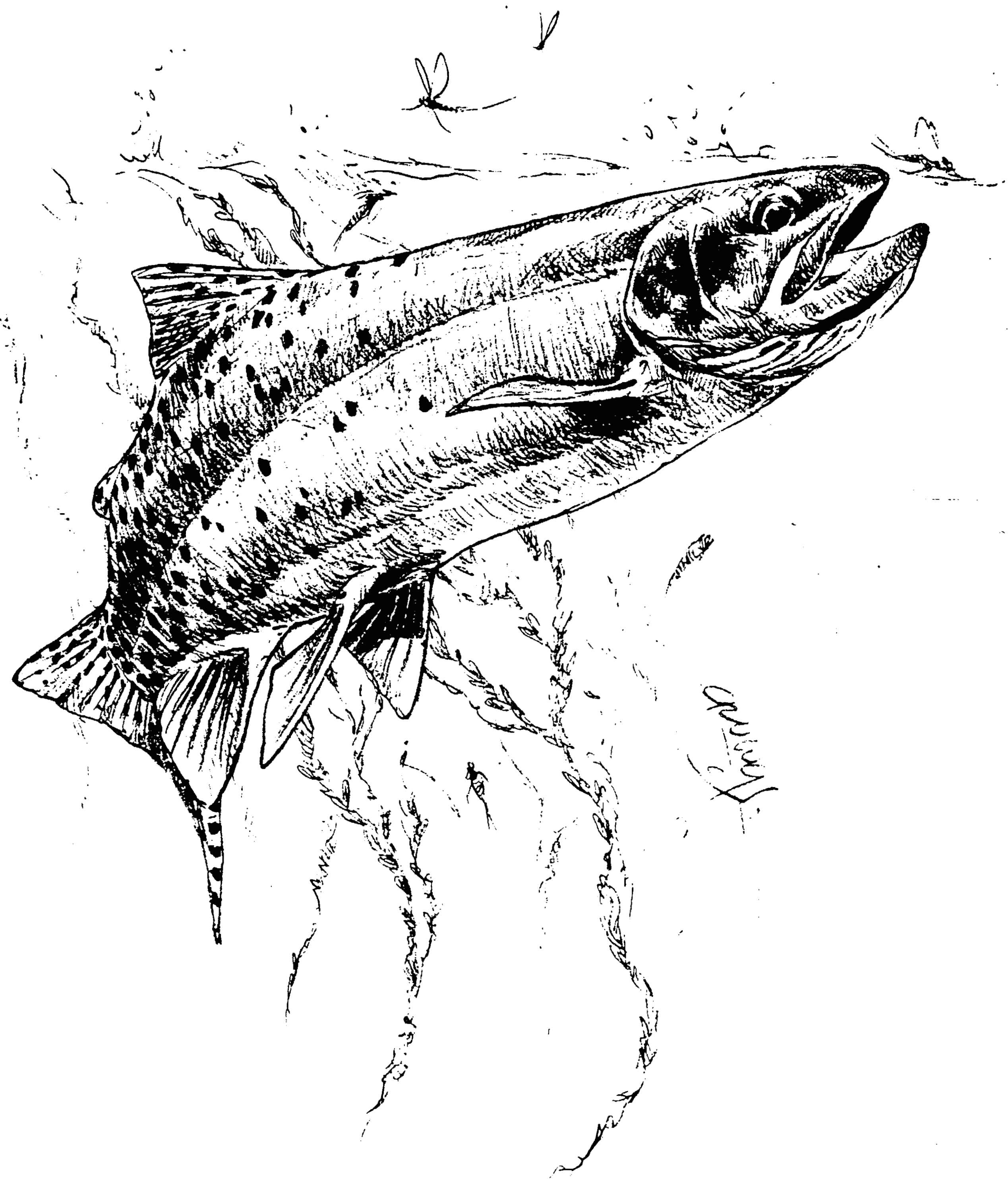

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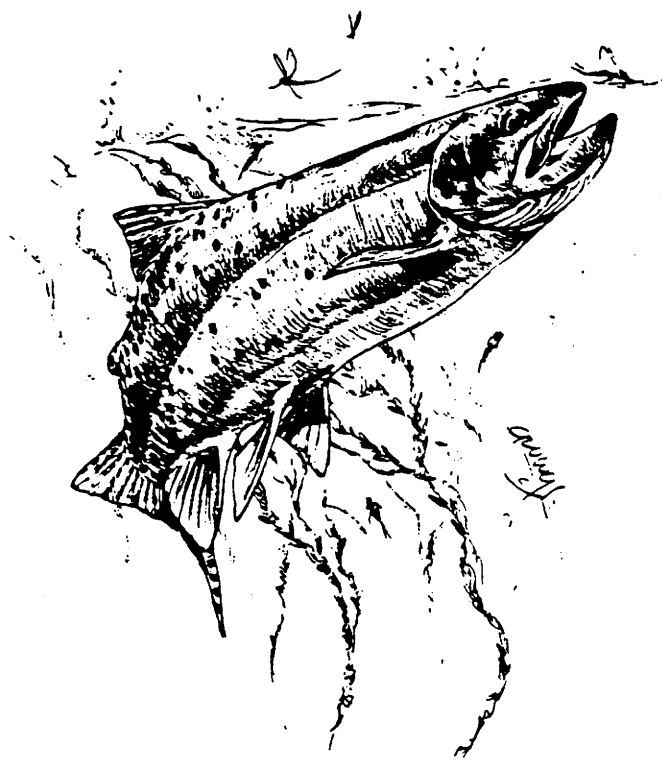

Relation of Geomorphology to Stream Habitat and Trout Standing Stock in Small Rocky Mountain Streams[1]

Thomas A. Wesche[2] and Wayne A. Hubert[3]

Abstract.--Evidence that drainage basin morphology and trout standing stock are related through a functional link between geomorphic features and stream habitat quality is presented. Numerous significant univariate correlations were found between geomorphic variables, stream habitat variables, and trout standing stock in both high-elevation forest and low-elevation rangeland streams. Canonical correlations between geomorphic variables and stream habitat variables provided in-sight into the form of the functional link. Multiple-regression equations predicting trout standing stock were dominated by geomorphic variable. When geomorphic variables alone were incorporated into regression models they predicted trout standing stock as accurately as did stream habitat variables.

SUMMARY OF RESULTS

Relations between measures of drainage basin geomorphology, stream habitat quality, and trout standing stock were demonstrated in this study by numerous univariate correlations between geomorphic and stream habitat variables, high canonical correlations between geomorphic variates stream habitat variates, and the extent to which geomorphic variables accounted for variance the standing stock of trout. Platts (1979) and Parsons et al. (1981) also looked at the relations between drainage basin geomorphology stream habitat. Platts (1979) found that as stream order increased, stream width, depth, and the percent of rubble substrate also increased, whereas the percent of pool habitats, channel gradient, and the percent of gravel substrate. Parsons et al. (1981) correlated a habitat condition score generated from measured features of stream habitat to four measures of drainage basin geomorphology. All of these relations combine to provide substantial evidence that stream habitat is a function of geologic processes within the drainage basin.

Geomorphic variable dominated our multiple-regression models where both variable types were incorporated. In addition, when used separately, trout standing stock was predicted as accurately with geomorphic variables as it was with stream habitat variables. Other studies have successfully used measures of drainage basin geomorphology to predict salmonid standing stock or abundance in streams (Ziemer 1971; Burton and Wesche 1974; Swanston et al. 1977). These observations suggest that geomorphic variables are useful in predicting the potential habitat quality of trout streams.

Our data confirm that small, gently sloping drainage basins produce the best trout habitat.

[1]Paper presented at the Wild Trout IV Symposium, Yellowstone National Park, Wyoming, September 18-19, 1989. For additional detail, the reader should consult the following citation:
Lanks, R.P., W.A. Hubert and T.A. Wesche. 1987. Relation of geomorphology to stream habitat and trout standing stock in small Rocky Mountain streams. Transactions of the American Fisheries Society 116:21-28.

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Basin relief, relief ratio, and gradient indicate (by their negative relation to trout standing stock) that a large drop in elevation over the drainage basin leads to reduced trout habitat quality. Branson et al. (1981) stated that high basin relief resulted in greater channel slope and increased drainage density, both of which were negatively related to trout standing stock in our study. The combined effect of watershed features, such as increased basin slope (basin relief and relief ratio), increased channel slope (gradient), and a more dendritic drainage pattern (drainage density), may tend to decrease response time of stream discharge to rainfall events. Drainage basins with these characteristics, when subjected to high-intensity, thunderstorms (which are common in Wyoming), generally have greater flow variability, decreased storage of water in depressions and as groundwater, and lower base flows (Viessman et al. 1977). Low base flows and high flow variability result in poor habitat quality for trout (Binns and Eiserman 1979).

Highest trout biomass was associated with the transition zone between forest and rangeland stream types, which occurred between elevations of 2,100 and 2,455 m in forest streams and 2,100 and 2,224 m in rangeland streams. Platts (1979) found a similar situation in Idaho, and Elser (1968) observed the best habitat quality at the transition between high-gradient, boulder-substrate habitat (characteristic of forest streams) and lower-gradient, gravel-substrate habitat (characteristic of rangeland streams).

Increasing stream size, as reflected by geomorphic variables, resulted in reduced trout density in our study. This relation may be the result of a decrease in relative abundance of riparian cover or an increase in human impact with increasing stream size. Data presented by Conder (1982) indicated that as stream order increased in the Bighorn Basin of Wyoming human impact on the aquatic and riparian resources increased.

Statistical evidence leads us to the conclusion that the relation between drainage basin geomorphology and trout standing stock is the result of a functional link between measurable features of a drainage basin and stream habitat. This linkage may enable the use of simple measures of drainage basin geomorphology to predict potential habitat quality for trout.

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