Evidence: Impacts of dredging

Compiled by Judy England and Lydia Burgess-Gamble

August 2013

This update summarises the current sources of evidence relating to the impacts of dredging. The key findings are:

- **Changing water levels:** Dredging can reduce water levels at some locations but this depends on local conditions and is therefore case specific. It is not clear from the evidence whether we can infer that local reductions in water levels automatically mean a reduction in flood risk. We cannot infer that dredging would automatically prevent out of bank flow from occurring.
- **Increasing risk downstream**: Dredging could in theory speed up flow and potentially increase the risk of flooding downstream. This is fully covered by the existing research.
- **Over-riding effect of impoundments:** Impounding structures such as weirs control water levels on many of our watercourses. In some cases it was found that dredging in impounded watercourses did not reduce water levels since the impounding structures had an over-riding effect on water levels.
- **Artificial channel deepening and the role of catchment management**: Channels which have been artificially deepened by dredging silt-up more frequently as they return to their pre-dredged state. In these situations dredging will be an unsustainable activity since it needs to be repeated regularly. The best approach is to identify the sediment source and address the issue at source rather than treat the impact. For example, sediment runoff from agricultural land could be reduced through changing field ploughing regimes or introducing rural SUDS so preventing it from entering the watercourse and avoiding the need for dredging.
- **Understanding sediment sources:** We have a case study example where a full assessment of sedimentation processes in a catchment have shown that areas of sediment deposition are not correlated with flood risk hot-spots. In Carlisle there was a perception that sedimentation was increasing flood risk, but in this case it was found to be in-stream structures, rather than sedimentation, were increasing flood risk. Additionally one of the sources of sediment was the degraded flood defence walls. This shows that managing sediment in a catchment is complex and that decisions to dredge should be evidence based. The Sediment Matters Handbook may help with assessing the situation.
- **Impacts on ecology**: Dredging can damage ecology by directly affecting its physical habitat, disrupting riverine processes and reduced connectivity with the floodplain. This can prevent the achievement of WFD objectives and could result in the deterioration of status. Direct removal of exposed sediments can impact on specialised species which may be protected (Invertebrates of exposed riverine sediments). Dredging may also make a channel more vulnerable to exploitation by invasive non-native species such as signal crayfish and Himalayan balsam.
- **Sustainable dredging techniques**: If dredging must go ahead then there are more sustainable/targeted ways it can be undertaken to minimise its impact on geomorphology and ecology.
- **Development of self-cleansing channels:** In some cases by not dredging it is possible for the river to become self-cleansing which means future dredging is not needed and impacts upon ecology are reduced.

The evidence listed is not exhaustive so if you come across any additional reports or articles please let us know - Judy England

Copies of journal articles may be available online or if not can be requested through information resources - information.resources@environment-agency.gov.uk of call on 9117 934 4700 (7 12 4700).

Environment Agency evidence:

- Dredging pilot studies: Report and Appendices
- Sediment transport & alluvial resistance in rivers: Report
- River channel maintenance: Guide
- Fluvial design guide: Guide
- Rural sustainable drainage systems (RSuDS): Report and Summary
- River sediment and habitats: Impact of capital works and maintenance: Report, Summary and Recommendations
- Invertebrates of exposed riverine sediments: Phase 1, Phase 2 and Phase 3
- Scoping the environmental impacts of dredging of riverine, estuarine and marine sediments (including commercial dredging and dredging for navigation) and reclamation. Report
- Sediment matters: Handbook

CIRCA (the construction industry research and information association):

- Land use management effects in flood flows and sediments - guidance on prediction (C719): Report

UK Technical Advisory Group on the Water Framework Directive (UKTAG):

- UK environmental standards and conditions: Phase 1, Phase 2
- Recommendations on Surface Water Classification Schemes for the purposes of the Water Framework Directive

Books:

O'Grady, M F (2006). Channels and challenges. The enhancement of salmonid rivers, Irish Freshwater Fisheries Ecology and Management Series: Number 4. Central Fisheries Board, Dublin.

This is a training manual designed to be easily understood by the layman which outlines a number of management options for rivers. The manual first indicates the importance of baseline surveys to understand natural riverine communities and how changes in plant and invertebrate communities can indicate environmental change (such as variation in water quality). The key attributes of healthy rivers for salmonid fish and other fauna and flora are then discussed and examples of damaged riverine habitats and loss of ecological features are provided. Numerous physical management options for different issues likely to be encountered in the riparian zone and in-stream are then described, with diagrams and images indicating the particular measures in operation. Overall this is a very well illustrated and useful guide covering a wide range of options for river management.

Journal articles:

D. E. Barbe, K. Fagot and J. A. McCorquodale 2000 "Effects on dredging due to diversions from the lower Mississippi River" Journal of Waterway Port Coastal and Ocean Engineering-Asce 126 (3): 121-129

This paper presents the development, calibration, and use of a model to analyze the long-term effects on dredging due to freshwater diversions along the lower Mississippi River. The study area includes the Mississippi River from Tarbert Landing, Miss., located at mile 306 above Head of Passes, just downstream of the control structure at Old River, to the Gulf of Mexico by way of Southwest Pass. To determine the extent of the riverine effects, an HEC-6 model was developed. HEC-6 is a numerical model used to predict changes in river profiles due to deposition and scour over a period of time. Modification to the HEC-6 code was necessary to accurately reflect the actual processes occurring in the Mississippi River. An option allowing the reintroduction of dredged material back into the system was added. The calibration, choice of parameters, and results obtained from the model are presented and discussed.

J. R. Bellmore, C. V. Baxter, A. M. Ray, L. Denny, K. Tardy and E. Galloway (2012) "Assessing the Potential for Salmon Recovery via Floodplain Restoration: A Multitrophic Level Comparison of Dredge-Mined to Reference Segments." Environmental Management 49 (3): 734-750

Pre-restoration studies typically focus on physical habitat, rather than the food-base that supports aquatic species. However, both food and habitat are necessary to support the species that habitat restoration is frequently aimed at recovering. Here we evaluate if and how the productivity of the food-base that supports fish production is impaired in a dredge-mined floodplain within the Yankee Fork Salmon River (YFSR), Idaho (USA); a site where past restoration has occurred and where more has been proposed to help recover anadromous salmonids. Utilizing an ecosystem approach, we found that the dredged segment had comparable terrestrial leaf and invertebrate inputs, aquatic primary producer biomass, and production of aquatic invertebrates relative to five reference floodplains. Thus, the food-base in the dredged segment did not necessarily appear impaired. On the other hand, we observed that off-channel aquatic habitats were frequently important to productivity in reference floodplains, and the connection of these habitats in the dredged segment via previous restoration increased invertebrate productivity by 58%. However, using a simple bioenergetic model, we estimated that the invertebrate food-base was at least 4x larger than present demand for food by fish in dredged and reference segments. In the context of salmon recovery efforts, this observation questions whether additional food-base productivity provided by further habitat restoration would be warranted in the YFSR. Together, our findings highlight the importance of studies that assess the aquatic food-base, and emphasize the need for more robust ecosystem models that evaluate factors potentially limiting fish populations that are the target of restoration.

K. E. Bray (1996) "Habitat models as tools for evaluating historic change in the St Marys river Canadian Journal of Fisheries and Aquatic Sciences." 53: 88-98

Two habitat models are applied to long-term data to evaluate changes to physical attributes of fish habitat in the St. Marys River in relation to anthropogenic influences related to dredging; infilling; construction of locks, power canals, and dams; and water regulation. The Instream Flow Incremental Methodology for rainbow trout (Oncorhynchus mykiss) and the caddisfly (Hydropsyche sp.) is used for rapids habitat and the northern pike (Esox lucius) Habitat Suitability Index model for areas of aquatic vegetation. These habitats are also examined for long-term change in area. Results indicate that wetland habitat has been lost because of structural changes in localized areas where the physical stresses of shoreline infilling and urbanization have been concentrated. More extensive losses in rapids habitat occurred and increased fluctuations in habitat suitability because of continuing human influence in the rapids are affecting habitat in the river. Habitat change is probably not the sole cause of reported fish community changes. For example, substantial natural change has occurred because of fluctuations in water levels. However, the application of habitat models can provide a useful benchmark tool in retrospective analyses where a long-term data set exists.

H. Y. Cai, H. H. G. Savenije, Q. S. Yang, S. Y. Ou and Y. P. Lei (2012) "Influence of River Discharge and Dredging on Tidal Wave Propagation: Modaomen Estuary Case" Journal of Hydraulic Engineering-Asce 138 (10): 885-896

Dredging and flow reduction in the Modaomen Estuary in China have had a measurable impact on tidal propagation and damping. This paper includes an assessment of the impacts of these human interventions through the use of a new analytical hydraulic model procedure. The model calculates tidal propagation and damping as a function of bathymetry and river discharge through a simple iterative procedure with explicit analytical equations. The results obtained are accurate and allow both an analysis of the historic development and a sensitivity analysis to assess the effect of possible further dredging and flow reduction. Particularly in the upper reaches of the estuary, tidal damping and wave celerity are sensitive to dredging and flow reduction. Historic analysis shows that due to these activities, since 1993, the tidal amplitude in the Modaomen Estuary has increased by more than 0.1 m, while the travel time of the tidal wave has decreased by 30 min in the middle part of the estuary and up to 80 min in the upper reaches. In the future, the tidal amplitude and the wave celerity will increase even further if flow reduction and dredging continue. Moreover, this development would increase the risk of salinization in the estuary and facilitate the inland propagation of storm surges.

C. Claret, P. Marmonier, M. J. Dole-Olivier and E. Castella (1999) "Effects of management works on the interstitial fauna of floodplain aquatic systems (River Rhone, France)" Biodiversity and Conservation 8 (9): 1179-1204

Long-term changes in composition, structure and biodiversity (i.e. taxonomic richness, diversity index, species traits and habitat-affinity) of interstitial assemblages were studied in two floodplain systems: a restored backwater and an artificial drainage canal. Before restoration, the backwater, affected by both terrestrialisation and eutrophication, was weakly populated by a low diversified fauna dominated by walkers, macrofauna, detritivores, and stygoxenes (i.e. taxa that occur incidentally in ground waters) that reproduce biparentally and lack parental care. This backwater displayed an upstream-downstream gradient in response to restoration works. Upstream, the dredging of fine organic sediments favoured inputs of nutrient-poor groundwater and exchanges between groundwater and surface water that induced an increase in taxonomic richness (in both herbivores and stygoxenes). Downstream the deposition of fine sediment that was suspended in the water column by restoration work enhanced colmation that induced a decrease in herbivore and swimming taxa, and an increase in mesofaunal taxa, whilst phreatobites (i.e. taxa specialized to interstitial life) remained absent from the system. The drainage canal that was artificially hollowed-out to lower the surrounding water table, harbors mixed assemblages of epigean (i.e. taxa of surface-water habitats) and hypogean (i.e. taxa of groundwater habitats) taxa. The upstream part, which is weakly influenced by surface waters, was colonized by phreatobites as oligotrophic conditions increased. The intermediate part, which is fed by surface water and where mesotrophic conditions occurred as habitats progressively matured and diversified, showed diversification of its fauna. The downstream part of the drainage canal displayed the reverse dynamic - this suggests a reduction in groundwater supply due to the clogging of sediment interstices fine sediments, the deposition of which is linked to the Rossillon backwater restoration works.

G. Cook and A. Int Erosion Control (1997) "Dredging the Little Wekiva River: A pilot project Conference 28 of the International-Erosion-Control-Association on Erosion Control and the Environment - Working in Harmony Nashville", Proceedings of conference 28 - international erosion control association.

The Little Wekiva River is located in central Florida, which includes Orange and Seminole counties in the St. Johns River Water Management District. Most of the upper reaches of the river have been channelized to accommodate urban expansion during the late 1960's and early 1970's. Erosion and sedimentation are significant problems that have resulted in degradation of water quality, loss of wetland habitat, and increased flooding. In August of 1995, Seminole County requested an emergency authorization from the district to remove sediment from an area where several homes had flooded and an access bridge had been overtopped by flood waters. Although it was acknowledged that sediment removal was vital to maintaining flood conveyance capacity, there was concern about the environmental integrity of the dredging process. Water quality issues were critical because the dredging operation was to occur approximately one quarter mile upstream of a designated Outstanding Florida Water (waters of special concern). To address these concerns, the scope of the project was limited to the removal of approximately 850 cubic yards of material in a flood prone residential area. The permit required a district engineer to be on site to ensure that the work complied with water quality standards. This monitoring activity included evaluating and assisting in the type and placement of turbidity controls, taking water samples, and approval of the final site stabilization. Prior to dredging, a series of sediment samples was analyzed for constituent pollutants. The work had to be conducted under specified low flow conditions. Although turbidity readings within the work containment area often exceeded state standards, they were never exceeded at the downstream sampling stations, a result of appropriately placed and maintained turbidity controls. This pilot project demonstrated that a carefully conceived and executed dredging process, which includes sediment pollutant analysis, turbidity monitoring, site access and spoil removal logistics, and a final stabilization plan, can result in a successful project without violating water quality standards. The initial results of this project, in addition to longer term monitoring data, will be used for further district study and application as larger, more ambitious projects are proposed.

T. D. Crail, J. F. Gottgens and A. E. Krause (2011) “Fish community response to evolving channel complexity in an agricultural headwater system Journal of Soil and Water Conservation” 66 (5): 295-302

Headwaters in many watersheds in the midwestern United States are often dominated by ditches that are dredged to drain farmland and are maintained as homogeneous channels. These ditches may provide important headwater habitat for fish but are rarely managed as such. With reduced dredging, these ditches tend to stabilize their cross-sectional profile with patchy sediment deposits and plant growth. We tested the impact of such channel complexity on the structure of fish communities in agricultural ditches of the upper Ottawa River (Ohio), a western Lake Erie tributary, by comparing twelve 20 m (66 ft) channel segments with and without such complexity (heterogeneous [Ht] and homogeneous [Hob respectively). Fish communities were sampled at low water with block seines in each site eleven times between June 2005 and October 2006. Temperature, pH, turbidity, dissolved oxygen, conductivity, and discharge were comparable between Ht and Ho segments during each sampling event. A total of 10,843 fish representing 24 species were identified, assessed for spawning condition and age class, and released. In spite of the large variability in fish community metrics over time, Ht habitat had a higher species richness (Ht = 6.56 +/- 0.63, Ho = 4.17 +/- 0.63; p = 0.02), Shannon diversity (Ht = 1.33 +/- 0.12, Ho = 0.90 +/- 0.12; p = 0.03), and number of feeding guilds (Ht = 3.2 +/- 0.20, Ho = 2.2 +/- 0.20; p = 0.01). Fish abundance and Index of Biotic Integrity showed no significant effect for habitat. The community was dominated by tolerant cyprinids (Pimephales promelas and P. notatus) but also contained 1,514 Etheostoma microperca a previously undocumented population and species listed as a "State Species of Concern" in Ohio. The majority (73%) of E. microperca were found in Ht segments. In spite of the prevalence of exotic species in other regional aquatic systems, only 0.7% of the total catch belonged to nonnative species. With the majority of headwaters in the midwestern United.States consisting Of dredged ditches, balancing management for efficient drainage while allowing some level of channel complexity may benefit native fishes and contribute to surprisingly rich communities.

S. E. Darby and C. R. Thorne (1995) “Fluvial maintenance operations in managed alluvial rivers.” Aquatic Conservation-Marine and Freshwater Ecosystems 5 (1): 37-54

Fluvial maintenance is frequently undertaken to preserve the flood capacity, visual amenity, conservation value and geomorphic stability of managed river channels. Maintenance tasks include the management of both riparian and in-channel vegetation and maintenance dredging. 2. Riparian vegetation is traditionally managed by physical methods such as cutting of grasses or removal of trees. Less environmentally severe alternative practices include grazing or shading for grasses, and practices such as pollarding or coppicing for trees. 3. While a range of alternative maintenance practices, with varying environmental impact, are usually available for river managers to select, the potential for improving maintenance practices varies according to the particular task considered and the constraints imposed by the need to reach and maintain the target standard of service in terms of flood defence and land drainage. 4. This review shows that economic and environmental impacts associated with fluvial maintenance operations may be reduced at three scales. First, at the smallest scale, it is shown that there is often potential for improving the local operational efficiency of individual fluvial maintenance tasks. Second, it may be possible to reduce the intensity of maintenance in channel reaches which are presently over-serviced. Third, at the largest scale, it is shown that efficient maintenance is best achieved within the framework of Integrated Basin Management, and by giving appropriate consideration to future maintenance requirements at the design stage of new projects to reduce the overall need for fluvial maintenance. Examples of the way in which these policies may be implemented to reduce environmental impact without compromising engineering objectives are illustrated through case studies from the UK and the USA.

R. G. Darmody, J. C. Marlin, J. Talbott, R. A. Green, E. F. Brewer and C. Stohr (2004) "Dredged Illinois River sediments: Plant growth and metal uptake." Journal of Environmental Quality 33 (2): 458-464

Sedimentation of the Illinois River in central Illinois has greatly diminished the utility and ecological value of the Peoria Lakes reach of the river. Consequently, a large dredging project has been proposed to improve its wildlife habitat and recreation potential, but disposal of the dredged sediment presents a challenge. Land placement is an attractive option. Previous work in Illinois has demonstrated that sediments are potentially capable of supporting agronomic crops due to their high natural fertility and water holding capacity. However, Illinois River sediments have elevated levels of heavy metals, which may be important if they are used as garden or agricultural soil. A greenhouse experiment was conducted to determine if these sediments could serve as a plant growth medium. A secondary objective was to determine if plants grown on sediments accumulated significant heavy metal concentrations. Our results indicated that lettuce (Lactuca sativa L.), barley (Hordeum vulgare L.), radish (Raphanus sativus L.), tomato (Lycopersicon lycopersicum L.), and snap bean (Phaseolus vulagaris L. var. humillis) grown in sediment and a reference topsoil did not show significant or consistent differences in germination or yields. In addition, there was not a consistent statistically significant difference in metal content among tomatoes grown in sediments, topsoil, or grown locally in gardens. In the other plants grown on sediments, while Cd and Cu in all cases and As in lettuce and snap bean were elevated, levels were below those considered excessive. Results indicate that properly managed, these relatively uncontaminated calcareous sediments can make productive soils and that metal uptake of plants grown in these sediments is generally not a concern.

M. De Jonge, C. Belpaire, C. Geeraerts, W. De Cooman, R. Blust and L. Bervoets (2012) "Ecological impact assessment of sediment remediation in a metal-contaminated lowland river using translocated zebra mussels and resident macroinvertebrates." Environmental Pollution 171: 99-108

The present study investigated to what extent accumulated metal levels in aquatic invertebrates can reflect environmental contamination and how these tissue levels can be related to alterations in macroinvertebrate communities in the dredged River Dommel. Metal accumulation was measured in translocated zebra mussels (Dreissena polymorpha) and resident Chironomidae. Furthermore, macroinvertebrate community composition was assessed. Our results indicated that trends of total metal concentrations in surface water of the Dommel in time are reflected well by metal levels in tissue of D. polymorpha. In contrast, sediment-bound metals were the most dominant exposure route for Chironomidae. Alterations in macroinvertebrate community composition were observed during dredging and significant relations between metal levels in invertebrate tissues and ecological responses were found. Our results demonstrated that metal accumulation in both zebra mussels and Chironomidae can be used as an integrated measure of metal bioavailability and to predict ecological effects of metal toxicity on macroinvertebrate communities.

J. A. Freedman and J. R. Stauffer (2013) "Gravel dredging alters diversity and structure of riverine fish assemblages." Freshwater Biology 58 (2): 261-274

1. Human activities affect fish assemblages in a variety of ways. Large-scale and long-term disturbances such as in-stream dredging and mining alter habitat and hydrodynamic characteristics within rivers which can, in turn, alter fish distribution. Habitat heterogeneity is decreased as the natural rifflepoolrun sequences are lost to continuous pools and, as a consequence, lotic species are displaced by lentic species, while generalist and invasive species displace native habitat specialists. Sediment and organic detritus accumulate in deep, dredged reaches and behind dams, disrupting nutrient flow and destroying critical habitat for habitat specialist species. 2. We used standard ecological metrics such as species richness and diversity, as well as stable isotope analysis of d13C and d15N, to quantify the differences in fish assemblages sampled by benthic trawls among dredged and undredged sites in the Allegheny River, Pennsylvania, U.S.A. 3. Using mixed-effects models, we found that total catch, species richness and diversity were negatively correlated with depth ($P < 0.05$), while species richness, diversity and proportion of species in lithophilic (rock-loving) reproductive guilds were lower at dredged than at undredged sites ($P < 0.05$). 4. Principal components analysis and manova revealed that taxa such as darters in brood hider and substratum chooser reproductive guilds were predominantly associated with undredged sites along principal component axis 1 (PC1 and manovaP < 0.05), while nest spawners such as catfish and open

substratum spawners including suckers were more associated with dredged sites along PC2 ($P < 0.05$). 5. Stable isotope analysis of d13C and d15N revealed shifts from reliance on shallow water and benthic-derived nutrients at undredged sites to reliance on phytoplankton and terrestrial detritus at deep-water dredged sites. Relative trophic positions were also lower at dredged sites for many species; loss of benthic nutrient pathways associated with depth and dredging history is hypothesised. 6. The combination of ecological metrics and stable isotope analysis thus shows how anthropogenic habitat loss caused by gravel dredging can decrease benthic fish abundance and diversity, and that species in substratum-specific reproductive guilds are at particular risk. The effects of dredging also manifest by altering resource use and nutrient pathways within food webs. Management and conservation decisions should therefore consider the protection of relatively shallow areas with suitable substratum for spawning for the protection of native fishes.

R. M. Frings, B. M. Berbee, G. Erkens, M. G. Kleinhans and M. J. P. Gouw (2009) "Human-induced changes in bed shear stress and bed grain size in the River Waal (The Netherlands) during the past 900 years." Earth Surface Processes and Landforms 34 (4): 503-514

Human impact has changed the flow characteristics and bed-sediment characteristics of lowland rivers, affecting channel stability, flood risk, navigability and biodiversity. We analysed the effect of human activities on the flow and bed-sediment characteristics of the River Waal (The Netherlands). The objectives were: (a) to reconstruct the historical change in bed shear stress during the past 900 years; (b) to reconstruct the contemporary change in bed grain size; and (c) to identify the main causes of these changes. Various data types were used, such as borehole descriptions, historical river maps and modern hydraulic data. It was found that the bed shear stress in the River Waal strongly increased during the past 900 years. In the same period, the gravel content of the sandy river bed increased, causing a coarsening of the river bed. Before AD 1870 the shear stress increase and bed coarsening were mainly due to embankment (artificial levee construction). After AD 1870, the shear stress increase and bed coarsening were mainly due to river narrowing and dredging. The systematic grain-size difference between present-day and historical rivers should be taken into account in river restoration projects.

F. Gob, G. Houbrechts, J. M. Hiver and F. Petit (2005) "River dredging, channel dynamics and bedload transport in an incised meandering river (the River Semois, Belgium) River Research and Applications." 21 (7): 791-804

Dredging in the rivers of the Ardenne is generally carried out on a smaller scale to that described in the literature and is not conducted for commercial purposes. Extractions within the river channel are made in order to prevent flooding; hence the quantity of gravel extracted is limited. This study aims to evaluate the impact of dredging and the resilience of the riverbed in the Semois. This river is found in the south of the Ardenne region and is characterized by large incised meanders, a narrow flood-plain, few pebble bars, numerous bedrock outcrops and a limited stock of sediment. The bed is particularly flat and shallow and the bankfull discharge (130 m(3) s(-1)) is frequently attained (0.9 yr). Pebble tracers allowed the critical parameters (discharge, Shields criterion, and stream power), the diameter of mobilized sediment and the distance of sediment transport to be determined. A major dredging campaign resulted in the formation of a channel nearly I km long and 2 m deep which functioned as a sediment trap. Topographical cross-sections made before and after the dredging campaign and again 4 yr later allowed bedload discharge to be estimated (1.1 t km(-1) yr(-1)). In order to examine the efficiency of the sediment trap, the sediment transport equations of Meyer-Peter and Muller, Schoklitsch, Bagnold and Martin were applied. With the exception of Bagnold's equation (1980), the observed transport values and those calculated theoretically are relatively close. Between October 1997 and June 2001, 5010 t were caught in the sediment trap. For the same period the equations calculate values between 6147 and 10571 t. The overestimation from the theoretical calculations may result from a lack of sediment supply due to the characteristics of the basin and the frequency and magnitude of flood events during the study period. From the magnitude of the sediment transport rate, a return to the initial state of the riverbed (before dredging) may be expected after approximately 10 yr. Despite the scale of the dredging campaign for a river of this size, its results are limited in terms of flood prevention.

A. M. Gurnell, J. M. O'Hare, M. T. O'Hare, M. J. Dunbar and P. M. Scarlett (2010) "An exploration of associations between assemblages of aquatic plant morphotypes and channel geomorphological properties within British rivers." Geomorphology 116 (1-2): 135-144

Riparian vegetation, particularly trees and shrubs, can play a crucial role in the construction and turnover of fluvial landforms, but aquatic plants may also act as river ecosystem engineers. Macrophyte and environmental data from 467 British river reaches are used to explore associations between aquatic plant morphotypes and the physical characteristics of the reaches. The abundance of five plant morphotypes (mosses, linear-submerged, patch-submerged, linear emergent, branched emergent) is estimated for each river reach. Cluster analysis is applied to the abundances of the five morphotypes across the 467 reaches to identify six typical assemblages or clusters of the morphotypes. These clusters are found to be associated with statistically significantly different values of seven physical variables (altitude, slope, median annual flood discharge, channel width, mean bed sediment size, percentage cover of sand and silt on the river bed, and unit stream power). Associations between the morphotype clusters and combinations of the physical variables are explored using Canonical Correspondence Analysis and standard slope-discharge-sediment calibre-channel style graphs. Several of the morphotype clusters are discriminated by unit stream power and bed sediment size. In particular, morphotype clusters dominated by emergent and submerged macrophytes are associated with granules, sand, and finer bed sediments and are rarely found where unit stream power exceeds 100 W m(-2). One cluster characterised by branched emergent species with relatively low cover of submerged morphotypes is confined to sites with unit stream power below 20 W m(-2); and another cluster characterised by linear emergents with low cover of submerged morphotypes is associated with particularly extensive, fine bed sediments, suggesting possible smothering of submerged plants. In contrast, mosses reach their highest abundance in two clusters associated with the highest unit stream power and coarsest bed sediments, with the patch-submerged morphotype reaching relatively high abundance in the slightly lower energy cluster of these two. British rivers have been modified over hundreds of years such that the sample of study reaches have predominantly single-thread channels. However, the plotting positions of these reaches on established graphs describing slope-discharge-sediment calibre-channel style associations, illustrates the potential of some of these sites to develop wandering or braided forms and, in lower energy situations, the potential for aquatic plants to trap fine sediments and contribute to landform building and channel change if maintenance (cutting and dredging) of the emergent and submerged morphotypes were reduced.

C. P. Henry and C. Amoros (1996) "Are the banks a source of recolonization after disturbance: An experiment on aquatic vegetation in a former channel of the Rhone river." Hydrobiologia 330 (2): 151-162

Are the banks a source of recolonization after disturbance: An experiment on aquatic vegetation in a former channel of the Rhone river 0018-8158 WOS:A1996VM48300008 Recolonization of vegetation on 1 m(2) quadrats was surveyed after a major disturbance induced by a restoration experiment, carried out by dredging in a former river channel. Various spatial and temporal patterns of recolonization were determined by the analysis of vegetation (re-)establishment on adjacent quadrats located along transects from one bank to the other in several zones. Most species, except emergent species that remained on bank quadrats (e.g. Phalaris arundinacea), initially (re-)established on the banks and later expanded towards the center of the channel (e.g. Callitriche platycarpa). Several species (re-)established simultaneously on both bank and center quadrats, and this in all three zones (e.g. Nasturtium officinale, Potamogeton pusillus). This suggests that the fine sediment contains a propagule bank. New species (not observed prior to restoration) generally established on the center quadrats first (e.g. Groenlandia densa), suggesting immigration via propagule drift. At the channel scale, several species (re-)established first upstream and then downstream (e.g. Nasturtium officinale), confirming the role of propagule drift from upstream habitats. Few species (re-)established downstream first (e.g. Callitriche platycarpa). Recolonization patterns of dominant species (location and timing of (re-)establishment) are related to biological traits such as the efficiency and means of reproduction.

S. Hossain, B. D. Eyre and L. J. McKee (2004) "Impacts of dredging on dry season suspended sediment concentration in the Brisbane River estuary, Queensland, Australia." Estuarine Coastal and Shelf Science 61 (3): 539-545

Extensive dredging in the Brisbane River estuary since European settlement has significantly altered estuarine hydrological and sediment transport processes. A large tidal ingress resulting from extensive dredging in the lower Brisbane River estuary and gravel extraction including point and non-point inputs in the upper estuary are currently maintaining two distinct turbidity maximum zones within the estuary: at the mouth (100-150 mg/L) and at about 60 km upstream (> 300 mg/L). In addition, extensive dredging has also increased Brisbane estuary dry season flushing time significantly (> 300 days) and as a consequence the estuary is currently unable to flush any point and non-point inputs beyond 35 km upstream from its mouth during the entire dry season resulting in a very high suspended sediment (SS) concentration all along the estuary except an area between two turbidity zones. In general, this work shows strong ramifications of dredging estuaries in other parts of the world, which are currently facing increased pressure from urbanisation and navigation requirements in conjunction with industrial developments.

R. B. Jacobson, D. W. Blevins and C. J. Bitner (2009) "Sediment regime constraints on river restoration-An example from the Lower Missouri River." In L. A. James, S. L. Rathburn and G. R. Whittecar "Management and Restoration of Fluvial Systems with Broad Historical Changes and Human Impacts." Geological Society of America Special Papers 451: 1-22

Dammed rivers are subject to changes in their flow, water-quality, and sediment regimes. Each of these changes may contribute to diminished aquatic habitat quality and quantity. Of the three factors, an altered sediment regime is a particularly unyielding challenge on many dammed rivers. The magnitude of the challenge is illustrated on the Lower Missouri River, where the largest water storage system in North America has decreased the downriver suspended-sediment load to 0.2%-17% of predam loads. In response to the altered sediment regime, the Lower Missouri River channel has incised as much as 3.5 m just downstream of Gavins Point Dam, although the bed has been stable to slightly aggrading at other locations farther downstream. Effects of channel engineering and commercial dredging are superimposed on the broad-scale adjustments to the altered sediment regime. The altered sediment regime and geomorphic adjustments constrain restoration and management opportunities. Incision and aggradation limit some objectives of flow-regime management: In incising river segments, ecologically desirable reconnection of the floodplain requires discharges that are beyond operational limits, whereas in aggrading river segments, small spring pulses may inundate or saturate low-lying farmlands. Lack of sediment in the incising river segment downstream of Gavins Point Dam also limits sustainable restoration of sand-bar habitat for bird species listed under the Endangered Species Act. Creation of new shallow-water habitat for native fishes involves taking sediment out of floodplain storage and reintroducing most or all of it to the river, raising concerns about increased sediment, nutrient, and contaminant loads. Calculations indicate that effects of individual restoration projects are small relative to background loads, but cumulative effects may depend on sequence and locations of projects. An understanding of current and historical sediment fluxes, and how they vary along the river, provides a quantitative basis for defining management constraints and identifying opportunities.

B. R. Kaenel and U. Uehlinger (1999) "Aquatic plant management: ecological effects in two streams of the Swiss Plateau." Hydrobiologia 415: 257-263

Effects of plant removal on habitat conditions, stream metabolism and benthic invertebrates were studied in two macrophyte-rich streams (Chriesbach, Muhlibach) of the Swiss Plateau. We monitored a control reach (no treatment) and two impact reaches (removal of plants by cutting or dredging) in each stream. Sampling was conducted during a 2-4 month period before and a 9 month period after the removal of 84-94% of the plant biomass. Oxygen concentrations were continuously recorded for 3-4 months. Plant removal decreased water depth and increased current velocity. The total number of invertebrates decreased by about 65%. Plant cutting mainly affected taxa that used macrophytes as habitat. Highly mobile taxa and taxa living on or within the bed sediment were less affected. Invertebrate densities recovered within 4-6 months. The removal of plants resulted only in a moderate increase in nocturnal oxygen concentrations. In the stream where plants were cut in spring, macrophytes recovered within the same growing season. In the other stream, where plant growth started later, plants were cut in summer and no recovery of plants occurred until the following spring.

T. M. Koel and K. E. Stevenson 2002 “Effects of dredge material placement on benthic macroinvertebrates of the Illinois River.” Hydrobiologia 474 (1-3): 229-238

Since the 1930s, dredge material has been removed from the Illinois River and placed along the main channel border in shallow depths to maintain a 2.7 m deep main channel for commercial navigation. Placement of this material changes the sediment composition from primarily silt/clay to primarily sand, and it buries pre-existing benthic invertebrates. During 1997 and 1998, the benthos of an 125 km reach of the middle Illinois River (La Grange Reach) was studied by extracting 1065 Ponar samples from randomly-selected sites which had never received dredge material, received dredge material one year previous, or received dredge material during the current year. Although total numbers of macroinvertebrates collected was lower in 1998 than in 1997, relative abundances of eight targeted taxa were highly similar between years. Chironimidae were most abundant and comprised >66% of all macroinvertebrates collected both years. Differences in densities of Chironomidae, Ephemeroptera, Sphaeriidae, Corbicula fluminea (Muller, 1774), Dreissena polymorpha (Pallas, 1771), Odonata, and Gastropoda among the three classes of dredge material placement were all significant (P< 0.05). For all taxa, densities were highest at sites that had never received dredge material; and, for all taxa except Chironimidae, densities were lowest at sites that received dredge material during the current year. No significant recovery by macroinvertebrates was noticed on dredge areas of this reach after one year (P>0.05). Future operations to maintain a channel for navigation should consider preexisting densities of macroinvertebrate taxa. Because benthic macroinvertebrates are an important component of the food web and shifting sand does not support diverse macroinvertebrate communities, strategic placement of dredge material by avoiding islands or other areas of high macroinvertebrate diversity could improve overall system productivity and biotic integrity of large river-floodplains.

G. M. Kondolf (1994) “Geomorphic and environmental effects of instream gravel mining.” Landscape and urban planning. 28 (2-3): 225-243.

Instream gravel mining involves the mechanical removal of gravel and sand directly from the active channel of rivers and streams. Active channel deposits are desirable as construction aggregate because they are typically durable (weak materials having been eliminated in river transport), well-sorted, and frequently located near markets or on transportation routes. Instream gravel mining commonly causes incision of the channel bed, which can propagate upstream and downstream for kilometers. As a result, bridges and other structures may be undermined, spawning gravels lost and alluvial water tables lowered. In analyzing the effects of instream gravel mining, a sediment budget analysis sheds light on the relative magnitude of gravel supply, transport and extraction. Computer models of sediment transport are simplifications of complex natural processes; they can be useful components of a sediment budget analysis but should not be relied upon alone. A historical analysis of channel change and sediment supply is needed to understand the underlying processes responsible for present conditions. While instream gravel mining can be a useful tool in flood control and river stabilization in aggrading rivers, most rivers in the developed world (certainly the vast majority below reservoirs) are not aggrading and are more prone to incision-related effects of instream gravel mining

P. Laffaille, A. Baisez, C. Rigaud and E. Feunteun (2004) “Habitat preferences of different European eel size classes in a reclaimed marsh: A contribution to species and ecosystem conservation Wetlands” 24 (3): 642-651

Habitat preferences of different European eel size classes in a reclaimed marsh: A contribution to species and ecosystem conservation 0277-5212 WOS:000224309600014 Freshwater reclaimed marshes along the European Atlantic coast are highly suitable for European eels (Anguilla anguilla). However, European eel stocks have declined, and the coastal marshes have been subjected to major disturbances. The objective of our study was to analyze the processes governing patterns of European eel microhabitat distribution of four eel size classes (from <160 mm to >360 mm) in a reclaimed marsh (France). Analyses were conducted using artificial neural network (ANN) techniques and ecological profiles. Our ANN results showed that eel densities were significantly related to three major influencing variables: the width of ditch section, the silt depth, and the density of emergent plants. Such ecological profiles were significantly different between small (<240 mm) and large eels (>360 mm): small eels were more widespread than large eels. Large eels were absent or at low densities in shallow ditches with a high aquatic plant cover obstructing the water column and a large quantity of silt. These characteristics seem to define the ditches not directly connected with the main river where dredging operations were rare. Management of regular dredging operations in the channels by maintaining a mosaic of permanent aquatic habitats and avoiding the heavy silt loads in most ditches should be promoted. This dredging operation was probably one of the most promising ways for restoring inland eel stocks.

J. Y. Lee, S. Lee, S. Woo and D. H. Shin (2011) "Framework of the approximate cost estimating model for river dredging construction Ksce." Journal of Civil Engineering 15 (1): 33-42

Recently, construction on the Four River Restoration Project began in South Korea. The project includes the maintenance of river embankments, the development of river areas, and river dredging. Accordingly, considerable attention is being paid to the necessary budget and estimation of construction costs. However, only a few studies have been carried out for the cost estimation of construction projects for river development or maintenance. In particular, approximate construction cost estimations for river dredging have not been studied. The lack of sufficient studies on estimating the approximate construction cost of river dredging has caused some doubt about the validity of the project's estimated construction cost. This study proposes a framework of an approximate cost estimating model for river dredging construction. For this purpose, the construction operation process, type of river section, and the combination of equipment employed for river dredging were analyzed from the historical data of river dredging projects conducted in South Korea. The appropriateness of the analysis was examined through interviews with experts in the field. The framework of the approximate cost estimating model for river dredging construction proposed in this study provides a basis from which to develop a more accurate construction cost estimation of river dredging at the planning stage.

M. Licursi and N. Gomez (2009) "Effects of dredging on benthic diatom assemblages in a lowland stream." Journal of Environmental Management 90 (2): 973-982

The objective of this study was to assess the effects of dredging on the structure and composition of diatom assemblages from a lowland stream and to investigate whether the response of diatom assemblages to the dredging is also influenced by different water quality. Three sampling sites were established in Rodriguez Stream (Argentina); physico-chemical variables and benthic diatom assemblages were sampled weekly in spring 2001. Species composition, cell density, diversity and evenness were estimated. Diatom tolerance to organic Pollution and eutrophication were also analyzed. Differences in physico-chemical variables and changes in benthic diatom assemblages were compared between the pre- and post-dredging periods using a t-test. Data were analyzed using Principal Components Analysis (PCA), non-metric Multidimensional scaling (MDS) ordination and cluster analysis. The effects of dredging in the stream involve two types of disturbances: (i) in the stream bed, by the removal and destabilization Of the Substrate and (ii) in the water column, by generating chemical changes and an alteration of the light environment of the stream. Suspended solids, Soluble reactive phosphorus and dissolved inorganic nitrogen were significantly higher in post-dredging periods. Physical and chemical modifications in the habitat of benthic diatoms produced changes in the assemblage: diversity and species numbers showed an immediate increase after dredging, decreasing at the end of the study period. Changes in the tolerance of the diatom assemblage to organic pollution and eutrophication were also observed as a consequence of dredging; in the post-dredging period sensitive species were replaced by either tolerant or most tolerant species. These changes were particularly noticeable in site 1 (characterized by its lower amount of nutrients and organic matter previous to dredging), which showed an increase in the amount of nutrients and oxygen demand as a consequence of sediment removal. However, these changes were not so conspicuous in sites 2 and 3, which already presented a marked water quality deterioration before the execution of the dredging works.

P. P. Maron, D. E. Reeve, D. Rihouey and J. Dubranna (2008) "Transverse and longitudinal eigenfunction analysis of a navigation channel subject to regular dredgings: The Adour River mouth, France." Journal of Coastal Research 24 (1A): 206-215

The Adour river mouth is located in Anglet, on the southwest coast of France, and it provides access to the commercial harbour of Bayonne. The navigation channel suffers from a recurring problem of silting and needs regular dredging. The construction of breakwaters and jetties has not solved the silting problem. Recently, a preventive trench was dug south of the channel to decrease the rate of siltation in the navigation channel. Bathymetric data of the river mouth were monitored for 26 mo, and 40 bathymetric sets of data were analysed. During the investigation period, four dredging campaigns were carried out. The surveys provide a very unusual bathymetric record because the sampling in time is extremely dense for such data. Eigenfunction analysis was performed along transects perpendicular and parallel to the direction of the river flow. These analyses are usually used to explain natural bathymetric or topographic evolutions. Here, there are also used to describe anthropogenic influences. The first spatial eigenfunction corresponds approximately to the mean bathymetry over the study period. It does not show the preventive trench. This demonstrates that the trench is an ephemeral feature of the bathymetric record. The subsequent eigenfunctions represent the variations about the mean. The second eigenfunction explains the majority of the seabed evolution and reaches a maximum amplitude at the location of the preventive trench. The corresponding temporal eigenfunction presents important discontinuities during the dredging campaigns; its maximum amplitudes correspond to the maximum siltation, and its minimum amplitudes correspond to the dredging periods. A two dimensional empirical eigenfunction analysis confirmed that there was little evidence for any directional bias in the seabed evolution. In conclusion, this study shows that empirical eigenfunction analysis methods can be a helpful tool for analysing the impact of dredging activities and could have a useful role in estuarine management planning.

G. T. McCabe, S. A. Hinton and R. L. Emmett (1998) “Benthic invertebrates and sediment characteristics in a shallow navigation channel of the lower Columbia River, before and after dredging.” Northwest Science 72 (2): 116-126

Little is known about the impact of dredging on benthic invertebrates in navigation channels of the lower Columbia River. To help fill this informational void, we conducted benthic invertebrate and sediment studies in a shallow navigation channel in the river before and after dredging. Benthic invertebrate and sediment samples were collected with a 0.1-m(2) Van Veen grab sampler at seven stations in the Wahkiakum County Ferry Channel, Washington (River Kilometer 70), and at an upstream reference area in 1993-1995. No significant effects ($P > 0.05$) of the ferry channel dredging project on Corbicula fluminea, Ceratopogonidae larvae, Corophium spp., or total benthic invertebrate densities were detected in the statistical analysis, although benthic invertebrate densities were significantly different ($P < 0.05$) between surveys and areas for some organisms. During all eight surveys, Corbicula fluminea, Corophium spp., and Ceratopogonidae (Diptera) larvae were generally the most common benthic invertebrates in both the ferry channel and the reference area. Two measures of community structure, Diversity (H) and Equitability (E), were calculated for each area for each survey. No significant effects ($P > 0.05$) of the ferry channel dredging project on the benthic invertebrate community structure, as measured by H and E, were detected. No significant effects ($P > 0.05$) of the ferry channel dredging project on sediment median grain size or percent volatile solids were detected. Results from this study will provide information to aquatic resource agencies that assess the potential environmental effects of dredging in similar habitats of the lower Columbia River.

A. C. Miller and B. S. Payne (2004) “Reducing risks of maintenance dredging on freshwater mussels (Unionidae) in the Big Sunflower River, Mississippi.” Journal of Environmental Management 73 (2): 147-154

In response to proposed dredging in a 122-km reach of the Big Sunflower River, Mississippi, we studied freshwater mussels (family: Unionidae) using qualitative, semi-quantitative, and quantitative (0.25 m(2) total substratum removal) methods in 1987, 1993, 1994, 2001, 2002, and 2003. Our objectives were to identify important mussel resources, to devise methods for minimizing dredging risks, and to identify habitat improvement features. Approximately 60% of the fauna was located on two high-density shoals characterized by extreme dominance of the commercially valuable threeridge (Amblema plicata). Shallow nearshore and main channel areas comprised approximately 10 and 88% of the aquatic habitat in the project area; however, these areas were of less importance for mussels and supported densities of approximately 5 and 0.5 individuals/m(2), respectively. Throughout the project area the mussel fauna exhibited little or no evidence of recent recruitment, dominance of relatively few species (either A. plicata, or the bank climber Plectomerus dombeyanus), and low species diversity (H) and evenness. No federally listed endangered or threatened mussels were found, although the pyramid pigtoe (Pleurobema pyramidatum), a species listed as endangered in Mississippi, was collected in and upstream of the project area. Two other state-listed species, Plethobasus cyphyus (sheepnose) and Quadrula cylindrica (rabbitsfoot), were only found on gravelly shoals upriver of the project area. Maintenance plans were redesigned to minimize environmental damage; a hydraulic cutterhead dredge will be used in most of the mainstem to reduce risk to nearshore habitats. High-density assemblages on four shoals will not be dredged and 150 and 100 in buffer zones will be left immediately up and downriver. Enhancements for aquatic biota will be created with gravel substratum and wing dams.

J. Morin, P. Boudreau, Y. Secretan and M. Leclerc (2000) "Pristine Lake Saint-Francois, St. Lawrence River: Hydrodynamic simulation and cumulative impact." Journal of Great Lakes Research 26 (4): 384-401

Lake Saint-Francois is a fluvial lake of the St. Lawrence system which is used for hydropower production and commercial navigation. For 150 years, it was dredged and dammed regularly without any impact analysis being made. The cumulative impact of dredging and damming on large rivers such as the St. Lawrence is an issue with only qualitative answers. Bidimensional hydrodynamics was used to simulate ancient flow conditions and to produce quantitative descriptors. Two Numerical Field Models (NFM) were prepared, one representing present state geometry, which contains 300,000 sounding points, and the other representing pristine stare, based on 1900 and 1870 measurements and containing 70,000 soundings. These two NFMs were compared, showing important changes in the morphology of the lake. The NFMs were then used for bidimensional hydrodynamic simulations of both actual and pristine states for 3 different discharges: 5,000 m(3)/s, 7,500 m(3)/s, and 10,000 m(3)/s. Results highlight the cumulative physical transformation of the system. Hydrodynamic simulations and velocity differences show an increase of velocities over shoals for discharge under 8,800 m(3)/s, and a decrease of velocities in deeper water for the same range of discharge. Dredging and straightening around Cornwall Island resulted in changes from 64% to 71% of the total river flow passing through the south channel while the flow in the north channel decreased from 36% to 29%. These hydrodynamic transformations had a definitive impact on sedimentation and most probably on aquatic plans distribution.

M. L. Pedersen (2009) "Effects of channelisation, riparian structure and catchment area on physical habitats in small lowland streams." Fundamental and Applied Limnology 174 (1): 89-99

Rivers and streams form a longitudinal network in which physical conditions and biological processes change through the river system. Geomorphology, topography, geology and hydraulic conditions change from site to site within the river system, thereby creating a complex network of reaches that are dominated by a hierarchy of physical processes. The complexity is further enhanced by local human alteration of the physical structure, natural processes and alteration of the riparian areas. The aim of the Study was to analyse variations in land use and riparian characteristics along small Danish streams and to determine the effect of channelisation on physical habitats, Physical stream characteristics were measured in 149 stream small and medium sized Danish streams (catchment area: 0.1 to 67.2 km(2)). The measured physical parameters included discharge, stream slope, width, depth, Current velocity, Substrata and coverage of macrophytes. Riparian land use, valley form and information on channelisation and channel dredging were also collected. Small headwater streams were either dominated by forests or semi-natural land use. In contrast, the riparian areas of the streams in the larger streams were dominated by agricultural or semi-natural / meadow land use. The results suggest that a combination of within-system variations in geomorphological, hydrological and geological conditions as well as human alterations of the natural environment in small Danish catchinents facilitate discontinuous changes to the stream bed substrata and in-stream habitats. The physical habitats and substratum characteristics of the channelised streams were significantly different from the structure in natural streams unaffected by physical modifications. Riparian land use and valley form potentially influence the degree of channelisation, i.e. a confined and steep valley (V-shaped) is less likely to be used for agricultural production compared to a broad valley. The results are useful to water managers, who seek to identify natural and impacted physical conditions in large river systems. Pedersen, Morten Lauge

M. L. Pedersen, N. Friberg and S. E. Larsen (2004) "Physical habitat structure in Danish lowland streams." River Research and Applications 20 (6): 653-669

Dredging or channelization has physically modified the majority (90%) of the 64 000 km of Danish stream network with substantial habitat degradation as a result. Analyses of physical habitat structure in streams, biota, catchment features and regional differences in hydrology, topography and geology have never been carried out in Denmark. Therefore, there is little knowledge of processes, interactions and patterns across the different scales. Physical habitats, catchment parameters and macroinvertebrates were sampled at 39 sites in three major river systems during summer and winter 1993. In-stream physical conditions and catchment attributes affect the physical habitat structure in Danish lowland streams. Local differences in hydrology, land use, catchment topography and soil types correlated to the in-stream physical habitat parameters. Local differences in hydrology and topography resulted in a separation of the Sus (a) over circle streams with respect to physical habitats. Mud deposition was pronounced at sites with low discharge and low near-bed current velocity. Low mud cover was primarily associated with streams with high discharge located in pristine catchments. Stability in the streams was therefore closely linked to in-stream deposition of fine sediment. Generally, macroinvertebrate community diversity increased as discharge increased. Mud cover negatively affected macroinvertebrate diversity and EPT taxon richness. Regional physical habitat structure and macroinvertebrate community structure were primarily associated with local variations in hydrology, geology and topography. Low-energy streams were primarily located in the Sus (a) over circle river system and the high-energy streams in the Guden (a) over circle and Stor (a) over circle river systems, leading to extensive deposition of mud during summer. Streams in the Sus (a) over circle river system generally had lower diversity and species richness compared to the streams in the Guden (a) over circle and Stor (a) over circle river systems. Hydraulic conditions and substratum dynamics in streams are important when managing lowland streams. This study therefore analysed interactions and parameter correlations between physical habitats, stream stability and catchment attributes as well as macroinvertebrate community structure across multiple scales.

T. C. M. Pedersen, A. Baattrup-Pedersen and T. V. Madsen (2006) "Effects of stream restoration and management on plant communities in lowland streams." Freshwater Biology 51 (1): 161-179

We evaluated restoration success on macrophyte species diversity and composition in lowland streams using communities in 30 naturally meandering stream reaches in the western part of Jutland, Denmark, as reference target communities. Fuzzy set clustering was used to examine the floristic and environmental similarity among reaches, whereas fuzzy set ordination was used to relate floristic patterns to environmental variables. 2. Two major groups of streams were identified based on their floristic composition. One group consisted of reference and restored reaches and the other of the majority of channelised reaches. We found that management exerted a strong influence on the macrophyte communities and that the identified groups were related to differences in management intensity. 3. Our results also indicate that bank morphology and bed level affected macrophyte communities in the streams, particularly the richness and abundance of terrestrial species. The analyses performed suggest that shallow and wide banks allow for a larger migration of species from the stream banks into the streams, thereby enhancing species diversity within the stream channel. 4. The results of this study suggest that macrophyte communities in channelised lowland streams can recover following restorative interventions given that stream management (i.e. weed cutting and dredging) is minimised and that stream banks are reprofiled to improve the lateral connectivity between the stream and its valley.

Romagnoli R, Doody JP, VanDewalker HM, Hill SA (2002) "Environmental dredging effectiveness: lessons learned." In: Porta A, Hinchee RE, Pellei M (eds) "Management of contaminated sediment." Battelle Press, Columbus, pp 181–188

Throughout the United States and abroad, environmental dredging is often considered as a potential remedial alternative for contaminated sediment sites. Despite this fact, only about 50 sediment removal projects (environmentally related) have been completed within the United States through the year 2000 - the majority of which targeted less than 50,000 cubic yards (cy) of material. In addition to this, sufficient pre-/post-monitoring data have not routinely been collected as part of these projects; consequently, the amount of monitoring data available is somewhat limited. Although adequate monitoring data have not been captured from most of the environmental dredging sites, there are several exceptions - exceptions that could serve as a model for future endeavors. Specifically, a handful of dredging projects (mostly associated with the removal of PCB-containing sediments) implemented intensive monitoring activities as part of the overall operation. Two of these projects (Grasse River and Fox River, USA) are evaluated herein. The purpose of this evaluation is to understand the usefulness of environmental monitoring programs, and to explore some of their more significant findings.

G. A. Skilleter, A. Pryor, S. Miller and B. Cameron (2006) "Detecting the effects of physical disturbance on benthic assemblages in a subtropical estuary: A Beyond BACI approach." Journal of Experimental Marine Biology and Ecology 338 (2): 271-287

The effects of dredging on the benthic communities in the Noosa River, a subtropical estuary in SE Queensland, Australia, were examined using a 'Beyond BACF experimental design. Changes in the numbers and types of animals and characteristics of the sediments in response to dredging in the coarse sandy sediments near the mouth of the estuary were compared with those occurring naturally in two control regions. Samples were collected twice before and twice after the dredging operations, at multiple spatial scales, ranging from metres to kilometres. Significant effects from the dredging were detected on the abundance of some polychaetes and bivalves and two measures of diversity (numbers of polychaete families and total taxonomic richness). In addition, the dredging caused a significant increase in the diversity of sediment particle sizes found in the dredged region compared with elsewhere. Community composition in the dredged region was more similar to that in the control regions after dredging than before. Changes in the characteristics of the sedimentary environment as a result of the dredging appeared to lead to the benthic communities of the dredged region becoming more similar to those elsewhere in the estuary, so dredging in this system may have led to the loss or reduction in area of a specific type of habitat in the estuary with implications for overall patterns of biodiversity and ecosystem function.

L. M. Smith and B. R. Winkley (1996) "The response of the Lower Mississippi River to river engineering Engineering" Geology 45 (1-4): 433-455

An examination of the response of the Lower Mississippi River (LMR) to a variety of engineering activities is presented through the discussion of: (a) a brief history of engineering investigations and activities on the LMR; (b) the impact of artificial cutoffs on the channel geometry and water surface profiles of adjacent reaches; (c) the impact of channel alignment activities on channel morphology; and (d) the apparent impact of all of the LMR engineering activities on sediment dynamics in the channel. Investigations by many agencies reflect over 150 years of study of the hydraulics and hydrology of the LMR, which have contributed significantly to our understanding of large alluvial rivers. In an effort to provide for hood control and navigation on the largest river in North America, private landowners and the US Army Corps of Engineers have performed a wide range of river engineering activities, including construction of levees, floodways, artificial cutoffs, bank revetment, training dikes, dredging, channel alignment, and reservoirs on the major tributaries. This unprecedented program of river engineering activities on the river during the last 100 years has resulted in the evolution of a freely meandering alluvial river to a highly trained and confined meandering channel. The LMR has increased its overall gradient and average top-bank width and generally increased its channel depth. The immediate response of the river to increased gradient as a result of the construction of artificial cutoffs was dampened in some locations by local geological controls. Examination of the trends in sediment dynamics of the LMR reveals that the suspended load of the river has decreased during the 20th century. Conversely, a trend in the bed load transport in the channel for the years 1930 and 1989 cannot be determined with confidence because of the difficulty in acquiring representative samples. The highly trained river now responds to channel forming flows by attempting to build mid-channel bars rather than natural cutoffs of meanders. The LMR should maintain a relatively stable plan form in the intermediate future, barring a very large and unprecedented flood. The river will continue to adjust its channel geometry and its local gradients as a response to variations in significant discharges. Continued channel maintenance and occasional dredging will insure the present state of sediment and water transport efficiency.

K. L. Spencer, R. E. Dewhurst and P. Penna (2006) “Potential impacts of water injection dredging on water quality and ecotoxicity in Limehouse Basin, River Thames, SE England, UK.” Chemosphere 63 (3): 509-521

The use of water injection dredging (WID) is increasing in the UK's inland waterways and marinas. Jets of water are injected under low pressure directly into bottom sediment creating a turbulent water-sediment mixture that flows under the influence of gravity. Many of these sediments are highly contaminated and little is known of the effects of contaminant release on water quality or the risk to biota living in both the sediment and the water column. Sediment cores were collected from Limehouse Basin, a proposed WID site in SE England and current sediment toxicity was assessed using a number of techniques. Comparison of metal data to US sediment quality guidelines indicated intermediate levels of toxicity while, calculation of acid volatile sulphide to simultaneously extracted metal ratios underestimated the potential toxicity to sediment dwelling organisms. In contrast, porewater ammonia concentrations were in excess of all published ecotoxicological guidelines and indicate serious risk to biota. Re-suspension experiments were used to mimic the effects of WID on overlying water quality and ecotoxicity tests were carried out on elutriates using Daphnia magna to examine the impacts on biota. Concentrations of a range of metals in the elutriates predict that adverse biological effects would be observed during WID, however only 10% of the elutriate samples caused an adverse effect on Daphnia. Limehouse Basin is a complex aquatic environment receiving predominantly fresh waters while the sediments have high porewater chloride concentrations reminiscent of previous tidal inputs to the basin, making the choice of test organism problematic.

S. H. Su, L. C. Pearlman, J. A. Rothrock, T. J. Iannuzzi and B. L. Finley (2002) “Potential long-term ecological impacts caused by disturbance of contaminated sediments: A case study.” Environmental Management 29 (2): 234-249

Several submerged barges were recently removed from the Passaic River, New Jersey, USA, in two areas (areas 1 and 2) where contaminated sediments are known to exist. During removal of the single barge in area 1, elevated turbidity levels and chemical parameters were measured, Greater increases were measured in area 2, where several barges were removed. In both areas, water column concentrations of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) and several metals exceeded one or more water quality criteria; turbidity levels in area 2 also exceeded regulatory criteria. Potential chemical bioaccumulation from the water column into residential aquatic receptors was estimated using standard models and assumptions, The modeled results predicted that steady-state tissue concentrations of bioaccumulative chemicals would not occur as a result of the brief increase in water column concentrations that occurred during barge removal but that metals and PCDD/Fs could bio-accumulate to levels that exceed regulatory ecological criteria during long-term sediment disturbance activities. In addition, based on some simplistic assumptions regarding settling of suspended sediments, we estimate that chemical bioaccumulation from surface sediments into the food web could result in substantial increases in PCDD/F body burdens in the benthic forage fish, mummichog, Our findings are consistent with the limited number of field studies that have measured increased body burdens of bioaccumulative chemicals following dredging. We suggest that, prior to consideration of extensive dredging as a remedial alternative for any river system, the potential significant and long-term impacts on the food web must be evaluated

P. B. L. Tamuno, M. D. Smith and G. Howard 2009 "Good Dredging Practices": The Place of Traditional Eco-livelihood Knowledge Water Resources Management 23 7 1367-1385 May "Good Dredging Practices":

Residents of most rural communities in developing countries depend on surface water resources for their livelihoods. The development and management of this vital resource should as much as possible take into consideration local socio-economic priorities if sustainable development is to be achieved at local levels in these countries. Inland river dredging is a water resource management strategy usually aimed at improving water courses for navigation, land reclamation and or mitigate flood in the dredged catchment. Dredging operations like most development projects have impacts that are often localised, and benefits that could be local, regional or national. "Good dredging practices", GDP, in industrialised countries have been aimed at balancing national/regional economic benefits, technical feasibility and environmental protection. These practices rely heavily on the quality, and quantity of available relevant base-line data. In most developing countries there is a dearth of baseline data, and often national/regional economic gains do not necessarily translate into local livelihood benefits. Hence, the basis of GDP should be extended to incorporate local livelihoods priorities, without ignoring the relevance of scientific data when it is available, the issue of technical feasibility, environmental sustainability and economic viability. This approach is relevant to the demand for equitable development in the developing world; could be used in conjunction with traditional eco-livelihoods knowledge in developing or determining appropriate approaches for sustainable surface water resources management, as well as reducing environmental conflicts between stakeholders.

D.Wishart, J. Warburton, and L. Bracken (2008) "Gravel extraction and planform change in a wandering gravel-bed river: The River Wear, Northern England. " Geomrophology 94 (1-2): 131-152.

Within-channel alluvial gravel extraction is one of the most important forms of anthropogenically induced morphological change in river channels. In British rivers commercial gravel extraction was widespread between the 1930s and 1960s, and limited gravel extraction operations to reduce flood risk or maintain navigation continue to the present day. Despite this, gravel extraction has received little attention in UK river studies. This paper examines the significance of within-channel gravel extraction, during the period 1945–1960, on the planform of the River Wear in northern England. The study focuses on two 3 km piedmont reaches at Wolsingham and Harperley Park, located at the margin of the upland zone. Examination of detailed archival accounts of the gravel extraction operations, supplemented by the analysis of aerial photographs has enabled the impact of gravel extraction on the channel of the River Wear to be determined. Sediment budget calculations suggest large sediment deficits in both study reaches, however, assessing potential impacts simply in terms of a sediment deficit may be misleading as channel adjustments depend on local factors and a detailed consideration of the reach-scale sediment budget. Differences in the nature of channel adjustments of both reaches were found to be primarily a function of the method of gravel extraction employed. Overall patterns of channel change along the extraction reaches, over the past 150 years, were similar to reaches where gravel extraction was not practiced. This highlights the difficulty of trying to establish the significance of different processes where both local (gravel extraction) and catchment-scale factors (climate and land use) are operating.