

Appendix K:

A Review of the Available Literature on the River Dovey and the Dovey Estuary

Sarah Page 2 May 2007

This literature review aims to review the available literature on the River Dovey and the Dovey Estuary. The River Dovey is sourced from the Cambrian Mountains and runs into Creiglyn Lake, through Machynlleth and to the Estuary which opens into Cardigan Bay (Ordnance Survey (2007)). It appears that the river has been largely neglected, in terms of scientific interest, whilst the Estuarine processes, the ecology and the salt marshes have been widely studied. There is also a shortage of literature which links together the river and the estuary and there is thus potential for further research in this area.

The literature available on the River Dovey is concerned largely with the history of the area and post-glacial sedimentation. The research which has been conducted on the estuary has looked at the foraminifera, vegetation, fauna and sedimentation in the estuary. There is also an abundance of literature on the salt marshes and on the changes in sea level within Cardigan Bay. This literature review first considers the literature available for the River Dovey, and secondly that which is available for the Dovey Estuary. The literature is discussed in terms of its focus, findings and potential use to future studies in the Dovey area.

Research into the River Dovey has concentrated largely on post-glacial sedimentation, physical attributes of the River and the geology of the catchment. There is also a large amount of literature on the history of the Dovey region; this extends to the railways and mining activities which have influenced the River and its use in the past.

With regards to the available literature on the sedimentation and physical aspects of the River Dovey, three key texts have thus far stood out. Johnstone (2004) looks at the response of the river to late quaternary environmental change; work which is aimed at complimenting former work carried out by Thomas et al (1982) and Jones (1995). These previous research studies, 'focused largely on aspects of landscape evolution during the late Devensian,' (Johnstone (2004)). Johnstone looked at these aspects too, and developed geological maps spanning nearly 30 km of the river, compiled valley floor elevation models and dated the Holocene terraces using radiocarbon dating of the organic matter taken from cores from palaeochannels (Johnstone (2004)). This paper is

very detailed and uses a number of methods which may be of use to future research on the River.

In addition to these three key papers, research has also been conducted by Thomas et al (1982) where sequences of glacio-fluvial, glacio-lacustrine and glacial sediments were identified in the middle reaches of the Dovey valley. Dennis (2000) looked at sediment loads in the river in order to reconstruct suspended sediment provenance in the River catchment.

Martin et al (1981) studied the geology of the Dovey region. This work is supported by Johnstone (2004) and by studies of the more general geology of Cardigan Bay, Machynlleth and Aberystwyth areas carried out by Keeping (1878), Jones et al (1935) and Cave et al (1986). With the exception of Johnstone (2004) and Dennis (2000), these are all relatively old studies and the methodologies and technology available has improved vastly since these times. A study which looks at the geology of the area would thus benefit from newer papers which use and evaluate these more modern techniques.

A review of the available literature about the history of the River Dovey has been included as these documents may aid in the reconstruction of past river channel patterns and they may provide useful information about past uses of and influences on the river and its contents. The literature covers pictorial histories of the valley, historical communities, railways, mining and water power as well as more general coverage of the area in question.

Davies (1996) and Taylor (1984) both provide pictorial reconstructions of the Dovey Valley and Estuary. Davies (1996) looks at Machynlleth includes pictures of the river which could be of use to future studies. Taylor (1984) reconstructs the lower Dovey Estuary in picture form and thus may be of use when establishing the changes in interaction between the Estuary and the River. Photographs of the Dovey also feature in Richards (2005), where the Dovey and Mawddach are studied.

Davies et al (2000 & 2000) consider the Late Bronze Age, Iron Age and Roman Wales; it is highly likely that the River Dovey will have influenced settlement patterns and have provided essential transportation during these eras and thus literature which covers the regional history of these times may prove to be of use in the future. The railways of Wales and Great Britain have also been well-documented and these papers may contain

photographic documentation of river patterns and changes in the uses of the river as the railways were introduced. Baughan (1991), Briwnant-Jones (1990) and Green (1996) have written literature about these railways and their papers may form part of future research proposals.

The Centre for Alternative Technology (CAT) in Machynlleth has compiled two texts about water power in the Dovey Valley. These texts may be of use with regards to providing information about the history of the Valley, particularly when looking at past uses of the river and the types of industrial and domestic properties that benefited from and influenced the hydro-dynamics of the river. Ashby wrote pamphlets for CAT in 1979 and 1983 and addressed the history of the water power, past power output from the river and theoretical future output. Ashby (1979 & 1983) also considers water power with regards to the law and how this influenced changes to the use of power on the River Dovey in 1963 with the introduction of the Water Resources Act of 1963. Also included in these pamphlets are old photographs of the Dovey Lead mine and past water turbines; these photographs may be of use to a study which considers the history of the River Dovey.

Mining in Wales will have had a significant influence on the sediment load of the River Dovey. Papers which examine the history of the mines, particularly with regards to the types of mines, and the dates during which they were in operation, may provide vital information about the sources of organic and inorganic materials obtained from cores taken in the Dovey valley. Bick (1978), Jones et al (1977) and Jones (1922) all provide literature about the mines in this part of Wales. Although these are relatively old papers, they may be of more use than modern papers as the memories of contributors and the information available about the mines may have been much better than that which may be obtained today. These papers were used by Johnstone (2004) in his paper which looked at the response of the river to later quaternary environmental change. This paper has been presented in this instance as one of the key pieces of available literature on the River Dovey, and these mining papers are evidently of use to modern research.

The research into the Dovey Estuary has focused largely on the flora and fauna, the salt marshes in the Estuary, and sediment patterns and influences. There is also some literature which addresses sea level change in Cardigan Bay.

Research into the flora and fauna of the Dovey Estuary has been extensive in the past; interest in the surrounding areas of Ynyslas sand dunes, Borth beach and Borth bogs has led to research in these areas, as well as in the salt marshes. Studies of the foraminifera have also been carried out in the Estuary and thus the relevant literature is assessed.

A wave of interest was given over to the Dovey Estuary in 1973 when Watkinson compiled the 'Handbook for Ynyslas'. This book contains information taken from a number of different sources; those described as follows have given particular attention to the flora and fauna of the Dovey Estuary.

Angew (1973) provides an account of the vegetation of the Ynyslas salt marsh (Rusca (1985)). Slater (1973) looks at the development of plant habitats in the Ynyslas and Borth areas during the Quaternary period, Savidge (1973) considers the climate of this area; this account also describes some of the fauna and flora in the vicinity of the Estuary. Wootton and Sinclair (1973) studied the fauna of the Ynyslas sand dunes and Fish (1973) studied the macro fauna on the Dovey Estuary and thus may also provide useful information for this research dissertation.

More focused studies have considered the vegetation within the salt marshes of the Estuary and the development of foraminifera in this area.

Rusca (1985) divides the research into the vegetation of the Dovey Estuary into two fragments; the first considers the vegetation before the, 'rapid spread of cord-grass *Spartina townsendii* in the 1940's,' (Rusca, (1985)). The second looks at the vegetation post 1940 and it is evident that a large amount of the literature is focused upon *Spartina townsendii*. Amongst the research available, Yapp et al (1916/17) and Richards (1934) looked at the vegetation in the first fragment. Yapp et al (1916/17) conducted a survey into the vegetation of the salt marshes in the estuary and identified five distinct vegetation zones according to Rusca (1985). Richards (1934) looked at the rates of different processes within the marshes over an eight year period. This work tied in with that of Yapp et al (1916/17) in terms of looking at the rate of vertical accretion. Richards (1934) also studied, 'the rate of colonisation of bare silts, growth of the young marsh, rate of erosion of the river front and the formation of secondary marsh,' (Rusca (1985)).

There is an abundance of literature on *Spartina townsendii* in the Dovey Estuary. Chater et al (1957) looked at the rate of spread of *Spartina* in the estuary from 1949 to 1953 (Rusca (1985)), and Chater later studied the Dwarf brown form of *Spartina* in 1965. In

1973, Chater looked at the history of this species and the development of the *Spartina* marshes in the Dovey estuary; other work on *Spartina* has been undertaken by Bakewell et al (1983).

Studies of the foraminifera in the Dovey estuary have proved to be of value in terms of finding new species and determining favourable conditions for foram development. Adams et al (1963) and Haynes et al (1973) undertook research which described one hundred and thirty and one hundred and sixty five species respectively. Adams et al (1963) also found three new species of foraminifera; in this study, cores were taken from Borth bogs, Ynyslas and Borth beaches and the Dovey marshes. Adams and Haynes have worked both together, in the Dovey estuary, and with separate research groups and have subsequently helped to expand the amount of literature in this area, particularly with regards to the Holocene foraminifera, and the development of this species in the Dovey estuary. Work undertaken by

Penner (1984), which looked at seasonal influences on the abundance, distribution and reproductive patterns of the foraminifera in the Dovey estuary, helped to support those results obtained by Haynes and Dobson in 1969, where a brief account of the living and dead forams was given (Rusca (1985)).

There is a relatively substantial amount of literature available on the salt marshes on the Dovey Estuary. As mentioned, some researchers have focused upon the ecology in the marshes, whilst others have provided a more general overview. Angew (1973) and Adams and Haynes (1965) provide overviews of the marshes whilst Richards (1934) considers the physical characteristics with regards to erosion, accretion and extension. Yapp has conducted a range of research into the marshes; looking particularly at the *Spartina townsendii* (Yapp (1923)) (as previously mentioned), and at the marshes as a whole (Yapp et al (1916 & 1917)) and Yapp (1922).

There are a number of papers which look at sediment in the Dovey Estuary and Cardigan Bay. This is particularly so with regards to sedimentation since the last ice age. Shi has conducted a significant proportion of this work, both individually and with colleagues. This work has considered late Quaternary stratigraphy and recent sedimentation in the estuary (Shi (1992)), tidal influences with regards to the bedding and the water circulation within the estuary (Shi (1991)) and the evolution of the sediment in the post-glacial era (Shi and Lamb (1991)). Shi (1992) noted that the work on the, 'sedimentological aspects of the

inter-tidal sediments,' had not been greatly studied until the writing of this Ph.D. thesis in 1992. Reference is made to Haynes and Dobson (1969), however but their paper looked also at the foraminifera and physiography of the estuary and thus the sedimentation was considered only briefly. Shi (1992) also made reference to Moore (1968) who looked more generally at Cardigan Bay but did touch on the inter-tidal sediments in brief. Wilks' (1979) paper focused upon the mid-Holocene sea level changes and this work also looked at the interactions of the sediments within the Dovey Estuary. Zhong (1992) tests the Pejrup approach to classifying sediments and thus may be a useful piece of research in terms of helping to indicate the relative advantages of using such a method in future research. The sediment in the Dovey estuary has thus been studied on a number of levels, and the available literature may prove to be of use to future studies, particularly with regards to supporting new findings and providing evaluations of useful research methodologies. It is apparent, however, that there is a very small amount of literature which links together the processes which occur in the Estuary and the processes which occur in the River, and those which mark the interactions between the two fluvial phenomenon.

As mentioned, there are also some texts which look at the changes in sea level in Cardigan Bay. These texts are of use to studies which look at the influences on sedimentation in the estuary and are thus reviewed here. Prince (1988) was referred to by Shi (1992) with regards to the techniques which were used to analyse and interpret the unconsolidated estuarine sediments in the Bay and Estuary. Prince analysed fossils including foraminifera, pollen and diatoms in order to determine the late glacial and post glacial sea level movements in the Bay. This text may thus provide some useful insight into the types of techniques which are effective for analysing and interpreting the sediments. The findings of this work may also be helpful in acting as analogues for future research. Wilks (1977 & 1979) studied mainly the Holocene sea level changes and the sedimentary interactions within the estuary. Wilks is thus a key player in the analysis of sea level and sediment changes and thus this work may be useful in supporting findings of future research.

This literature review has looked at the available literature on the River Dovey and the Dovey Estuary. It is evident that there has not been a significant amount of scientific research undertaken on the river, whilst the Estuary and the processes acting within it, has been widely studied. It has also become evident that there is a distinct shortage of

literature which links together the river and the estuary and thus, there is great potential for scientific research in this area.

The literature available on the River Dovey is concerned largely with the history of the area and post-glacial sedimentation. Amongst this literature are old photographs of the river and Machynlleth which may offer insight into the external processes impacting upon the river. There is also literature available on the railways and mines within the river catchment which may be of use to future studies. The three key texts, by Johnstone (2004), Thomas et al (1982) and Jones (1995) not only support one another, they are also the most significant with regards to the scientific research and the kinds of research methods which may be viable to employ in the future.

The research which has been conducted on the estuary has looked at the foraminifera, vegetation, fauna and sedimentation. It is evident that there is marked interest in the *Spartina townsendii* and the development of the *Spartina* marshes in the estuary. With regards to the sedimentation patterns, there has been interest in the influence of the tides on sedimentation patterns, but no interest in the influence of the river.

The literature review has thus assessed a wide range of literature on the Dovey River and Estuary and has subsequently found papers which will aid future research in terms of establishing which areas require attention and which techniques may be of use.

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ASSIGNMENT COVER SHEET (ELECTRONIC SUBMISSIONS)

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Degree Scheme	F800
Module Code	GG22110
Title of Module	Tutorial
Tutor/Staff (for the attention of)	Joe Wheaton

Date & Time: 02.05.2007
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Literature Review

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