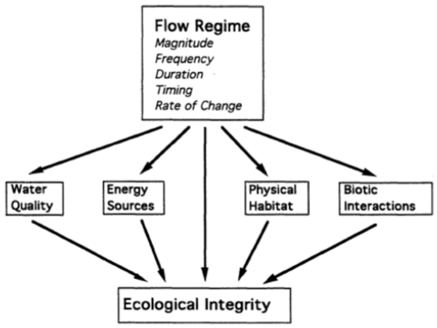
Pressures on Fishes

- Impoundments
  - Habitat loss
  - Habitat alteration
  - Hydrograph alterations

Figure 1. Flow regime is of central importance in sustaining the ecological integrity of flowing water systems. The five components of the flow regime—magnitude, frequency, duration, timing, and rate of change—influence integrity both directly and indirectly, through their effects on other primary regulators of integrity. Modification of flow thus has cascading effects on the ecological integrity of rivers. After Karr 1991.



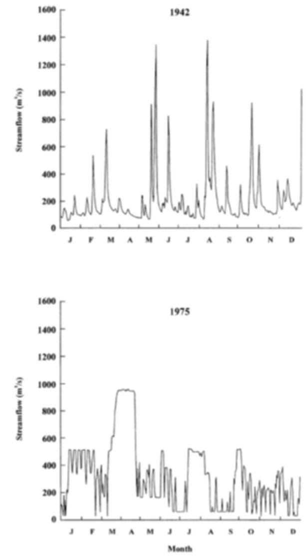


Figure 1. Two hydrographs for the Roanoke River at Roanoke Rapids in North Carolina can be characterized by the five general features of a hydrologic regime: magnitude, frequency, duration, timing, and rate of change. These regime features can be altered by human influences such as dams, as illustrated by a comparison of the upper pre-dam hydrograph for 1942 with the lower post-dam hydrograph for 1975 (cms = cubic meters per second = 35.315 cubic feet per second).

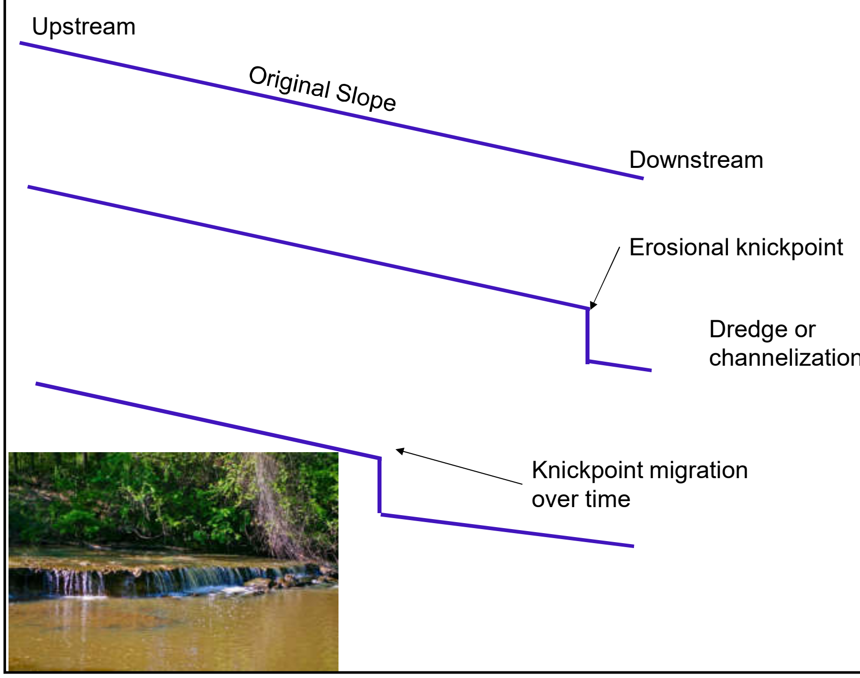
Table 1. Physical responses to altered flow regimes.

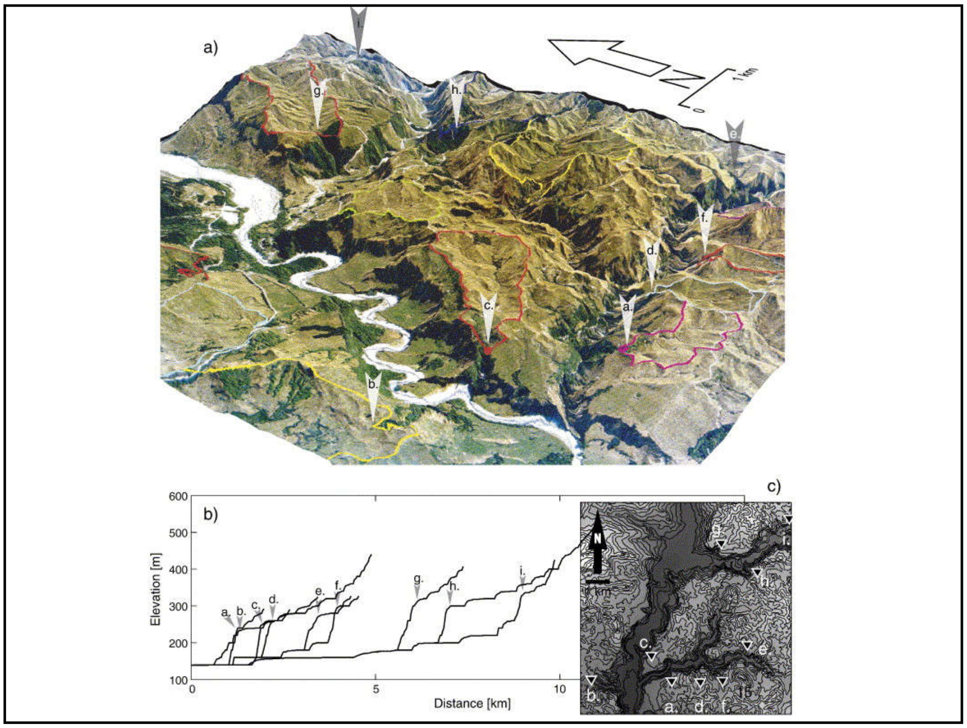
Source(s) of alteration	Hydrologic change(s)	Geomorphic response(s)	Reference(s)
Dam	Capture sediment moving downstream	Downstream channel erosion and tributary headcutting	Chien 1985, Petts 1984, 1985, Williams and Wolman 1984
		Bed armoring (coarsening)	Chien 1985
Dam, diversion	Reduce magnitude and frequency of high flows	Deposition of fines in gravel	Sear 1995, Stevens et al. 1995
		Channel stabilization and narrowing	Johnson 1994, Williams and Wolman 1984
		Reduced formation of point bars, secondary channels, oxbows, and changes in channel planform	Chien 1985, Copp 1989, Fenner et al. 1985
Urbanization, tiling, drainage	Increase magnitude and frequency of high flows	Bank erosion and channel widening	Hammer 1972
		Downward incision and floodplain disconnection	Prestegaard 1988
	Reduced infiltration into soil	Reduced baseflows	Leopold 1968
Levees and channelization	Reduce overbank flows	Channel restriction causing downcutting	Daniels 1960, Prestegaard et al. 1994
		Floodplain deposition and erosion prevented	Sparks 1992
		Reduced channel migration and formation of secondary channels	Shankman and Drake 1990
Groundwater pumping	Lowered water table levels	Streambank erosion and channel downcutting after loss of vegetation stability	Kondolf and Curry 1986

Table 2. Ecological responses to alterations in components of natural flow regime.[a]

Flow component	Specific alteration	Ecological response	Reference(s)
Magnitude and frequency	Increased variation	Wash-out and/or stranding	Cushman 1985, Petts 1984
		Loss of sensitive species	Gehrke et al. 1995, Kingsolving and Bain 1993, Travnichek et al. 1995
		Increased algal scour and wash-out of organic matter	Petts 1984
		Life cycle disruption	Scheidegger and Bain 1995
		Altered energy flow	Valentin et al. 1995
	Flow stabilization	Invasion or establishment of exotic species, leading to:	
		Local extinction	Kupferberg 1996, Meffe 1984
		Threat to native commercial species	Stanford et al. 1996
		Altered communities	Busch and Smith 1995, Moyle 1986, Ward and Stanford 1979
		Reduced water and nutrients to floodplain plant species, causing:	
		Seedling desiccation	Duncan 1993
		Ineffective seed dispersal	Nilsson 1982
		Loss of scoured habitat patches and secondary channels needed for plant establishment	Fenner et al. 1985, Rood et al. 1995, Scott et al. 1997, Shankman and Drake 1990
		Encroachment of vegetation into channels	Johnson 1994, Nilsson 1982
Timing	Loss of seasonal flow peaks	Disrupt cues for fish:	
		Spawning	Fausch and Bestgen 1997, Montgomery et al. 1993, Nesler et al. 1988
		Egg hatching	Næsje et al. 1995
		Migration	Williams 1996
		Loss of fish access to wetlands or backwaters	Junk et al. 1989, Sparks 1995
		Modification of aquatic food web structure	Power 1992, Wootton et al. 1996
		Reduction or elimination of riparian plant recruitment	Fenner et al. 1985
		Invasion of exotic riparian species	Horton 1977
		Reduced plant growth rates	Reily and Johnson 1982
Duration	Prolonged low flows	Concentration of aquatic organisms	Cushman 1985, Petts 1984
		Reduction or elimination of plant cover	Taylor 1982
		Diminished plant species diversity	Taylor 1982
		Desertification of riparian species composition	Busch and Smith 1995, Stromberg et al. 1996
		Physiological stress leading to reduced plant growth rate, morphological change, or mortality	Kondolf and Curry 1986, Perkins et al. 1984, Reily and Johnson 1982, Rood et al. 1995, Stromberg et al. 1992
	Prolonged baseflow "spikes"	Downstream loss of floating eggs	Robertson 1997
	Altered inundation duration	Altered plant cover types	Auble et al. 1994
	Prolonged inundation	Change in vegetation functional type	Bren 1992, Connor et al. 1981
		Tree mortality	Harms et al. 1980
		Loss of riffle habitat for aquatic species	Bogan 1993
Rate of change	Rapid changes in river stage	Wash-out and stranding of aquatic species	Cushman 1985, Petts 1984
	Accelerated flood recession	Failure of seedling establishment	Rood et al. 1995

Pressures on Fishes




a)
N
1 km
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b)
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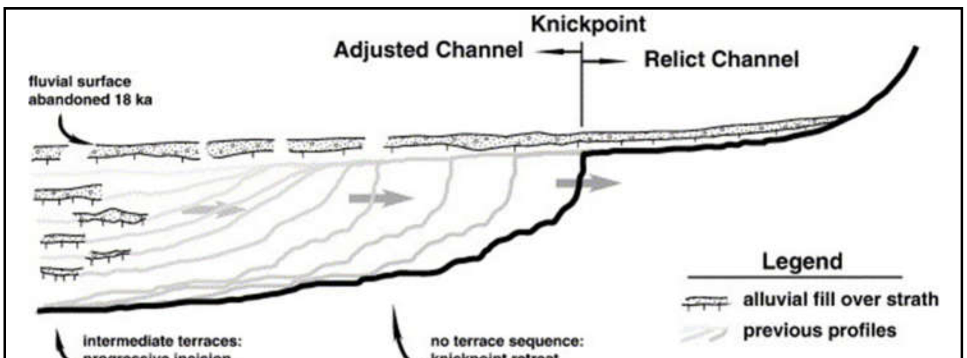
Knickpoint
Adjusted Channel
Relict Channel
fluvial surface
abandoned 18 ka
Legend
alluvial fill over strath
previous profiles
intermediate terraces:
progressive incision
no terrace sequence:
knickpoint retreat

Copeia, 2001(4), pp. 916–927

Stream Erosion and Densities of *Etheostoma rubrum* (Percidae) and Associated Riffle-Inhabiting Fishes: Biotic Stability in a Variable Habitat

Stephen T. Ross, Martin T. O'Connell, David M. Patrick, Carlos A. Latorre, William T. Slack, Jeremy G. Knight, and S. David Wilkins

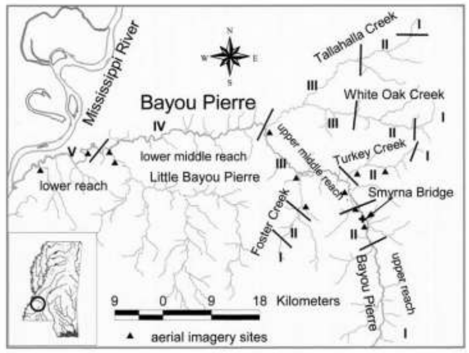

TABLE 2. MOVEMENT OF THE KNICKPOINT AT SITE I-12 ON THE UPPER REACH OF BAYOU PIERRE (nd = NO DATA). Data from 1994 are based on field observations.

	Year						
	1940	1964	1978	1985	1990	1992	1994
Distance (m) between knickpoint and Smyrna bridge	−4115	−2956	−1433	122	975	1500	3000
Average knickpoint migration rate (m/yr)	nd	48	124	222	171	263	750

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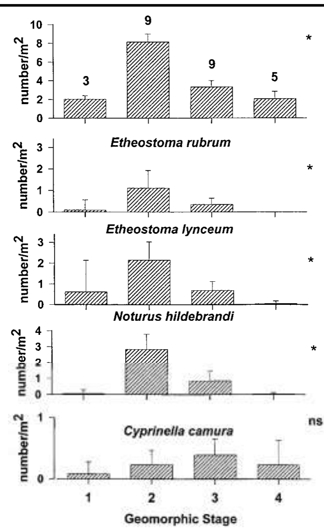

FIG 4. Densities of all riffle-inhabiting fishes and the four numerically dominant species in 1993–1994 enclosure samples from Bayou Pierre. Vertical lines are 95% CI; asterisks indicate significant differences. Differences for total riffle fishes tested with ANOVA ($F = 4.04$; $P = 0.012$); differences for individual species tested with K-W with α corrected for multiple comparisons (*Etheostoma rubrum*, $\chi^2 = 12.5$, $P = 0.006$; *Etheostoma lynceum*, $\chi^2 = 11.4$, $P = 0.010$; *Etheostoma hildebrandi*, $\chi^2 = 12.0$, $P = 0.007$; *Cyprinella camura*, $\chi^2 = 1.9$, $P = 0.592$).

Pressures on Fishes – Introduced Species

- Intentional introductions – aquaculture, mosquito control, vegetation control, game fish
- Unintentional introductions – aquaculture, ornamentals, ballast water

- Impacts on natives
  - Predation
  - Competition
  - Hybridization
  - Disease

- Assessing impacts

UGANDA - L. VICTORIA WATERS TRAWL MEAN CATCH RATES BY SPECIES, NORTHERN SECTOR

Species	1968–71	1981	1982	1983
	510 hauls ca.510 hrs	127 hauls 144.5 hrs	191 hauls 223.4 hrs	263 hauls 269.5 hrs
Haplochromis spp.	668.20	543.30	294.34	270.84
Oreochromis esculentus	29.79	0.15	0.04	0.01
O. variabilis	1.04	8.70	1.97	1.07
O. niloticus	3.36	13.60	6.56	5.03
O. leucostictus	0.18	0.11	0.02	0.01
Tilapia zillii	-	-	-	-
Bagrus docmac	33.26	4.09	8.37	11.24
Clarias mossambicus	32.60	15.07	7.16	4.32
Protopterus aethiopicus	22.08	2.66	1.09	2.23
Lates niloticus	0.96	5.02	42.08	57.47
Synodontis victoriae	4.77	0.91	0.27	0.35
S. afrofischeri	0.10	0.01	0.00	0.01
Other species	2.56	0.32	1.40	2.69
Total	796.72	594.94	363.30	355.28

Source : Okaronon et al. (1984)

Cascading Effects of the Introduced Nile Perch on the Detritivorous/Phytoplanktivorous Species in the Sublittoral Areas of Lake Victoria

Tijs Goldschmidt; Frans Witte; Jan Wanink

Conservation Biology, Vol. 7, No. 3. (Sep., 1993), pp. 686-700.

(1) Lates replaced 109+ species of haplochromine piscivors and the piscivorous catfishes (***Bagrus docmak*** and ***Clarias gariepinis***).
(2) ***Oreochromis niloticus*** replaced the indigenous ***O. esculentus*** and ***O. variabilis***.
(3) The zooplanktivorous cyprinid ***Rastrineobola argentea*** replaced 20+ species of zooplanktivorous haplochromines.
(4) ***Caridina*** replaced the detritivorous haplochromines.

Long term trends…

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Patterns of fish invasions in the Great Plains of North America

Keith B. Gido [a,*], Jacob F. Schaefer [b], Jimmie Pigg [c,✡]

[a] Division of Biology, Kansas State University, Ackert Hall, Manhattan, KS 66506, USA
[b] Department of Biology, Southern Illinois University at Edwardsville, Edwardsville, IL 62026, USA
[c] State Environmental Laboratory, Oklahoma Department of Environmental Quality, Oklahoma City, OK 73117-1295, USA

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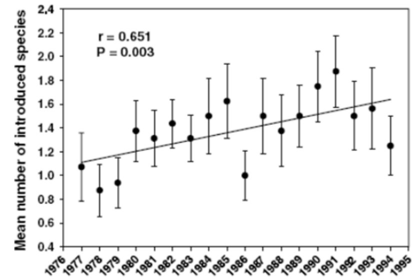

Fig. 5. Relationship between mean number of introduced species across 18 years of sampling 16 stream sites in Oklahoma between 1977 and 1994. Vertical bars represent one standard error.

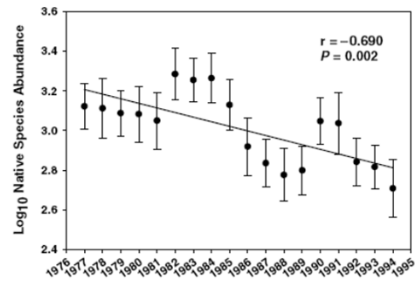

Fig. 6. Relationship between mean abundance of native species across 18 years of sampling 16 stream sites in Oklahoma between 1977 and 1994.