

T11050q1/2

**Restoration of Riverine Fisheries Habitats**

**First Project Report for period  
July 1991 - February 1992**

**Institute of Freshwater Ecology**

**February 1992**

**First Project Report 326/2/A**



**NRA**

*National Rivers Authority*



Restoration of Riverine Fisheries Habitats  
First Project Report for Period July 1991 - February 1992

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NRA R&D Contract No. DO3.4.90

Research Contractor: Institute of Freshwater Ecology  
Project Leader: R.H.K.Mann  
Report Date: February 1992  
Customer: National Rivers Authority  
NRA Report Ref: 326/2/A  
IFE Report Ref: ERG/T11050q1/2  
TFS Project Ref: T11050q1

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## 1. TECHNICAL PROGRESS

Details of progress from July 1991 to September 1991 are given in the Progress Report for that period (NRA Report Ref: 326/1/A). Aspects of that report are repeated and updated as appropriate in this report.

The initial phase of this examination of the effectiveness of the restoration of riverine fisheries habitats comprised three parts.

### 1.1 Initial meeting

Mr R.H.K.Mann (IFE Project Leader) and Dr J.S.Wortley (NRA Project Officer) met at NRA, Norwich on 22.7.91 to clarify details of the project. The NRA requested that information on NRA restoration projects (Strategy, method. Phase 1, point 2) be entered on the database FOXPRO. This database has been purchased by IFE and installed on an Elonex 386 computer; Mr Mann is currently learning details of the program.

Dr Wortley suggested that a short article publicising the project be sent to the editor of the Institute of Fisheries Management's journal 'FISH'. Mr Mann wrote the article, which was seen by Dr Wortley before being submitted on 20.9.91. It appeared in the October 1991 issue (see Appendix A) and included a request for information on restoration projects that had had no NRA/Water Authority involvement; however, no such information has been received to date.

### 1.2 Compilation and circulation of questionnaire

The questionnaire for circulation to NRA staff in the ten Regions was prepared in two sections.

Section I sought to obtain information on the perceived needs for restoration schemes in the ten NRA Regions, with details for salmon, trout and coarse fish being identified separately.

Section II requested detailed information on individual restoration projects.

The questionnaires (see Appendix B) were sent out on 29-30 August 1991 to 54 NRA Fisheries Managers, Officers and Scientists (list of names provided by Dr Wortley). A request was made that the forms should be completed and returned by 31 October 1991. Not all returns were made by this date and many telephone calls were required to obtain replies. The last reply was received in January 1992.

To date (14.2.92) 12 Section I replies have been received, covering areas in all ten NRA Regions except the Southwest. A request has been sent to the Southwest Region for information regarding Section I.

68 Section II replies have been received from the ten NRA Regions as follows:

Anglian	19	Southern	6	Welsh	4
Northumbrian	2	Severn-Trent	2	Wessex	11
Northwest	1	Southwest	9	Yorkshire	13
Thames	1				

Letters were received from Anglian (Essex), Severn-Trent (Lower Severn and Lower Trent) stating that no restoration work had been carried in those areas.

Only one Section II reply was received from the Thames Region. The Senior Fisheries Officers for the two component areas (West and East) considered that the way that restoration work was carried out in Thames NRA made it impossible to identify specific projects as required by the questionnaire. This is because most restoration work in Thames comprises relatively small scale, day-to day exercises, rather than larger, discrete projects.

Therefore Mr Mann visited the two Senior Fisheries Officers concerned (Mr A.Butterworth, Thames West and Mr J.Reeves, Thames East) and some of their staff on 21.11.91 and 28.11.91, respectively. From the information collected, Mr Mann was able to complete two more Section II forms. However, most of the information provided is not compatible with the questionnaire data, and will require separate treatment in the Final Report.

Table 1 shows a breakdown of the Section II replies into projects concerned with salmon, trout and coarse fish. Note that these total more than 68 (the number of replies) because some fisheries had salmon/trout or trout/coarse fish in equal status.

Table 1. Number of restoration projects with salmon, trout or coarse fish as the principal fisheries, as recorded in the questionnaire (Section II) replies.

	Salmon	Trout	Coarse Fish
Anglian	0	10	12
Northumbrian	0	1	1
Northwest	1	0	0
Severn-Trent	1	0	1
Southern	2	3	2
Southwest	9	3	0
Thames	0	1	2
Welsh	0	4	0
Wessex	0	1	9
Yorkshire	1	7	6

### 1.3 Literature search and review

A computerised literature search on restoration schemes and procedures in the U.K., Europe and North America. References have been obtained from Aquatic Sciences and Fisheries Abstracts 1979-1990, and from the Freshwater Biological Association's current awareness files 1970-1991. A database has been compiled to include all relevant items from these searches, together with previously known references: this database now contains 250 records. Inter-library loans have been obtained for references not held at the Freshwater Biological Association's library at The Ferry House, Windermere.

A list of the 197 papers examined to date is given in the bibliography in Appendix C. These references comprise details of specific restoration projects, general aspects of restoration work in rivers, and information on methods of assessing the impact of restoration work on fish populations.

The majority of references (144) are from North America and deal with salmonid fisheries or general aspects of the rehabilitation of lotic systems. Considerably fewer references relate to the U.K. (46) and Europe (7), or to coarse fisheries. Many references originally identified in the literature searches were found to deal solely with restoration of rivers in terms of water quality rather than physical restoration. These references are not included in the bibliography.

All the papers listed in the bibliography have been examined by Mr Mann and/or Dr Winfield and their contents are being collated for the literature review. Mr Mann is responsible for the review of salmonid studies and Dr Winfield for the coarse fish studies.

## APPENDIX A

Contents of the article that appeared in FISH, Issue No. 24, October 1991, page 33.

### Restoration of Riverine Fisheries Habitats

Many schemes have been carried out in recent years to improve fisheries by physically restoring riverine habitats. The techniques used include the installation of gabions and low level weirs, increasing river meanders and altering the pool/riffle sequences. But how effective are these and similar remedial measures - and how should their effectiveness be assessed ?

To address these and related questions the NRA has commissioned an R & D Project on fisheries habitat improvement

schemes. The first, one-year, phase started in July 1991, the work being carried out by the NERC Institute of Freshwater Ecology led by Mr Richard Mann, with Dr Jonathon Wortley acting as the NRA co-ordinator. The study seeks to examine current and recent restoration schemes throughout the NRA regions and to quantify future needs in the regions for habitat improvement of rivers. Information will also be collected on the procedures used in other countries.

Fisheries for salmon, trout and coarse fish are being examined separately and an initial questionnaire has been sent already to over 50 NRA Fisheries Managers, Officers and Scientists regarding restoration schemes in their area. By close consultation with the biologists and engineers responsible for designing and carrying out restoration projects, it is hoped to identify the criteria needed to implement successful schemes, and to recommend where they may be more widely applied.

It may be that there are some schemes that have had little or no Water Authority/NRA involvement and Richard Mann would be pleased to receive information about them. His address is: I.F.E., Eastern Rivers Laboratory, c/o Monks Wood Experimental Station, Abbots Ripton, Huntingdon, Cambs. PE17 2LS (tel. 04873-381).

SECTION I  
-----

1. NAME:
  
2. NRA REGION (or subregion)
  
3. HOW MANY MILES OF RIVER ARE THERE IN YOUR REGION/SUBREGION UNDER THE FOLLOWING CATEGORIES ?

SALMON FISHERY

TROUT/SEA TROUT FISHERY

COARSE FISHERY

In the case of mixed fisheries please fill in more than one category.

4. IN YOUR OPINION HOW MANY MILES OF RIVER IN YOUR REGION/SUBREGION WOULD BENEFIT FROM HABITAT IMPROVEMENT UNDER THE FOLLOWING CATEGORIES:

SALMON FISHERY

TROUT/SEA TROUT FISHERY

COARSE FISHERY

SECTION II (Please use one form per restoration project)  
-----

1. NRA REGION:

2. NAME OF RIVER:

3. LOCATION (MAP REF):

4. TYPE OF FISHERY (Please tick: more than one if necessary, but encircle the principal fishery):

SALMON

TROUT/ SEA TROUT

COARSE FISH

5. REASON FOR THE RESTORATION:

6. TYPE OF RESTORATION (i.e. physical modification, including any changes to the river gradient, channel morphology, banks etc.)

7. WHO CARRIED OUT THE RESTORATION (Please tick)

WATER AUTHORITY/N.R.A.

OTHER (Please specify)



14. WAS A FISH SURVEY CARRIED OUT AFTER RESTORATION ?

YES NO (Please tick)

IF YES - HOW MANY SURVEYS:

DATE(S) - MONTH/YEAR:

WHAT TYPE OF SURVEY(S) - Please tick:

POPULATION ESTIMATES }- NETTING  
                                  }- ELECTRO-FISHING  
                                  }- OTHER (Please specify)

15. WERE ANY OTHER ENVIRONMENTAL IMPACT ASSESSMENTS MADE IN CONJUNCTION WITH THE RESTORATION ? Please tick:

BEFORE AFTER

RIVER CORRIDOR SURVEY

INVERTEBRATE SURVEY  
(e.g. RIVPACS)

OTHER (Please specify)

16. HOW DID THE FISHERY CHANGE AS A RESULT OF THE RESTORATION ?  
Please tick:

CONSIDERABLE IMPROVEMENT:

MODERATE IMPROVEMENT:

NO CHANGE:

DETERIORATED:

UNKNOWN:

17. HOW WAS THE CHANGE IN THE FISHERY ASSESSED ?

18. WHAT WAS THE COMMITMENT CONCERNING MAINTENANCE OF THE RESTORATION (Please tick)

RESTORATION IS MAINTENANCE FREE

COMMITMENT BY WATER AUTHORITY/N.R.A.

NO COMMITMENT

OTHER (Please specify)

19. IS A REPORT(S) OR UNPUBLISHED PAPER(S) AVAILABLE CONCERNING THE RESTORATION PROJECT ?

Please tick:

ON THE ENGINEERING ASPECTS:

ON THE FISHERIES ASPECTS:

ON OTHER ASPECTS (please specify):

20. PLEASE GIVE ANY FURTHER DETAILS OR COMMENTS THAT WILL  
CONTRIBUTE TO THIS STUDY:

21. NAME OF NRA CONTACT CONCERNING THE ENVIRONMENTAL (FISHERIES)  
ASPECTS OF THE RESTORATION PROJECT

NAME:

ADDRESS:

TEL. NO.

FAX NO.

Thank you for your cooperation.

## BIBLIOGRAPHY

- Alabaster, J.S. (ed.) (1985) Habitat Modification and Freshwater Fisheries. (FAO) London: Butterworths.
- Angermeier, P.L. and Karr, J.R. (1984) Relationships between woody debris and fish habitat in a small warmwater stream, Trans. Am. Fish. Soc., 113, 716-726.
- Angermeier, P.L. and Karr, J.R. (1986) Applying an index of biotic integrity based on stream-fish communities: considerations in sampling and interpretation, N. Am. J. Fish. Mgmt, 6, 418-429.
- Allen, K.R. (1969) Distinctive aspects of the ecology of stream fishes: a review, J. Fish. Res. Bd Canada, 26, 1429-1438.
- Armitage, P.D. (1979) Stream regulation in Great Britain. In The Ecology of Regulated Streams, edited by J.V.Ward and J.A.Stanford, 165-181. New York and London: Plenum Press.
- Bacalbasa-Dobrovici, Nicolau, C. and Nitu, M. (1990) Fisheries management and hydraulic regime in the Danube delta. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B. Steinmetz and R.H.Hughes, 447-461. EIFAC, Wageningen: Pudoc.
- Bain, M.B. and Finn, J.T. (1990) Analysis of microhabitat use by fish: investigator effect and investigator bias, Rivers: Studies in the Science, Environmental Policy, and Law of Instream Flow 16p.
- Banks, J.W. (1990) Fisheries management in the Thames basin, England, with special reference to the restoration of a salmon population. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B. Steinmetz and R.H.Hughes, 511-519. EIFAC, Wageningen: Pudoc.
- Barton, D.R., Taylor, W.D. and Biette, R.M. (1985) Dimensions of riparian buffer strips required to maintain trout habitat in Southern Ontario streams, N. Am. J. Fish. Mgmt, 5, 364-378.
- Belaud, A., Chaverocche, P., Lim, P. and Sabaton, C. (1989) Probability-of-use curves applied to brown trout (Salmo trutta fario L.) in rivers of southern France, Reg. Riv.: Res. & Mgmt, 3, 321-336.
- Berkman, H.E., Rabeni, C.F. and Boyle, T.P. (1986) Biomonitors of stream quality in agricultural areas: fish versus invertebrates, Env. Mgmt, 10, 413-419.
- Binns, N.A. (1986) Habitat, macroinvertebrate and fishery response to stream improvement efforts in the Thomas Fork Bear River drainage, Wyoming. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 105-116. Lock Haven Univ.

Binns, N.A. and Eiserman, F.M. (1979) Quantification of fluvial trout stream habitat in Wyoming, Trans. Am. Fish. Soc., 108, 215-228.

Bley, P.W. (1987) Age, growth, and mortality of juvenile Atlantic salmon in streams: a review, Biol. Rep. U.S. Fish Wildl. Serv., 87, 29p.

Boussu, M.F. (1954) Relationship between trout populations and cover on a small stream, J. Wildl. Mgmt, 18, 229-239.

Bovee, K.D. (1982) A Guide to Stream Habitat Analysis using the Instream Flow Incremental Methodology. Flow Information Paper No.12, U.S.Dept of the Interior, Fish & Wildl. Serv, Colorado, Fort Collins, 248p.

Bowlby, J.N. and Imhof, J.G. (1989) Alternative approaches in predicting trout populations from habitat in streams. In Alternatives in Regulated Stream Management, edited by J.A.Gore and G.E.Petts, 318-330. Boca Raton, Florida: CRC Press Inc.

Brookes, A. (1988) Channelized Rivers: Perspectives for Environmental Management. Chichester: John Wiley.

Brookes, A. (1989) Alternative channelization procedures. In Alternatives in Regulated River Management, edited by J.A.Gore and G.E.Petts, 140-162. Boca Raton, Florida: CRC Press Inc.

Brookes, A. (1992) Recovery and restoration of some engineered British river channels. In River Conservation and Management, edited by P.J.Boo, P.Calow and G.E.Petts, 337-352. Chichester: Wiley.

Brookes, A. and Gregory, K.J. (1987) An assessment of river channelization in England and Wales, Sci. Total Environ., 27, 97-111.

Brooker, M.J. (1981) The impact of impoundments on the downstream fisheries and general ecology of rivers, Adv. appl. Ecol., 6, 91-152.

Burgess, S.A. and Bider, J.R. (1980) Effects of stream habitat improvements on invertebrates, trout populations, and mink activity, J. Wildl. Mgmt, 41, 871-880.

Cairns, J. (1990) Lack of theoretical basis for predicting rate and pathways of recovery. Env. Mgmt, 14, 517-526.

Calhoun, A. (1966) Habitat protection and improvement, In Inland Fisheries Management, edited by A. Calhoun, 40-48. Cal. Dept Fish Game.

Carline, R.F. and Klosiewski, S.P. (1985) Responses of fish populations to mitigation structures in two small channelized streams in Ohio, N. Am. J. Fish. Mgmt, 5, 1-11.

Chandler, J.R. (1990) Integrated catchment management in England and Wales. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B. Steinmetz and R.H.Hughes, 520-525. EIFAC, Wageningen, Pudoc.

Chapman, D.W. (1966) Food and space as regulators of salmonid populations in streams, Am. Nat., 100, 345-357.

Cooper, E.L. (1972) Management of trout streams, Spec. Publs Am. Fish. Soc., No.7, 153-162.

Cornell, H., Hurd, L.E. and Lotrich, V.A. (1976) A measure of response to perturbation used to assess structural changes in some polluted and unpolluted stream fish communities, Oecologia (Berlin), 23, 335-342.

Cowx, I.G. (1990) Application of creel census data for the management of fish stocks in large rivers in the United Kingdom. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B. Steinmetz and R.H.Hughes, 526-534. EIFAC, Wageningen, Pudoc.

Cowx, I.G. and Gould, R.A. (1989) Effects of stream regulation on Atlantic salmon, Salmo salar L., and brown trout, Salmo trutta L., in the upper Severn catchment, U.K., Reg. Riv.: Res. & Mgmt, 3, 235-245.

Cowx, I.G., Wheatley, G.A. and Mosley, A.S. (1986) Long-term effects of land drainage works on fish stocks in the upper reaches of a lowland river, J. Env. Mgmt, 22, 147-156.

Cresswell, R.C. (1989) Conservation and management of brown trout, Salmo trutta, stocks in Wales by the Welsh Water Authority, Freshwat. Biol., 21, 111-123.

Crisp, D.T. (1989) Some impacts of human activities on trout, Salmo trutta, populations, Freshwat. Biol., 21, 21-33.

Debano, L.F. and Hansen, W.R. (1989) Rehabilitating depleted riparian areas using channel structures. In Practical Approaches to Riparian Resource Management: an Educational Workshop, edited by R.E.Cresswell, B.A.Barton and J.L. Kershaw, 141-147. U.S. Bureau of Land Management.

Dumas, J. (1979) Projet de restauration du saumon atlantique dans le bassin de la dordogne, Saumon, 29, 6-9.

Edwards, C.J., Griswold, B.L., Tubb, R.A., Weber, E.C. and Woods, L.C. (1984) Mitigating effects of artificial riffles and pools on the fauna of a channelized warmwater stream, N. Am. J. Fish. Mgmt, 4, 194-203.

Edwards, R.W. and Crisp, D.T. (1982) Ecological implications of river regulation in the United Kingdom. In Gravel-bed Rivers, edited by R.D.Hey, J.C. Bathurst and C.R.Thorne, 843-865. New York, John Wiley.

Ehlers, R. (1956) An evaluation of stream improvement devices constructed eighteen years

ago, Calif. Fish Game, 42, 203-217.

Espinosa, A. (1984) Natural propagation and habitat improvement, Vol. 3 Idaho. A.S.F.A. 15(4), 8970.

Everest, F.H. and Sedell, J.R. (1984) Evaluating effectiveness of stream enhancement projects. In Pacific Northwest Stream Habitat Management Workshop, edited by T.J.Hassler, 246-256. Arcata, California: Humboldt State Univ.

Fahy, E. (1989) Conservation and management of brown trout, Salmo trutta, in Ireland, Freshwat. Biol., 21, 99-109.

Fausch, K.D., Karr, J.R. and Yant, P.R. (1984) Regional application of an index of biotic integrity based on stream fish communities, Trans. Am. Fish. Soc., 113, 39-55.

Fedorenko, A.Y. and Shepherd, B.G. (1984) Review of salmonid resource studies in Indian River and Indian Arm, and enhancement proposals for the area. Can. MS Rep. Fish. Aquat. Sci., No. 1769, 30p.

Finnigan, R.J., Marshall, D.E., Mundie, J.H., Slaney, P.A. and Taylor, G.D. (1980) Stream Enhancement Guide, Fisheries and Oceans, Vancouver, British Columbia, 95p.

Fraleley, J., Marotz, B., Decker-Hess, J., Beattie, W. and Zubik, R. (1989) Mitigation, compensation, and future protection for fish populations affected by hydropower development in the Upper Columbia system, Montana, U.S.A. Reg. Riv.: Res. & Mgmt, 3, 3-18.

Frenette, M., Dulude, P. and Beaurivage, M. (1988) The restoration of the Jacques-Cartier: a major challenge and a collective pride. In Atlantic Salmon: Planning for the Future, Proc. 3rd Int. Atl. Salm. Symp., Biarritz, edited by D.Mills and D.Piggins, 400-414.

Fuchs, U. and Statzner, B. (1990) Time scales for the recovery potential of river communities after restoration: lessons to be learned from smaller streams. Reg. Riv.: Res. & Mgmt, 5, 77-87.

Gabelhouse, D.W. (1984) A length-categorization system to assess fish stocks, N. Am. J. Fish. Mgmt, 4, 273-285.

Gablehouse, D.W. (1984) An assessment of crappie stocks in small midwestern private impoundments, N. Am. J. Fish. Mgmt, 4, 371-384.

Gardiner, J.L. (1988) Environmentally sound river engineering - examples from the Thames catchment, Reg. Riv.: Res. & Mgmt, 2, 445-469.

Gibson, J.R. (1988) Mechanisms regulating species composition population structure, and production of stream salmonids; a review, Pol. Arch. Hydrobiol., 35, 469-495.

Giles, N. (1989) Assessing the status of British wild brown trout, Salmo trutta, stocks: a pilot study utilizing data from game fisheries, Freshwat. Biol., 21, 125-133.

Glover, R.D. (1986) Trout stream rehabilitation in the Black Hills of South Dakota. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 7-15. Lock Haven Univ.

Gore, J.A., editor (1985) The Restoration of Rivers and Streams: Theories and Experience. London: Butterworths.

Gore, J.A., Kelly, J.R. and Yount, J.D. (1990) Application of ecological theory to determining recovery potential of disturbed lotic ecosystems: research needs and priorities, Env. Mgmt, 14, 755-762.

Gorman, O.T. and Karr, J.R. (1978) Habitat structure and stream fish communities, Ecology, 59, 507-515.

Gould, R.W. (1982) Freshwater aspects of anadromous salmonid enhancement, Tech. Rep. natn. ocean. atmos. Admin. NMFS Circular 447, 21-22.

Graesser, N.W. (1979) Effect on salmon fisheries of afforestation, land drainage and road making in river catchment areas, Salm. Net, 12, 38-45.

Graesser, N.W. (1979) How land improvements can damage Scottish salmon fisheries, Salm. Trout Mag., 215, 39-43.

Gravel, Y. and Dubé, J. (1980) Les conditions hydriques et le rôle de la végétation dans une frayère à grands brochets Esox lucius Linné, Eau Que, 13, 229-230.

Grossman, G.D., Dowd, J.F. and Crawford, M. (1990) Assemblage stability in stream fishes: a review, Env. Mgmt, 14, 661-671.

Gustafson-Greenwood, K.I. and Moring, J.R. (1991) Gravel compaction and permeabilities in redds of Atlantic salmon, Salmo salar L., Aquat. Fish. Mgmt, 22, 537-540.

Hale, J.G. (1969) An evaluation of trout stream habitat improvement in a north shore tributary of Lake Superior, Minnesota Fish. Invest., 5, 37-50.

Hall, J.D. and Baker, C.O. (1982) Influence of forest and rangeland management on anadromous fish habitat in western North America, USDA For. Serv., General Tech. Rep PNW-138, 29p.

Hall, J.D. and Field-Dodgson, M.S. (1981) Improvement of spawning and rearing habitat for salmon, Occ. Publ. Fish. Res. Div. Min. Ag. Fish. (N.Z.), 21-28.

Hamilton, J.B. (1989) Response of juvenile steelhead to instream deflectors in a high gradient stream. In Practical Approaches to Riparian Resource Management: an Educational Workshop, edited by R.E.Cresswell, B.A.Barton and J.L.Kershaw. U.S. Bureau of Land Mgmt, 149-158.

Harper, D.M., Smith, C.D. and Barham, P.J. (1992) Habitats as the building blocks for river conservation assessment. In River Conservation and Management, edited by P.J.Boon,

P.Calow and G.E.Petts, 311-319. Chichester, Wiley.

Hawkes, H.A. (1981) Biological surveillance of rivers in relation to fisheries - potential and limitations, Proc. 2nd Brit. Freshwat. Fish. Conf., Liverpool, 248-257.

Heede, B.H. and Rinne, J.N. (1990) Hydrodynamic and fluvial morphologic processes: implications for fisheries management and research, N. Am. J. Fish. Mgmt, 10, 249-268.

Hellawell, J.M. (1976) River management and the migratory behaviour of salmonids, Fish. Mgmt, 7, 57-60.

Hickley, P. and Dexter, K.F. (1979) A comparative index for quantifying growth in length of fish, Fish. Mgmt, 10, 147-151.

Holcik, J. (1990) Effects of hydraulic engineering on habitat and fish community in river anabranches of the middle Danube. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B.Steinmetz and R.H.Hughes, 14-24. EIFAC, Wageningen: Pudoc.

Horwitz, R.J. (1978) Temporal variability patterns and the distributional patterns of stream fishes, Ecol. Mgmt, 48, 307-321.

House, R.A. and Boehne, P.L. (1985) Evaluation of instream enhancement structures for salmonid spawning and rearing in a coastal Oregon stream, N. Am. J. Fish. Mgmt, 5, 283-295.

House, R.A. and Boehne, P.L. (1986) Effects of instream structures on salmonid habitat and populations in Tobe Creek, Oregon, N. Am. J. Fish. Mgmt, 6, 38-46.

Hubbs, C.L., Greeley, J.R. and Tarzwell, C.M. (1932) Methods for the improvement of Michigan trout streams, Bull. Inst. Fish. Res., 1, 1-54.

Hubert, W.A. and Rahel, F.J. (1989) Relations of physical habitat to abundance of four nongame fishes in high-plains streams: a test of habitat suitability index models, N. Am. J. Fish. Mgmt, 9, 332-340.

Huntington, C.W. (1985) Deschutes River spawning gravel study, A.S.F.A 17(7), 9571.

Huet, M. (1959) Profiles and biology of western European streams as related to fish management, Trans. Am. Fish. Soc., 88, 155-163.

Hughes, R.M. and Gammon, J.R. (1987) Longitudinal changes in fish assemblages and water quality in the Willamette River, Oregon, Trans. Am. Fish. Soc., 116, 196-209.

Hughes, R.M., Larsen, D.P. and Omernik, J.M. (1986) Regional reference sites: a method for assessing stream potentials, Env. Mgmt, 10, 629-635.

Hughes, R.M. and Omernik, J.M. (1983) An alternative for characterizing stream size. In

Dynamics of Lotic Ecosystems, edited by T.D.Fontaine and S.M.Bartell, 87-101. Ann Arbor Science, Butterworths.

Hughes, R.M., Whitter, T.R., Rohm, C.M. and Larsen, D.P. (1990) A regional framework for establishing recovery criteria, Env. Mgmt, 14, 673-683.

Hulbert, P.J. (1986) Longevity and maintenance requirements of stream improvement structures in New York waters. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 199-207. Lock Haven Univ.

Hunt, R.L. (1971) Responses of a brook trout population to habitat development in Lawrence Creek, Tech. Bull. Dep. nat. Resour., Wis., 48, 35p.

Hunt, R.L. (1976) A long-term evaluation of trout habitat development and its relation to improving management-related research, Trans. Am. Fish. Soc., 105, 361-364.

Hunt, R.L. (1986) An evaluation of brush bundles and half-logs to enhance carrying capacity of two brown trout streams. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 31-62. Lock Haven Univ.

Hunt, R.L. (1988) A compendium of 45 trout stream habitat development evaluations in Wisconsin during 1953-1985, Tech. Bull. Dep. nat. Resour., Wis., 162, 80p.

Hunter, C.J. (1991) Better Trout Habitat: A Guide to Restoration and Management, Washington: Island Press, 320p.

Hyatt, K.D. and Steer, G.J. (1987) Barkley Sound sockeye salmon (Oncorhynchus nerka): evidence for over a century of successful stock development, fisheries management, research, and enhancement effort. In Sockeye salmon (Oncorhynchus nerka) population biology and future management, edited by H.D.Smith, I.Margolis and C.C.Wood, Can. Spec. Publ. Fish. Aquat. Sci., 96, 435-457.

Inskip, P.D. (1982) Habitat suitability index models: northern pike, U.S. Dep. Int., Fish Wildl. Serv., 40p.

Jester, D.B. and McKirdy, H.J. (1966) Evaluation of trout stream improvement in New Mexico, Proc. West. Ass. Game Fish. Comm., 46, 316-333.

Jones, R.A. (1988) Atlantic salmon restoration in the Connecticut River. In Atlantic Salmon: Planning for the Future, Proc. 3rd Int. Atl. Salm. Symp, Biarritz, edited by D.Mills and D.Piggins, 415-426.

Jutila, E. (1992) Restoration of salmonid rivers in Finland. In River Conservation and Management, edited by P.J.Boon, P.Calow and G.E.Petts, 353-362. Chichester: Wiley.

Karr, J.R. (1981) Assessment of biotic integrity using fish communities, Fisheries, 6, 21-27.

Karr, J.R. (1987) Biological monitoring and environmental assessment: a conceptual

framework. Env. Mgmt, 11, 249-256.

Karr, J.R., Fausch, K.D., Angermeier, P.L., Yant, P.R. and Schlosser, I.J. (1986) Assessing biological integrity in running waters: a method and its rationale. Illinois Spec. Publ, No. 5, 28p.

Karr, J.R. and Schlosser, I.J. (1978) Water resources and the land-water interface. Science, 201, 229-234.

Karr, J.R., Toth, L.A. and Dudley, D.R. (1985) Fish communities of midwestern rivers: a history of degradation, BioScience, 35, 90-95.

Karr, J.R., Yant, P.R. and Fausch, K.D. (1987) Spatial and temporal variability of the index of biotic integrity in three midwestern streams, Trans. Am. Fish. Soc., 116, 1-11.

Keller, E.A. (1976) Channelization: environmental, geomorphic, and engineering aspects. In Geomorphology and Engineering, edited by D.R.Coates, 115-140. Pennsylvania, U.S.A., Dowden, Hutchinson & Ross Inc.

Kelly, J.R. and Harwell, M.A. (1990) Indicators of ecosystem recovery, Env. Mgmt, 14, 527-545.

Kemp, S. (1986) A helping hand, Salm. Trout Mag., 232, 43-45.

Kennedy, G.J.A. (1981) Some observations on the inter-relationships of juvenile salmon (Salmo salar L.) and trout (Salmo trutta L.), Proc. 2nd Brit. Freshwat. Fish. Conf., Liverpool, 143-149.

Kennedy, G.J.A. (1984) Evaluation of techniques for classifying habitats for juvenile Atlantic salmon (Salmo salar L), Atlantic Salmon Trust, Workshop of Salmon Enhancement, 26p.

Kennedy, G.J.A., Cragg-Hine, D., Strange, C.D. and Stewart, D.A. (1983) The effects of a land drainage scheme on the salmonid populations of the River Camowen, Co. Tyrone, Fish. Mgmt, 14, 1-16.

Kerr, K. (1992) Rehabilitation of streams in south-west Germany. In River Conservation and Management, edited by P.J.Boon, P.Calow and G.E.Petts, 321-335. Chichester: Wiley.

Kinsolving, A.D. and Bain, M.B. (1990) A new approach for measuring cover in fish habitat studies, J. Freshwat. Ecol., 5, 373-378.

Klassen, H.D. and Northcote, T.G. (1986) Stream bed configuration and stability following gabion weir replacement to enhance salmonid production in a logged watershed subject to debris torrents, Can. J. For. Res., 16, 197-203.

Klassen, H.D. and Northcote, T.G. (1988) Use of gabion weirs to improve spawning habitat

for pink salmon in a small logged watershed, N. Am. J. Fish. Mgmt, 8, 36-44.

Kober, W.W. and Kehler, S.E. (1986) An analysis of design features in mitigating highway construction impacts on streams. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 221-232. Lock Haven Univ.

Koonce, G.P. and Urbani, J. (1984) Channel bedform manipulation: an alternative to traditional structure oriented stream enhancement methods. Proc. 19th Ann. Mtg. Wyoming Chapt. Col., Am. Fish. Soc., 106-112.

Kozel, S.J. and Hubert, W.A. (1989) Testing of habitat assessment models for small trout streams in the Medicine Bow National Forest, Wyoming, N. Am. J. Fish. Mgmt, 9, 458-464.

Lake, D.J. and Richards, F.P. (1986) Trout habitat enhancement relative to reservoir development planning. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 133-161. Lock Haven Univ.

Landgraf, K.G. (1986) Long term effects of gabion structures of stream bank stabilization, North River, Virginia. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 209-219. Lock Haven Univ.

Lamber, T.R. and Hanson, D.F. (1989) Development of habitat suitability criteria for trout in small streams, Reg. Riv.: Res. & Mgmt, 3, 291-303.

Le Cren, E.D. (1984) The Enhancement of Salmon Stocks. Pitlochry: Atlantic Salmon Trust, 20p.

Lee, K.N. and Lawrence, J. (1986) Adaptive management: learning from the Columbia River Basin fish and wildlife program, Env. Law, 16, 431-460.

Leonard, P.M. and Orth, D.J. (1986) Application and testing of an index of biotic integrity in small, coolwater streams, Trans. Am. Fish. Soc., 115, 401-414.

Lill, A.F. (1981) A perspective of the salmonid enhancement program in British Columbia, Bio-Eng. Symp. Fish Cult (FCS Publ. 1) Am. Fish. Soc., 274-281.

Linfield, R.S.J. (1981) The current status of the major coarse fisheries in Anglia, Proc. 2nd Brit. Freshwat. Fish. Conf., Liverpool, 67-79.

Linfield, R.S.J. (1985) The effect of habitat modification on freshwater fisheries in lowland areas of eastern England. In Habitat Modification and Freshwater Fisheries, edited by J.S.Alabaster, 147-155. London: Butterworths.

Logan, W.D. (1977) Goshute Creek habitat improvement for an endangered subspecies of cutthroat trout, Cal-Neva Wildl. Trans., 1977, 75-79.

Lyons, J. and Courtney, C.C. (1990) A review of fisheries habitat improvement projects in

warmwater streams, with recommendations for Wisconsin, Tech. Bull. Dep. nat. Resour., Wisc., No.169, 34p.

Mann, R.H.K. (1988) Fish and fisheries of regulated rivers in the U.K. Reg. Riv.: Res. & Mgmt, 2, 411-424.

Mann, R.H.K. (1989) The management problems and fisheries of three major British rivers: the Thames, Trent and Wye, Proc. Int. Large Rivers Symp., edited by D.P.Dodge, Can. Spec. Publ. Fish. Aquat. Sci., 106, 444-454.

Marcus, M.D., Young, M.K., Noel, L.E. and Mullan, B.A. (1990) Salmonid-habitat relationships in the Western United States: a review and indexed bibliography, USDA For. Serv., Gen. Tech. Rep., RM-188, 84p.

Matter, W.J. and Mannan, R.W. (1988) Sand and gravel pits as fish and wildlife habitat in the southwest, U.S. Dep. Int. Fish. Wildl. Serv., Res. Publ., 171, 11p.

Maughan, O.E. and Nelson, K.L. (1980) Improving stream fisheries, Water Spectrum, 12, 10-15.

Maughan, O.E., Nelson, K.L. and Ney, J.J. (1978) Evaluation of stream improvement practices in southeastern trout streams, Bull. Va. Polytech. Inst. Wat. Resour. Res. Center, 115, 67p.

McCarthy, D.T. (1985) The adverse effects of channelization and their amelioration. In Habitat Modification and Freshwater Fisheries, edited by J.S.Alabaster, 83-97. London, Butterworths.

McClendon, D.D. and Rabeni, C.F. (1987) Physical and biological variables useful for predicting population characteristics of smallmouth bass and rock bass in an Ozark stream, N. Am. J. Fish. Mgmt, 7, 46-56.

McFadden, J.T. and Cooper, E.L. (1964) Population dynamics of brown trout in different environments, Physiol. Zool., 37, 355-363.

Meffe, G.K. and Sheldon, A.L. (1988) The influence of habitat structure on fish assemblage composition in southeastern blackwater streams, Am. Nat., 120, 225-240.

Mih, W.C. (1978) A review of restoration of stream gravel for spawning and rearing of salmon species, Fisheries, 3, 16-18.

Mih, W.C. and Bailey, G.C. (1981) The development of a machine for the restoration of stream gravel for spawning and rearing of salmon, Fisheries, 6, 16-20.

Miller, D.L., Leonard, P.M., Hughes, R.M., Karr, J.R., Moyle, P.B., Schrader, L.H., Thompson, B.A., Daniels, R.A., Fausch, K.D., Fitzhugh, G.A., Gammon, J.R., Halliwell, B.D., Angermeier, P.L. and Orth, D.J. (1988) Regional applications of an index of biotic integrity for use in water resource management, Fisheries, 13, 12-20.

Mills, D., editor (1991) Strategies for the Rehabilitation of Salmon Rivers, Atl. Salm. Trust, Inst. Fish. Mgmt, Linn. Soc. London, 210p.

Milner, N.J., Scullion, J., Carling, P.A. and Crisp, D.T. (1981) The effects of discharge on sediment dynamics and consequent effects on invertebrates and salmonids in upland Britain, Adv. appl. Biol., 6, 153-220.

Mohn, L.O. and Bugas, P.E. (1986) Stream habitat modification methods for protection and enhancement of fisheries habitat. In 5th Trout Stream Habitat Improvement Workshop, 183-190. Lock Haven Univ.

Murphy, B.D. and Phillips, C.L. (1989) Mitigation measures recommended in Connecticut to protect stream and riparian resources from suburban development. In Practical Approaches to Riparian Resource Management, edited by R.C.Cresswell, Barton, B.A. and Kershaw, K.L., 35 - 39, US Bureau of Land Mgmt,

Naslund, I. (1987) [Effects of habitat improvement on the brown trout (Salmo trutta L.) population of a north Swedish stream], Inf. Soevattenslab., Drottningholm, 28p.

Nunnally, N.R. (1978) Stream renovation: an alternative to channelization, Env. Mgmt, 2, 403-411.

Oberdorff, T. and Hughes, R.M. (in press) Modification of an index of biotic integrity based on fish assemblages to characterize rivers of the Seine basin, France. Hydrobiologia.  
[FULL REFERENCE NEEDED - RHKM ONLY HAS AN M/S]

Overton, K., Brock, W., Moreau, J. and Boberg, J. (1981) Restoration and enhancement program of anadromous fish habitat and populations on Six Rivers National Forest. In Propagation, Enhancement and Rehabilitation of Anadromous Salmonid Populations and Habitat in the Pacific Northwest, edited by T.J.Hassler, 158-168. Arcata, California: Humboldt State Univ.

Owens, O.D. (1986) Porcupines and triangles: restoration of a dredged limestone stream. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 233-238. Lock Haven Univ.

Parkinson, E.A. and Slaney, P.A. (1975) A review of enhancement techniques applicable to anadromous gamefishes, Fish. Mgmt Rep. Brit. Columbia Fish Wildl. Branch, 66, 100p.

Payne, N.F. and Copes, F. (1988) Wildlife and Fisheries Habitat Improvement Handbook, Fish. Wildl. Serv., Washington DC.

Petersen, R.C., Petersen, L.B.-M. and Lacoursière, J. (1992) A building-block model for stream restoration. In River Conservation and Management, edited by P.J.Boon, P.Calow and G.E.Petts, 291-309. Chichester: Wiley.

Platts, W.S. and Nelson, R.L. (1985) Stream habitat and fisheries response to livestock grazing and instream improvement structures, Big Creek, Utah, J. Soil Wat. Conserv., 40, 374-378.

Platts, W.S. and Rinne, J.N. (1985) Riparian and stream enhancement management and research in the Rocky mountains, N. Am. J. Fish. Mgmt., 5, 115-125.

Poff, N.L. and Ward, J.V. (1990) Physical habitat template of lotic systems: recovery in the context of historical pattern of spatiotemporal heterogeneity, Env. Mgmt., 14, 629-645.

Pott, D.B., Pizzimenti, J.J. and Huiting, J.T. (1986) Reversal of habitat degradation in a northern Illinois stream. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 17-29. Lock Haven Univ.

Pott, D.B. and Schellhaass, D. (1986) Rehabilitation of a trout stream, Public Works, June 1986, 90-93.

Reice, S.R., Wissmar, R.C. and Naiman, R.J. (1990) Disturbance regimes, resilience, and recovery of animal communities and habitats in lotic systems, Env. Mgmt., 14, 647-659.

Rosgen, D. and Fittante, B.L. (1986) Fish habitat structure - a selection guide using stream classification. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 163-179. Lock Haven Univ.

Rundquist, L.A., Bradley, N.E. and Jennings, T.R. (1986) Planning and design of fish stream rehabilitation. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 119-132. Lock Haven Univ.

Sale, M.J. (1985) Aquatic ecosystem response to flow modification: an overview of the issues. In Symp. Small Hydropower and Fisheries, Am.Fish. Soc., edited by F.W.Olson, R.G.White and R.H.Hamre, 25-31.

Saunders, J.W. and Smith, M.W. (1962) Physical alteration of stream habitat to improve brook trout production, Trans. Am. Fish. Soc., 91, 185-188.

Schiemer, F. and Waidbacher, H. (1992) Strategies for conservation of a Danubian fish fauna. In River Conservation and Management, edited by P.J.Boon, P.Calow and G.E.Petts, 363-382. Chichester:Wiley.

Schlosser, I.J. (1982) Fish community structure and function along two habitat gradients in a headwater stream, Ecol. Monogr., 52, 395-414.

Schlosser, I.J. (1990) Environmental variation, life history attributes, and community structure in stream fishes: implications for environmental management assessment, Env. Mgmt., 14, 621-628.

Sedell, J.R., Reeves, G.H., Hauer, F.R., Stanford, J.A. and Hawkins, C.P. (1990) Role of refugia in recovery from disturbances: modern fragmented and disconnected river systems, Env. Mgmt, 14, 711-724.

Semple, R.J. (1991) Atlantic salmon habitat survey: enhancement opportunities and problems in the Dunbar Stream, Nashwaak River, New Brunswick, Can. MS. Rep. Fish. Aquat. Sci., No. 2076, 42p.

Shetter, D.S., Clark, O.H. and Hazzard, A.S. (1946) The effects of deflectors in a section of a Michigan trout stream, Trans. Am. Fish. Soc., 76, 248-278.

Sheldon, A.L. (1968) Species diversity and longitudinal succession in stream fishes, Ecology, 49, 193-198.

Shields, F.D. (1983) Design of habitat structures for open channels, J. Wat. Res. Plan. Mgmt, 109, 331-344.

Sims, B.D. and Johnson, L.D. (1985) Structural anadromous fishery habitat improvement on the Siskiyou National Forest. In Riparian Ecosystems and their Management: Reconciling Conflicting Uses, edited by P.R.Johnson, C.D.Ziebell, D.R.Paton, P.F.Ffolliott and R.H.Hamre, 502-504, Pub. Gen. Tech. Rep., Rocky Mt. For. Range Exp. Stn.

Solomon, D.J. (1983) Salmonid enhancement in North America, Atl. Salm. Trust, 40p.

Sparks, R.E., Bayley, P.B., Kohler, S.L. and Osborne, L.L. (1990) Disturbance and recovery of large floodplain rivers, Env. Mgmt, 14, 699-709.

Spotts, D.E. (1986) Standing stock of fishes before and after a channel relocation in Blockhouse Creek, Lycoming County, Pennsylvania. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 85-91. Lock Haven Univ.

Standage, R.W. (1986) Streambank stabilization using geomatrix matting - Simpson Creek, Virginia. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 191-198. Lock Haven Univ.

Statzner, B., Gore, J.A. and Resh, V.H. (1988) Hydraulic stream ecology: observed patterns and potential applications, J. N. Am. Benthol. Soc., 7, 307-360.

Statzner, B. and Higler, B. (1985) Questions and comments on the river continuum concept, Can. J. Fish. Aquat. Sci., 42, 1038-1044.

Steedman, R.J. (1988) Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario, Can. J. Fish. Aquat. Sci., 45, 492-501.

Stolte, W. (1980) Planning as related to the restoration of Atlantic salmon in New England. In Atlantic Salmon: its Future, edited by A.E.J.Went, 135-145. Franham; Fishing Newsbooks.

Stuber, R.J. (1986) Stream habitat improvement evaluation: an alternative approach. In 5th Trout Stream Habitat Improvement Workshop, edited by J.G.Miller, J.A.Arway and R.F.Carline, 153-161. Lock Haven Univ.

Swales, S. (1982) Notes on the construction, installation and environmental effects of habitat improvement structures in a small lowland river in Shropshire, Fish Mgmt, 13, 1-10.

Swales, S. (1982) Environmental effects of river channel works used in land drainage improvement, J. Env. Mgmt, 14, 103-126.

Swales, S. (1988) Fish populations of a small lowland channelized river in England subject to long-term river maintenance and management works, Reg. Riv.: Res. & Mgmt, 2, 493-506.

Swales, S. (1989) The use of instream habitat improvement methodology in mitigating the adverse effects of river regulation on fisheries. In Alternatives in Regulated River Management, edited by J.A.Gore and G.E.Petts, 186-208. Boca Raton, Florida: CRC Press Inc.

Swales, S. and O'Hara, K. (1980) Instream habitat improvement devices and their use in freshwater fisheries management, J. Env. Mgmt, 10, 167-179.

Swales, S. and O'Hara, K. (1983) A short-term study of the effects of a habitat improvement programme on the distribution and abundance of fish stocks in a small lowland river in Shropshire, Fish Mgmt, 14, 135-144.

Tarzwel, C.M. (1936) Experimental evidence on the value of trout stream improvement in Michigan, Trans. Am. Fish. Soc., 66, 177-187.

Tarzwel, C.M. (1938) An evaluation of the methods and results of stream improvement in the southwest, Trans. 3rd N. Am. Wildl. Conf., 339-364.

Taylor, E. (1991) Habitat Improvement Manual, 2nd draft, Report to NRA, 42p.

Taylor, E., Harper, D., Wortley, J. and Smith, C. (1991) Riverbed manipulation in the tidal River Bure (Norfolk, England) using an artificial substratum. SIL Lowland Stream Restoration Int. Workshop, Lund, Sweden. Submitted MS.

Thielke, J. (1985) A logistic regression approach for developing suitability-of-use functions for fish habitat. In Symp. Small Hydropower Fisheries, Am. Fish. Soc., edited by F.W.Olson, R.G.White and R.H.Hamre, 32-38.

Vallipuram, S. and Wortley, J.S. (1990) Acquisition and computation of routine fisheries management data by Anglian Water Authority, England. In Management of Freshwater Fisheries, edited by W.L.T. van Densen, B.Steinmetz and R.H.Hughes, 569-581. EIFAC, Wageningen: Pudoc.

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. and Cushing, C.E. (1980) The river continuum concept, Can. J. Fish. Aquat. Sci., 37, 130-137.

Ward, B.R. and Slaney, P.A. (1981) Further evaluations of structures for the improvement of salmonid rearing habitat in coastal streams of British Columbia. In Propagation, Enhancement and Rehabilitation of Anadromous Salmonid Populations and Habitat in the Pacific Northwest, edited by T.J.Hassler, 99-108. Arcata: Humboldt State Univ.

Ward, J.V. (1982) Ecological aspects of stream regulation: responses in downstream lotic reaches, Wat. Poll. Mgmt Rev. (New Delhi), 2, 1-26.

Webster, J.R., Golladay, S.W., Benfield, E.F., Meyer, J.L., Swank, W.T. and Wallace, J.B. (1992) Catchment disturbance and stream response: an overview of stream research at Coweeta Hydrologic Laboratory. In River Conservation and Management, edited by P.J.Boon, P.Calow and G.E.Petts, 231-253. Chichester: Wiley.

Willis, D.W. and Scalet, C.G. (1989) Relations between proportional stock density and growth and condition of northern pike populations, N. Am. J. Fish. Mgmt, 9, 488-492.

Yount, J.D. and Niemi, G.J. (1990) Recovery of lotic communities and ecosystems from disturbance - a narrative review of case studies, Env. Mgmt, 14, 571-587.

