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The Vigil Network: a means of observing landscape change in drainage basins

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Abstract Long-term monitoring of geomorphic, hydrological, and biological characteristics of landscapes provides an effective means of relating observed change to possible causes of the change. Identification of changes in basin characteristics, especially in arid areas where the response to altered climate or land use is generally rapid and readily apparent, might provide the initial direct indications that factors such as global warming and cultural impacts have affected the environment. The Vigil Network provides an opportunity for earth and life scientists to participate in a systematic monitoring effort to detect landscape changes over time, and to relate such changes to possible causes. The Vigil Network is an ever-increasing group of sites and basins used to monitor landscape features with as much as 50 years of documented geomorphic and related observations.

Le Résau Vigile: une méthode pour observer les changements du paysage dans les bassins fluviaux

Résumé L'observation à long terme des caractéristiques géomorphologiques, hydrologiques et biologiques des paysages procure une méthode efficace pour comparer les changements observés avec leurs causes possibles. L'identification du changement des caractéristiques du bassin, particuliérement dans les régions arides où la réponse aux modifications du climat ou de l'utilisation des sols est généralement rapide et est facile à voir, peut fournir les prémiers signes directs que les éléments comme le réchauffement global et l'impact des cultures ont déjà affecté l'environment. Le Réseau Vigile offre une occasion aux specialistes des sciences de la terre et de la vie de participier à un effort d'observation systématique qui décèle les changements avec le temps du paysage, et qui permet de comparer ces modifications avec leurs causes possibles. Le Réseau Vigil est constitué par un ensemble de sites de bassins qui se développe constamment et qui est employé pour l'observation des caractéristiques du paysage avec déjà 50 années d'enrégistrement, d'observations géomorphologiques et d'autres qui se rapportent à la géomorphologie.

Open for discussion until 1 February 1992

OBSERVATIONS OF DRAINAGE BASIN CHANGE

A fundamental problem in geomorphic research is the difficulty of relating cause and effect. Is an increase in fluvial sediment load, for example, the result of changes in land use practices or climate variability (such as anthropogenic or induced global warming), or of the exceedance of an identifiable geomorphic threshold, or some other stress? In some instances, it is likely that changes in geomorphic processes result from several causes, none of which can be identified confidently on the basis of a short period of data collection that is unrepresentative of longer term conditions.

A traditional solution to the problem has been to collect ancillary data that significantly increase the time represented, thereby permitting trends in the geomorphic process to be recognised. Commonly used techniques include radiometric or isotopic tracers and dating techniques, a variety of palaeontological methods, comparison of landscapes using old photographs, dendrochronology, and determination of clay mineralogy. An alternative to those techniques, which have low resolution but provide information for extended time intervals, is direct measurement of landscape characteristics, which provide high-resolution information for shorter time intervals. That latter form of monitoring or networking has been used somewhat sparingly by most geomorphologists (Leopold, 1962).

Cause and effect cannot be understood solely through repeated measurement of individual physical characteristics. To be effective, interrelated information on hydrology, geology, ecology, botany, soils, and history of landscape modification also needs to be collected. Only by collecting a variety of information will it be feasible for scientists to link cause and effect, thereby discriminating between the results of stresses imposed by humans and those caused by natural variations in factors such as climate.

Long-term direct monitoring might prove particularly valuable in assessing the degree to which climate change has altered surface processes. Society is now faced with the possibility that climatic change may be imposed by man, and that possibility may lead to surface process changes that are recognizable before change in climate is detectable. Water scientists and managers, for example, have long been aware of cause and effect among geological, atmospheric, biotic and hydrological variables. A similar awareness is becoming more acute in the political arena, where government leaders need to have trustworthy information on effects before reforms concerning anthropogenic causes can be addressed. To gain a workable knowledge of these interrelations, it is imperative that earth and life scientists increase their understanding of the nature of, and effects emanating from, imposed changes, both natural and cultural.

Although the consequences of global changes are pertinent to all land areas, the opportunity to discriminate the effects of change might be greatest in small drainage basins of arid lands and polar areas. Small drainage basins generally have the advantage of having less variability in climate, biota, geomorphic features, and land use than do larger basins. Inherent variability, especially in climatic factors, characterizes arid areas, and this variability is reflected strongly by the biota. Climatic controls are commonly more dominant in arid lands than in wetter lands where water is not a limiting factor. The hydrological responses, even to minor climatic variations, are usually more specific and more prompt in arid lands than elsewhere. Polar landscapes might be especially sensitive to climate change, but routine monitoring in high latitude areas is typically difficult and expensive. Climate change probably is signalled most clearly, quickly, and efficiently by changes in rates of surface processes in small drainage basins of arid lands (Leopold, 1962; Emmett & Hadley, 1968).

A system of monitoring landscape characteristics therefore appears desirable in order that scientists may gain insights into surficial responses and managers may have information from which environmental policy can be formulated and modified. Although the monitoring might be most productive from small, undeveloped drainage basins in arid lands, it needs to be unrestricted relative to basin size or geographical location. Because climate change is of global scale, the monitoring ideally should be conducted at an international network of points and basins, where data identifying basic parameters governing the relation between humans and the landscape are collected.

THE VIGIL NETWORK

The type of monitoring advocated here was begun on a modest scale throughout much of the twentieth century, but an organized effort began only about three decades ago. Named from the Latin "vigilia" (a period of surveillance; a watch), a group of sites and small drainage basins was established in a Vigil Network. Geomorphic, hydrological and biological data were to be collected periodically at such sites and drainage basins (Leopold, 1962; Leopold & Emmett, 1975; Emmett, 1965; Emmett & Hadley, 1968). The original purposes of the Vigil Network were to record and interpret repeated observations of basic geomorphic and hydrological processes. Those purposes remain in effect, underscored perhaps by increasing perceptions of world-wide environmental damage due to rapid population increase, land development and advanced technology. The intention persists that Vigil Network observations be preserved for retrieval and analysis by future generations of scientists (Emmett & Hadley, 1968, p. 1). The repositories for data from Vigil Network sites allow access to anyone, and this is expected to encourage international cooperation among scientists and earth-resource managers.

Eighty-two sites and drainage basins presently (1990) comprise the Vigil Network in the conterminous United States (Fig. 1), Sweden (Fig. 2) Puerto Rico, Israel and Botswana. In the conterminous United States, sites and drainage basins are almost evenly divided between the eastern and western parts of the country, a majority being in Mississippi (27), Montana (24) and Wyoming (9) (Table 1). Some of the sites and drainage basins were established between 1962 and 1976 in direct response to the initiation of the Vigil Network; many others, particularly in Mississippi, are sites and drainage basins that were established as early as 1931, which were later determined to be suitable for inclusion in the Vigil Network.

Reasons for establishing a Vigil Network site or drainage basin vary

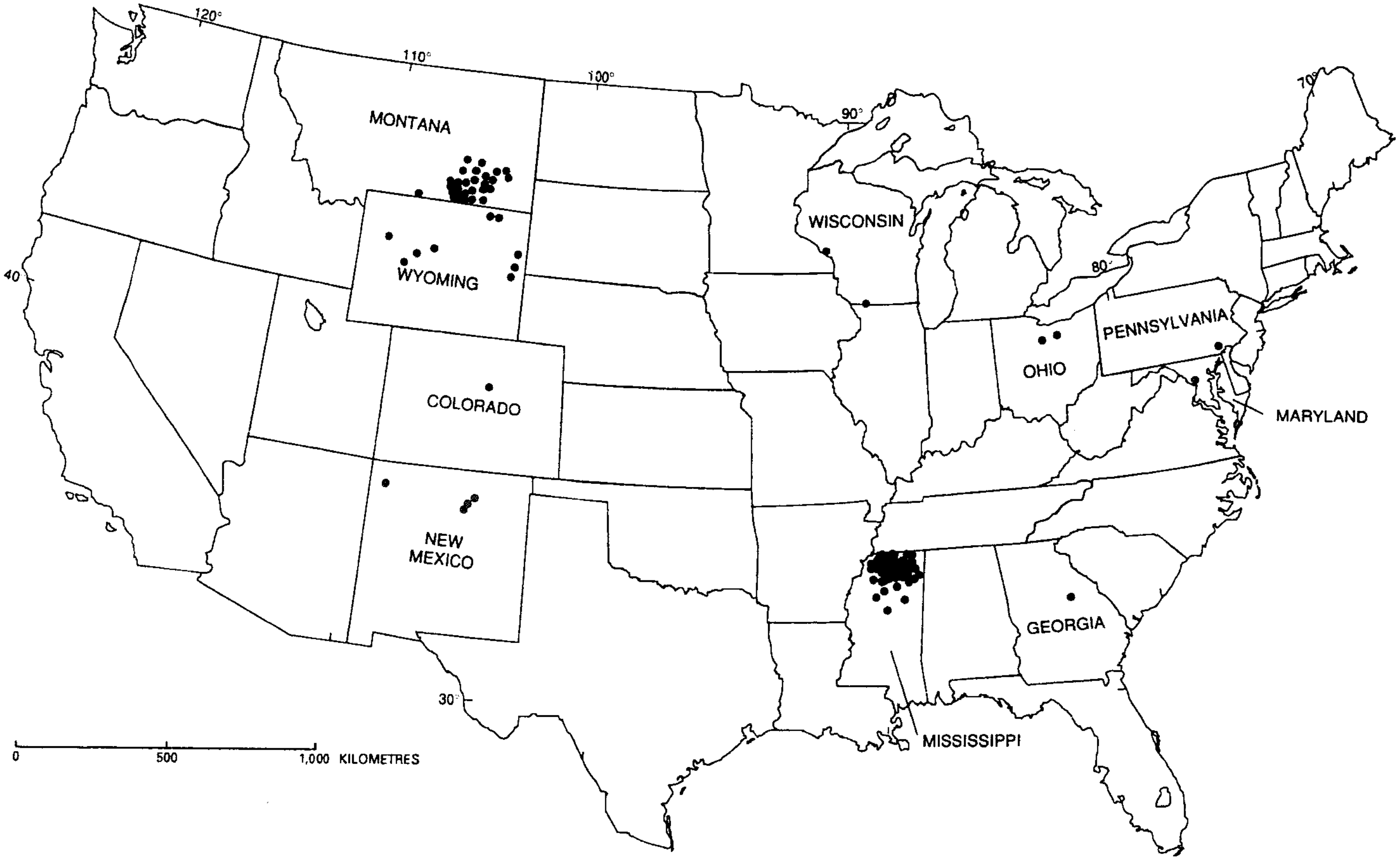

Fig. 1 Distribution of Vigil Network sites and drainage basins in the conterminous United States (details in Tables 1 and 2).

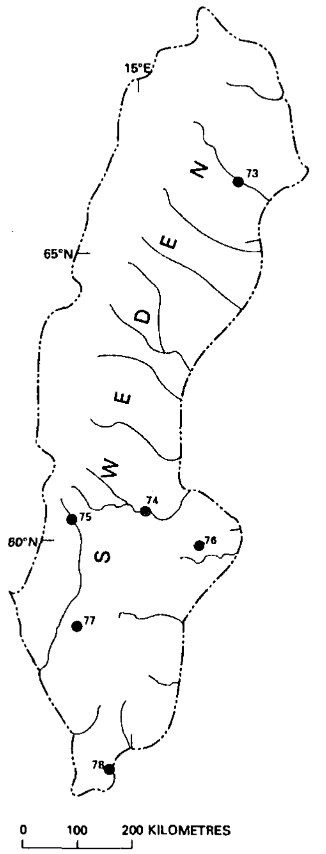

Fig. 2 Distribution of Vigil Network sites and drainage basins in Sweden (numbers are site and drainage basin numbers in Tables 1 and 2).

depending on the goals of individual researchers and the characteristics of the study areas. Most Vigil Network sites and drainage basins to date have been established to detect channel changes through time by means of bottom land cross sections or longitudinal bed profiles. At some sites and drainage basins, scour chains have been installed; at other sites and drainage basins, rates of head cut migration have been measured. Various types of water discharge and sediment data are collected ranging from continuous discharge records and indirect measurements of flood discharges to concentrations of dissolved and suspended constituents and measures of particle sizes of bed and bank material.

Hill slope processes at Vigil Network sites and drainage basins have been monitored using erosion stakes, mass movement pins, painted rock lines, cliff recession markers, repeated measurements of hillslope profiles and other appropriate means to identify change through time. Vegetation surveys along or in established transects and quadrats both on hill slopes and in the bottom lands are basic for distinguishing biotic change. Dendrochronological data are

Table 1 *Vigil Network sites and drainage basins*

Site or drainage basin number	*Site or drainage basin name, state or province and country*	*Latitude and longitude*[a]	*Date of establishment*	*Drainage basin area (km^2)*	*Average annua precipitation (mm)*
1	Tongue River, Montana, USA	45°23'16"N 106°27'00"W	June 1979	120	300
2	Oconee River, Georgia, USA	33°22'30"N 83°18'45"W	1969	7500	1200
3	Tiderishi Creek, Ohio, USA	40°55'50"N 83°43'40'W	January 1947	12.0	890
4	Norwalk Creek, Ohio, USA	41°14'00"N 82°32'30"W	January 1947	12.7	890
5	Pueblo Canyon, New Mexico, USA	35°31'34"N 105°59'38"W	August 1970	22.3	300
6	Canada de la Cueva, New Mexico, USA	35°26'24"N 105°59'49"W	August 1970	2.3	300
7	Young Pits Sisters Area, Maryland, USA	39°00'15"N 77°10'45"W	1964	-	1040
8	East Branch, Brandywine Creek, Pennsylvania, USA	40°03'05"N 75°43'20"W	October 1967	-	1105
9	Hasta Luego Draw, Montana, USA	45°41'30"N 108°07'30"W	July 1950	0.04	330
10	Aching Shoulder Slope, New Mexico, USA	36°36'19"N 108°56'43"W	August 1963	-	220
11	Ski Basin Slope, New Mexico, USA	35°46'07"N 105°48'26"W	August 1963	-	400
12	Big View Slope, Wyoming, USA	42°53"51"N 109°02'16"W	July 1963	-	400
13	Last Day Gully, Wyoming, USA	42°55'33"N 108°34'19"W	August 1962	0.22	250
14	Forsaken Gully, Wyoming, USA	43°11'24"N 107°44'07"W	August 1962	0.04	200
15	Gullies Numbers One and Two, Wyoming, USA	44°41'12"N 106°06'38"W	July 1950	-	330
16	Near Dark Gully, Wyoming, USA	44°41'12"N 106°05'00"W	July 1950	0.02	330
17	Drainage Area Number One, Wyoming, USA	43°13'18"N 104°36'41"W	July 1950	0.04	380
18	Drainage Area Number Two, Wyoming, USA	43°03'04"N 104°37'30"W	July 1950	0.20	380
19	Typical Section Number Three Wyoming, USA	43°07'40"N 104°36'43"W	August 1962	-	380
20	Ditch Creek, Wyoming, USA	43°40'15" 110°35'30"W	July 1989	69.9	810
21	Plum Creek, Colorado, USA	39°29'04"N 105°00'07"W	June 1965	782.0	380
22	Armells Creek, Montana, USA	46°06'03"N 106°45'44"W	July 1975	807.0	380
23	Rosebud Creek, Helvey Ranch, Montana, USA	45°14'44"N 106°57'57"W	July 1975	95.0	380

Table 1 continued

Site or drainage basin number	*Site or drainage basin name, state or province and country*	*Latitude and longitude*[a]	*Date of establishment*	*Drainage basin area (km^2)*	*Average annual precipitation (mm)*
24	West Fork Muddy Creek, Montana, USA	45°32’06"N 106°45’22"W	August 1975	91.0	380
25	East Fork Sarpy Creek, Montana, USA	45°49’02"N 106°59’38"W	August 1975	136.5	380
26	Ephemeral Tributary to Rosebud Creek, Montana, USA	46°08’38"N 106°27’40"W	August 1975	15.0	380
27	West Fork Tullock Creek, Montana, USA	45°31’29"N 107°07’28"W	August 1975	4.5	380
28	North Fork Rosebud Creek, Montana, USA	45°12’47"N 107°00’09"W	August 1975	21.0	380
29	South Fork Rosebud Creek, Montana, USA	45°12’45"N 107°00’07"W	August 1975	47.0	380
30	Main Stem Rosebud Creek, Montana, USA	45°12’48"N 107°00’04"W	August 1975	69.0	380
31	Lower Tullock Creek, Montana, USA	46°05’45"N 107°25’02"W	August 1975	1163.0	380
32	Lower Sarpy Creek, Montana, USA	46°12’48"N 107°07’39"W	August 1975	1165.5	380
33	Lower Owl Creek, Montana, USA	45°11’54"N 107°17’23"W	August 1975	221.0	380
34	Sarpy Creek, Montana, USA	45°55’07"N 107°07’41"W	August 1975	524.5	380
35	Upper Owl Creek, Montana, USA	45°07’57"N 107°14’38"W	August 1975	170.0	380
36	Mid Owl Creek, Montana, USA	45°08’47"N 107°15’02"W	August 1975	181.0	380
37	Otter Creek, Trusler Ranch, Montana, USA	45°35’16"N 106°15’12"W	August 1975	1816.5	380
38	Otter Creek, Sky Ranch, Montana, USA	45°31’38"N 106°11’30"W	August 1975	1517.0	380
39	Logging Creek, Montana, USA	45°34’32"N 106°24’16"W	August 1975	74.0	380
40	Pumpkin Creek, Montana, USA	46°03’21"N 105°33’42"W	September 1975	1308.5	380
41	Pumpkin Creek, Roger Ranch, Montana, USA	46°12’52"N 105°40’39"W	September 1975	1798.5	380
42	Tributary to Hollowwood Creek, Montana, USA	45°36’54"N 106°22’52"W	September 1975	2.0	380
43	Ephemeral Tributary Montana, USA	45°49’25"N 107°12’48"W	September 1975	2.0	380
44	Beaver Creek, Wisconsin, USA	44°02’30"N 91°20’00"W	1939	409.2	760
45	Galena River, Wisconsin, USA	42°22’30"N 90°27’00"W	1940	518.0	890
46	Beartail Creek, Mississippi, USA	34°43’50"N 89°55’15"W	1940	93.0	1320
47	Big Spring Creek, Mississippi, USA	34°32’30"N 89°27’15"W	1939	145.0	1370

Table 1 continued

Site or drainage basin number	*Site or drainage basin name, state or province and country*	*Latittude and longitude*[a]	*Date of establishment*	*Drainage basin area (km^2)*	*Average annual precipitation (mm)*
48	Billys Creek, Mississippi, USA	34° 08'30"N 89° 46'30"W	1940	52.0	1340
49	Clear Creek, Mississippi, USA	34° 25'00"N 89° 42'45"W	-	117.0	1340
50	Coldwater River, Mississippi, USA	34° 46'30"N 89° 54"30"W	1940	1142.0	1370
51	Goose Creek, Mississippi, USA	34° 24'30"N 89° 36'30"W	1937	-	1370
52	Graham Mill Creek, Mississippi, USA	34° 31'30"N 89° 29'30"W	1939	29.0	1340
53	Greasy Creek, Mississippi, USA	34° 28'00"N 89° 42'15"W	1939	52.0	1340
54	Hurricane Creek, Mississippi, USA	34° 30'00"N 89° 35'15"W	1937	83.0	1370
55	King Creek, Mississippi, USA	34° 28'00"N 89° 03'30"W	1939	65.0	1340
56	Lee Creek, Mississippi, USA	34° 31'00"N 89° 29'00"W	1931	50.0	1340
57	Long Creek, Mississippi, USA	34° 11'30"N 90° 01'00"W	1940	220.0	1340
58	Nelson Creek, Mississippi, USA	34° 10'30"N 89° 59'30"W	1970	15.0	1340
59	North Tillatoba Creek, Mississippi, USA	34° 00'30"N 90° 05'00"W	1940	132.0	1340
60	North Tippah Creek, Mississippi, USA	34° 42'45"N 89° 02'45"W	1939	63.0	1370
61	Potacocowa Creek, Mississippi, USA	33° 34'30"N 90° 06'00"W	1940	166.0	1320
62	Potlocona Creek, Mississippi, USA	34° 14'30"N 89° 23'30"W	1940	78.0	1340
63	Puskus and Cypress Creek, Mississippi, USA	34° 30'00"N 89° 15'30"W	1939	156.0	1340
64	Red Banks Creek, Mississippi, USA	34° 48'30"N 89° 46'00"W	1940	96.0	1370
65	Strayhorn and Egypt Creek, Mississippi, USA	34° 36'30"N 90° 13'00"W	1940	124.0	1320
66	Tippah Creek, Mississippi, USA	34° 42'50"N 89° 14'45"W	1970	975.0	1370
67	Toby Tubby Creek, Mississippi, USA	34° 29'00"N 89° 40'00"W	1937	145.0	1370
68	Turkey Creek, Mississippi, USA	33° 54'00"N 89° 41'33"W	1940	330.0	1340
69	Cypress Creek, Mississippi, USA	33° 56'30"N 89° 41'00"W	1940	57.0	1340
70	Wilhite Creek, Mississippi, USA	34° 32'00"N 88° 57'00"W	1939	42.0	1370
71	Yalobusha River, Mississippi, USA	33° 47'00"N 89° 59'00"W	1940	4440.0	1340
72	Yocona River, Mississippi, USA	34° 15'00"N 89° 17'45"W	1970	1940.0	1370

Table 1 continued

Site or drainage basin number	*Site or drainage basin name, state or province and country*	*Latittude and longitude*[a]	*Date of establishment*	*Drainage basin area (km^2)*	*Average annual precipitation (mm)*
73	Abacka Gully, Norrbotten, Sweden	66° 10'N 22° 52'E	March 1990	0.7	450
74	De Geer's Gullies, Dalarna, Sweden	60° 10'N 15° 40'E	March 1990	-	570
75	Femta Gully, Varmland, Sweden	60° 32'N 13° 08'E	March 1990	0.06	700
76	Berthaga Gully, Vastmarland, Sweden	59° 52'N 17° 35'E	March 1990	1.8	500
77	Uvered Gully, Vastergotland, Sweden	58° 21'N 13° 03'E	March 1990	-	550
78	Ravlunda Gully, Skane, Sweden	55° 43'N 14° 12'E	March 1990	0.07	650
79	Marimente Hillslope Site, Puerto Rico	18° 19'11"N 65° 45'9"W	January 1970	3.0	2500
80	Jorge Jimenez Hillslope Site, Puerto Rico	18° 04'38"N 66° 20'03"W	January 1970	0.6	950
81	Nahal Yael Watershed, Israel	29° 35'N 34° 56'E	1967	0.60	30
82	Metsemotlhaba River, Botswana	24° 44'S 25° 29'E	1987	615	400

[a] *Coordinates are for the lowest point in the drainage basin.*

collected at some sites and drainage basins to supplement geomorphic and hydrological data. Other biological observations appropriate for Vigil Network sites and drainage basins, but not commonly collected, include inventories of aquatic and terrestrial biota and pollen analyses.

Information available from the 82 Vigil Network sites and drainage basins in the conterminous United States and Sweden is summarized in Table 2. Not indicated in Table 2, but common to all network files, is information pertaining to topography, geology, available photography and the history of data collection activities at and near the site or drainage basin.

Observations and data of the Vigil Network are available to scientists worldwide; the use of this information is encouraged and documentation proposing new network sites or drainage basins is welcomed. Because observations might span more time than the life of an individual, data from Vigil Network sites and drainage basins need to be well documented, safe and available for future generations of scientists to use and extend. International repositories have been established to receive files of data pertaining to the Vigil Network. The principle repository has been moved to the US Geological Survey Library in Denver, Colorado, which will overview copying of files and assure that microfiche copies are distributed to adjunct repositories. The other repositories for microfiche data are at US Geological Survey libraries in Reston, Virginia and Menlo Park, California, the Department of Physical

Table 2 *Available data from Vigil Network sites and drainage basins*

Site or drainage basin number [a]	Channel cross sections	Bed profiles	Erosion data	Vegetation data
1	86	5	No	No
2	18	11	No	Yes
3	0	0	No	No
4	0	0	No	No
5	41	1	Yes	No
6	3	1	Yes	No
7	0	0	Yes[b]	No
8	12	0	No	No
9	6	1	No	No
10	3	1	Yes	No
11	0	0	Yes[b]	No
12	0	0	Yes	No
13	16	1	Yes	No
14	9	1	Yes	No
15	0	0	Yes	No
16	5	1	Yes	Yes
17	0	0	No	No
18	6	1	Yes	No
19	0	0	Yes	No
20	2	0	No	No
21	4	0	Yes	Yes
22	3	0	No	Yes
23	9	0	No	Yes
24	6	0	No	No
25	3	0	No	Yes
26	4	0	No	Yes
27	3	0	No	Yes
28	4	0	No	Yes
29	4	0	No	Yes
30	3	0	No	Yes
31	4	0	No	Yes
32	3	0	No	Yes
33	3	0	No	Yes
34	3	0	No	Yes
35	4	0	No	Yes
36	3	0	No	Yes
37	3	0	No	Yes
38	3	0	No	Yes
39	3	0	No	Yes
40	3	0	No	Yes
41	3	0	No	Yes
42	3	0	No	Yes
43	3	0	No	Yes
44	48	0	Yes[c]	No
45	49	0	Yes[c]	No
46	9	0	No	No
47	13	0	Yes[c]	No
48	4	0	No	No
49	3	0	No	No
50	7	0	No	No
51	16	0	Yes[c]	No
52	17	0	No	No
53	5	0	No	No
54	22	0	No	No
55	8	0	No	No
56	7	0	No	No
57	6	0	No	No
58	4	0	No	No
59	6	0	No	No
60	4	0	No	No
61	7	0	No	No
62	4	0	No	No
63	11	0	No	No

Table 2 continued

Site or drainage basin number [a]	*Channel cross sections*	*Bed profiles*	*Erosion data*	*Vegetation data*
64	6	0	No	No
65	6	0	No	No
66	4	0	No	No
67	16	0	Yes[c]	No
68	7	0	No	No
69	3	0	No	No
70	8	0	No	No
71	9	0	No	No
72	12	0	Yes[c]	No
73	5	1	Yes	No
74	5	1	Yes	No
75	6	1	Yes	No
76	8	1	Yes	No
77	2	1	Yes	No
78	12	1	Yes	No
79	0	4	Yes	Yes
80	0	4	Yes	Yes
81	35	1	Yes	Yes
82	15	1	Yes	No

[a] *From Table 1;* [b] *mass movement data; and* [c] *sedimentation data.*

Geography, Uppsala University, Uppsala, Sweden and the Jewish National and Hebrew University Library, Jerusalem, Israel. A sample file is presented in Emmett & Hadley (1968).

USE OF LONG-TERM RECORDS

An example of how Vigil Network data can be used to interpret landscape change is presented in Emmett (1974). Emmett (1974) used 10 to 12 years of geomorphic record from eight Vigil Network sites to indicate that an arroyo cutting epicyle beginning about AD 1880 at many locations in semiarid western United States had reversed, and channels at those sites were then (1974) aggrading. Data from one drainage basin in particular, Last Day Gully near Hudson, Wyoming, indicated a nearly consistent pattern of aggradation at 13 channel cross-sections through 11 years. Analysis of climate records from Santa Fe, New Mexico, indicated that arroyo cutting might be related to decreases in intensity of precipitation beginning about 1880, and a return to pre-1800 rainfall intensity initiated the general tendency of aggrading channels at the eight Vigil Network sites. Possible cause and effect relations between total precipitation or land use with alluviation were not apparent (Emmett, 1974). As additional data are included in other analyses and as the geomorphic record at Vigil Network sites becomes longer in time, relations between landscape change and factors such as land use and climatic change are likely to be developed.

More recently, observations of bottom land changes along Plum Creek, south of Denver, Colorado, have led to insights into geomorphic and vegetative responses after historic flooding (Osterkamp & Costa, 1987; Osterkamp, 1990). The downstream reach of Plum Creek is a sand bed stream east of the Rocky Mountains that, in June 1965, was greatly modified, including channel widening and destruction of about half of the woody vegetation, by a flood calculated as 15 times greater than the 50 year flood (Hardison, 1973). Since 1975, field observations of geomorphic and vegetative changes at established sites and valley cross-sections, combined with aerial photography from before the flood, have indicated that there are two principal processes by which a sand bed stream narrows toward adjustment after pronounced widening.

The more areally extensive of the two processes at Plum Creek has been the development of low bars adjacent to protected parts of the widened channel and islands between channel anabranches. Those features evolve by deposition of sand and gravel on their surfaces and by a long-term tendency toward incisement of the huge slug of coarse sediment that moved from tributary channels into the Plum Creek bottom land during the flood. Establishment of woody vegetation gradually stabilizes the surfaces.

The second process of channel narrowing occurs by sediment deposition behind channel obstructions, such as logs and tyres. In the absence of erosive flows, vegetation quickly develops and stabilizes such deposits to form channel islands. Subsequent flows incrementally deposit sediment on and adjacent to the downstream edges of an island; on each island, the added area is being stabilized by vegetation. Through time, islands coalesce, accrete to flood plain level and ultimately attach to channel banks, thereby increasing the flood plain area and decreasing channel width.

The effect of island expansion processes on channel width is summarized by the curves of Fig. 3 (Osterkamp & Costa, 1987). Those curves show changes in average width, number of vegetated channel islands and number of identifiable trees on the islands for a 4.08 km reach of Plum Creek from late 1964 to 1985. The changes are based on seven sets of aerial photography supported by field observations starting in 1965.

Prior to the June 1965 flood, Plum Creek had an average width of 26 m and contained 13 channel islands in the study reach; trees on channel islands were limited to 86. The average channel width was 68 m two years after the flood and three channel islands supported only two surviving trees. By August 1971, average channel width had increased to 72 m and an estimated 98 trees grew on 15 channel islands, the probable result of the elimination of flood plain vegetation and bank instability. Unusually persistent spring runoff in May 1973 caused additional channel widening and destruction of a small, unknown number of channel islands and trees. By June 1975, average channel width had increased to 116 m, but newly formed channel islands increased their number to 49 with 117 identifiable trees.

The rates of new channel island formation and the decrease of the number of channel islands by coalescing became approximately equal in 1978. Thus, the numbers of channel islands and trees growing on islands peaked at about 190 and 600, respectively, at that time. Average channel width narrowed to 70 m by 1978, largely because of channel islands with other channel islands and with the flood plain has resulted in steadily decreasing

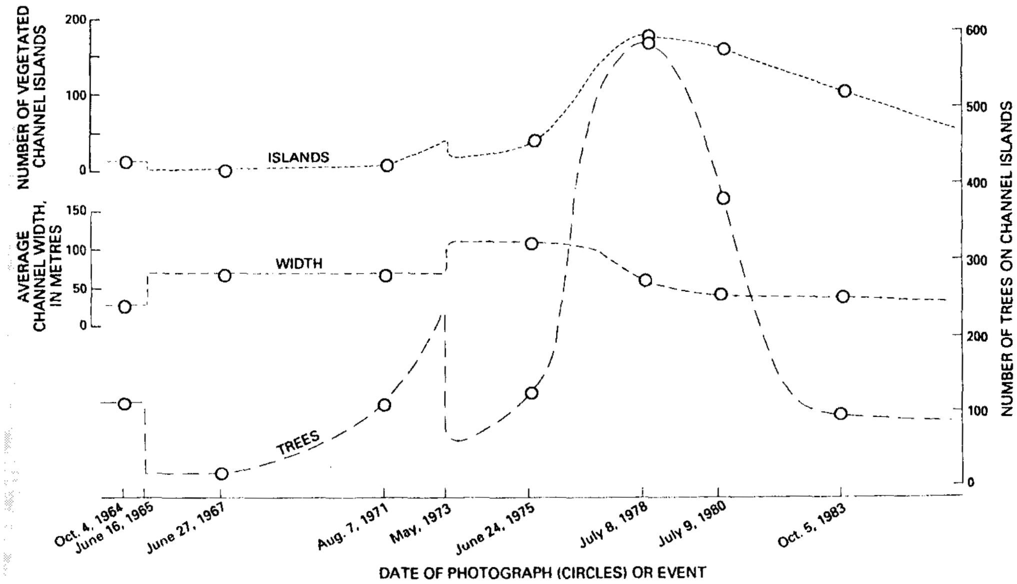

Fig. 3 Channel and vegetation changes, Plum Creek valley, Colorado, 1964 to 1985 (modified from Osterkamp & Costa, 1987).

average channel width, numbers of channel islands and numbers of trees on channel islands (Osterkamp & Costa, 1987). Vigil Network observations are continuing at Plum Creek and ultimately might demonstrate whether the bottom land will revert to pre-flood conditions.

PARTICIPATION IN THE VIGIL NETWORK

The Vigil Network is a small and not well known programme. Because personnel changes have introduced many younger scientists into earth-resource studies, much of this new generation of earth scientists is unfamiliar with the Vigil Network programme. This paper, therefore, is not only a request for a revival of interest in long-term monitoring of earth resources, but also reports how renewed interest can be exercised by participation in and use of the Vigil Network. New sites and new entries to the repositories are welcome, as are resurveys by original or subsequent investigators.

A detailed compilation of Vigil Network sites and available data is to be completed soon. The compilation will provide an opportunity for a new generation of geomorphologists and other earth and biological scientists, largely unaware of the Vigil Network, to become more familiar with this programme of long-term observations. For more information, contact W. R. Osterkamp or W. W. Emmett, US Geological Survey, Mail Stop 413, Denver, Colorado 80225-0046, USA.

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