Fossil fishes of Great Britain

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(Figure 6.18) D, E and F, from Miles and Westoll, (1968), 68, 372–476, figs. 24a and b, 25a.

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(Figure 9.15) A and B, from Dick, (1981), 72, 99–113, figs. 7 and 12.

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(Figure 15.7) from Coates, (1994), 84, 317–327, figs. 1,7 and 10.

(Figure 15.9) from Milner and Sequeira, (1994), 84, 331–361, fig. 5 and 18.

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Acknowledgements

The initial task to identify, inspect and assess the condition of sites from which notable fossil fishes had been collected in the past began under the auspices of the Nature Conservancy Council (NCC) in the 1980s. Miss S. Turner and, later, Miss M.A. Rowlands set the work in motion for the NCC, visiting localities and corresponding with many individuals with local knowledge or expertise in the field of palaeoichthyology. An appreciable fund of data was established for Palaeozoic sites, and the task of GCR site selection from the list of potential localities had been largely completed by the late 1980s. Work towards publication of the results of this part of the GCR was initiated and Miss Rowlands prepared the draft of a text on the pre-Mesozoic sites. The work was then delayed for some time. In 1995 the present senior author (D.L.D.) was engaged by the Joint Nature Conservation Committee ONCC) to revise and extend the account of the Palaeozoic sites and, with the assistance of SJ.M., to complete the task of examining localities within the Mesozoic and Cenozoic formations and to prepare this report. Subsequently it was agreed to add an account (Chapter 15) of fossil amphibian tetrapod sites.

Almost all of the sites described in this volume have been visited and assessed relatively recently, but it is possible that the condition of some of them may have changed in the ensuing two years. Many sites may be visited only with the express permission of third parties. Whenever sought by the present authors, this was immediately forthcoming, and it is pleasant to record our gratitude for this.

A large number of people have contributed to and helped in the work at all stages, and to them sincere thanks are extended. Professor M.J. Benton has been staunch in his support throughout. He and the following friends and colleagues have read parts of the draft text: Dr M.I. Coates, Mr R. Davidson, Dr C. Duffin, Dr Forey, Prof. B.G. Gardiner, Dr E.J. Loeffler, Dr A.R. Milner, the late Dr C. Patterson, Dr N.H. Trewin, Dr CJ. Underwood and Dr DJ. Ward. Their corrections and comments have much improved the outcome. At the University of Bristol much kind help has also been provided by Mrs P. Baldaro, Dr E. Cook, Dr P. Orr and Mr S. Powell.

Staff of the country conservation agencies and JNCC, Dr. N. Clark of the Hunterian Museum, Glasgow and Drs R. Paton and M. Taylor at the Royal Scottish Museum, Edinburgh, have responded most kindly to requests for information and assistance of one sort or another. Dr C.F. Pamplin and Dr S. White of Xipress IT Solutions have applied their enthusiasm, skill and care to producing the diagrams. Special thanks are due also to Dr D. Palmer, to Mr N. Ellis, Miss AJ. Carter and Mr N. Cousins of the GCR Unit, for their unstinting help throughout.

As well as those organizations who have given their kind permission for the reproduction of illustrations and photographs, thanks also go to the many authors named in the figure captions.

Access to the countryside

This volume is not intended for use as a field guide. The description or mention of any site should not be taken as an indication that access to a site is open or that a right of way exists. Most sites described are in private ownership and their inclusion herein is solely for the purpose of justifying their conservation. Their description or appearance on a map in this work should in no way be construed as an invitation to visit. Prior consent for visits should always be obtained from the landowner and/or occupier.

Information on conservation matters, including site ownership, relating to Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs) in particular counties or districts may be obtained from the relevant country conservation agency headquarters listed below:

Countryside Council for Wales, Plas Penrhos, Ffordd Penrhos, Bangor, Gwynedd LL57 2LQ.

English Nature, Northminster House, Peterborough PE1 1 UA.

Scottish Natural Heritage, 12 Hope Terrace, Edinburgh EH9 2AS.

Conserving our fossil heritage JNCC policy statement

Fossils are a key part of our natural heritage and form a major scientific, educational and cultural resource. They are fundamental to understanding the evolution of life and the character of ancient environments. Fossils also provide a basis for comparing the ages of rocks the world over.

The discovery, collection and study of the fossilized remains of ancient life can be enjoyable and stimulating activities that give people a fascinating insight into the geological and biological history of the Earth. However, the available fossil resource is finite. It is only through maintaining a prudent approach to the management of important fossil sites that future generations will be able to experience, study and enjoy this resource.

Responsible fossil collecting

In most circumstances, responsible fossil collecting is not harmful to the conservation of fossil sites. It can actually benefit our understanding of geology. This is particularly true where the fossils are relatively common or the sites in which they are found are subject to high levels of natural or artificial degradation, such as coastal cliffs that are being eroded or quarries that are being actively worked. In such situations collecting fossil specimens that might otherwise be destroyed can be beneficial to science, provided that they are properly documented and made available for study. Responsible fossil collecting can therefore be a valuable activity in the sustainable management and safeguard of our fossil heritage.

Irresponsible fossil collecting

Irresponsible collecting provides no scientific or educational gain and is therefore an unacceptable activity resulting in irreparable damage to our fossil heritage. It will pose a clear threat where fossils are rare or the fossil source is limited in extent, for example in a cave or a river channel deposit. Collecting without proper recording and curation, inexpert collecting, over-collecting and inappropriate use of power tools and heavy machinery are likely to reduce or even destroy the scientific value of such sites. Unless the activity is undertaken in an appropriate manner, the statutory nature conservation agencies, the Countryside Council for Wales, English Nature, Environment and Heritage Service and Scottish Natural Heritage, will oppose fossil collecting on the small number of Sites of Special Scientific Interest / Areas of Special Scientific Interest where this activity would cause significant damage to the features of special interest.

Code of good practice

Adopting a responsible approach to collecting is essential for conserving our fossil heritage. The basic principles set out below should be followed by all those intending to collect fossils.

Access and ownership — permission to enter private land and collect fossils must always be gained and local bylaws should be obeyed. A clear agreement should be made over the future ownership of any fossils collected.

Collecting — in general, collect only a few representative specimens and obtain these from fallen or loose material. Detailed scientific study will require collection of fossils *in situ.*

Site management — avoid disturbance to wildlife. Many invertebrates and lower plants live on or under loose rocks that should be replaced in their original positions whenever possible. Do not leave the site in an untidy or dangerous condition

for those who follow.

Recording and curation — always record precisely the locality at which fossils are found and, if collected *in situ,* record relevant details of the position of the rock layer from where the fossil was collected. Ensure that these records can be directly related to the relevant specimens. Where necessary, seek specialist advice on specimen identification and care. Fossils of prime scientific importance should be placed in a suitable repository, normally a museum with adequate curatorial and storage facilities.

Achieving positive management

In order to achieve the successful management of the fossil heritage of the United Kingdom, the statutory nature conservation agencies will:

- Promote the responsible approach outlined in the *Code of Good Practice,* above.
- Encourage the placement of scientifically important fossils into a suitable repository (such as a museum) in order to ensure their proper curation, longterm security and accessibility.
- Recognize the contribution that responsible fossil collectors can make to geological and palaeontological study.
- Encourage collaboration within the geological community to ensure that maximum educational and scientific gain is made from our fossil resource.
- Support and encourage initiatives that increase awareness and understanding of the value of our fossil resource and the need to conserve it.
- Increase awareness and understanding of the differing management needs of fossil sites. In particular, encourage landowners and occupiers to become advocates for conservation of the fossil resource.
- Review the need for export and import controls on the international trade in fossil specimens.

JNCC, 1997.

Preface

This book summarizes the results of part of the Geological Conservation Review (GCR), an extensive research programme that aimed to assess the scientific significance of Britain's geological and geomorphological localities so that a representative set of the most important ones could be protected by law. Ultimately, the GCR sites were selected with a view to their designation as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act (1981).

In this volume the scientific importance of the set of fossil fish GCR sites is described. The surveys of fossil fish sites were carried out initially for three GCR 'Blocks' — Silurian-Devonian Chordata, Carboniferous-Permian Fish/Amphibia and Mesozoic-Tertiary Fish/Amphibia. In each block, a list of candidate GCR sites was established on the basis of previous research and published material; the list was refined to contain only the most scientifically important localities after consultation with as many people as possible and visits to as many sites as possible. The refined list of GCR sites comprised those nationally and internationally important sites that were needed to reflect the diversity of the fossil fishes of Britain and the history of research and investigation already undertaken.

Because there is potentially a great wealth of sites from which to choose, inevitably reliance has to be placed on those that have already been discovered, documented and researched. Also, while some of the sites described have been the subject of research or study very recently, others have been known for over 100 years, and there may be other classic sites emerging as a result of research under way at the present time. This emphasizes that the sites included in this volume represent what might be thought of as a snapshot at a particular point in time reflecting the way in which the need for a range of sites of different types is reconciled with the background of the information that has become available. It is also important to remember that some potential sites may overlap with sites described in other volumes of the Geological Conservation Review Series which were selected for the GCR for other special interests, such as stratigraphy, fossil mammals (Benton *et al.,* in prep.) or fossil reptiles (Benton and Spencer, 1995).

Most of the SSSI proposals made as a result of the Geological Conservation Review have already been translated into site designations by the appropriate country conservation agencies (the Countryside Council for Wales, English Nature and Scottish Natural Heritage).

This volume is not intended to cover the practical problems involved in future site conservation, but rather to record the scientific justification for conserving particular sites and to demonstrate the character and significance that the sites have against the background of a wider palaeontological context. Although some of the sections necessarily use some technical terms, the accounts (particularly the 'conclusions' sections) have been constructed to be accessible to the non-specialist as far as possible; also the glossary at the end of the volume is compiled with this in mind.

We hope that readers will appreciate this volume as a foundation to describe the sites included but also bear in mind that these are only some of the sites that could have been designated. The purpose of the volume is not only to ensure that the selected GCR sites are available and documented for future generations but to acknowledge that, as further research is undertaken, additional knowledge can be added to that contained in this volume.

Museum abbreviations

BATM, Bath Museum.

BGS(GSM), British Geological Survey, Keyworth (old Geological Survey Museum collection, London).

BMB, Bedford Museum.

BRSMG, Bristol City Museum Geology Collections.

BRSUG, University of Bristol Geology Museum.

CAMMZ, Cambridge University Museum of Zoology.

CAMSM, Sedgwick Museum, Department of Earth Sciences, Cambridge University.

DORCM, Dorset County Museum, Dorchester.

EXEMS, Royal Albert Memorial Museum, Exeter.

GCM, Gloucester City Museum.

GLAHM, Glasgow Hunterian Museum.

LEICSM, Leicester City Museum.

MAIDM, Maidstone Museum.

NHM, Natural History Museum, London.

OUM, University Museum, Oxford.

RSM, Royal Scottish Museum.

SM, Stroud District Museum.

SMLU, Ludlow Museum.

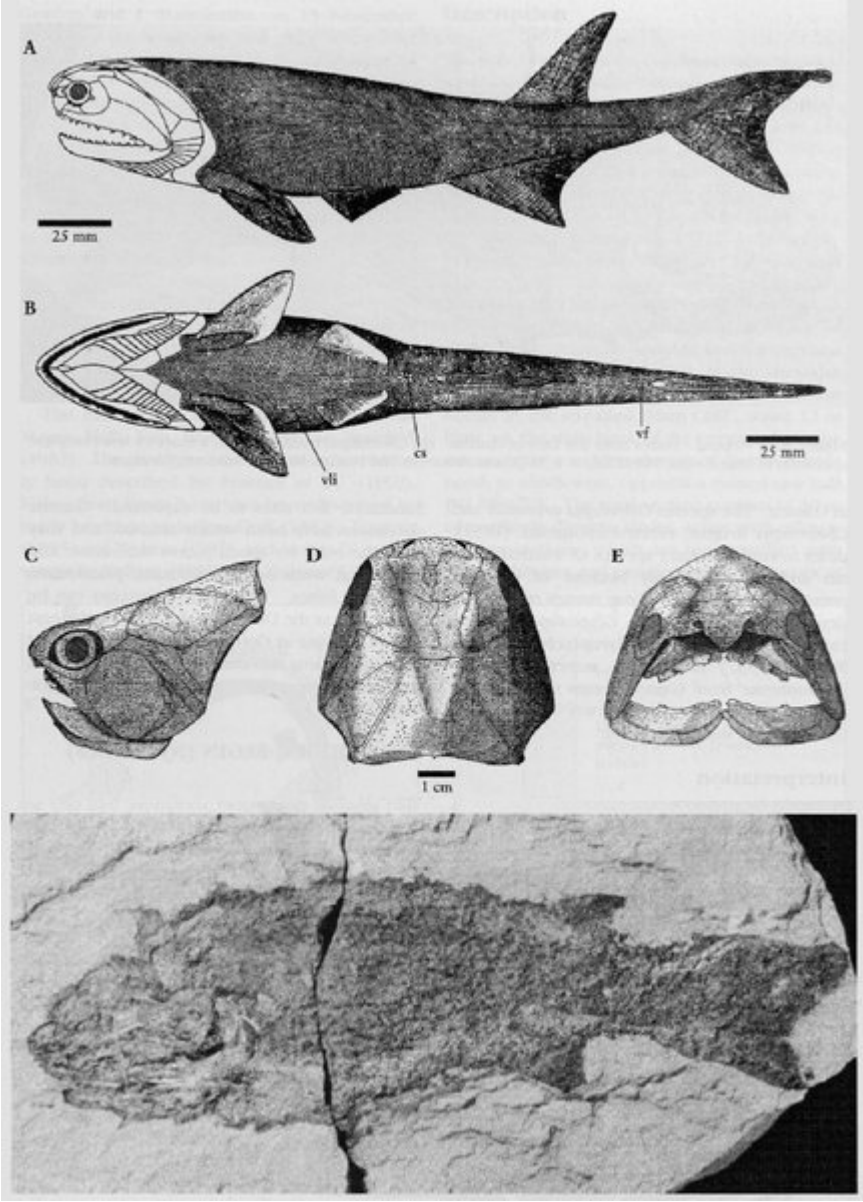
UCL, University College London.

UMXC, Museum of Department of Zoology, University of Cambridge.

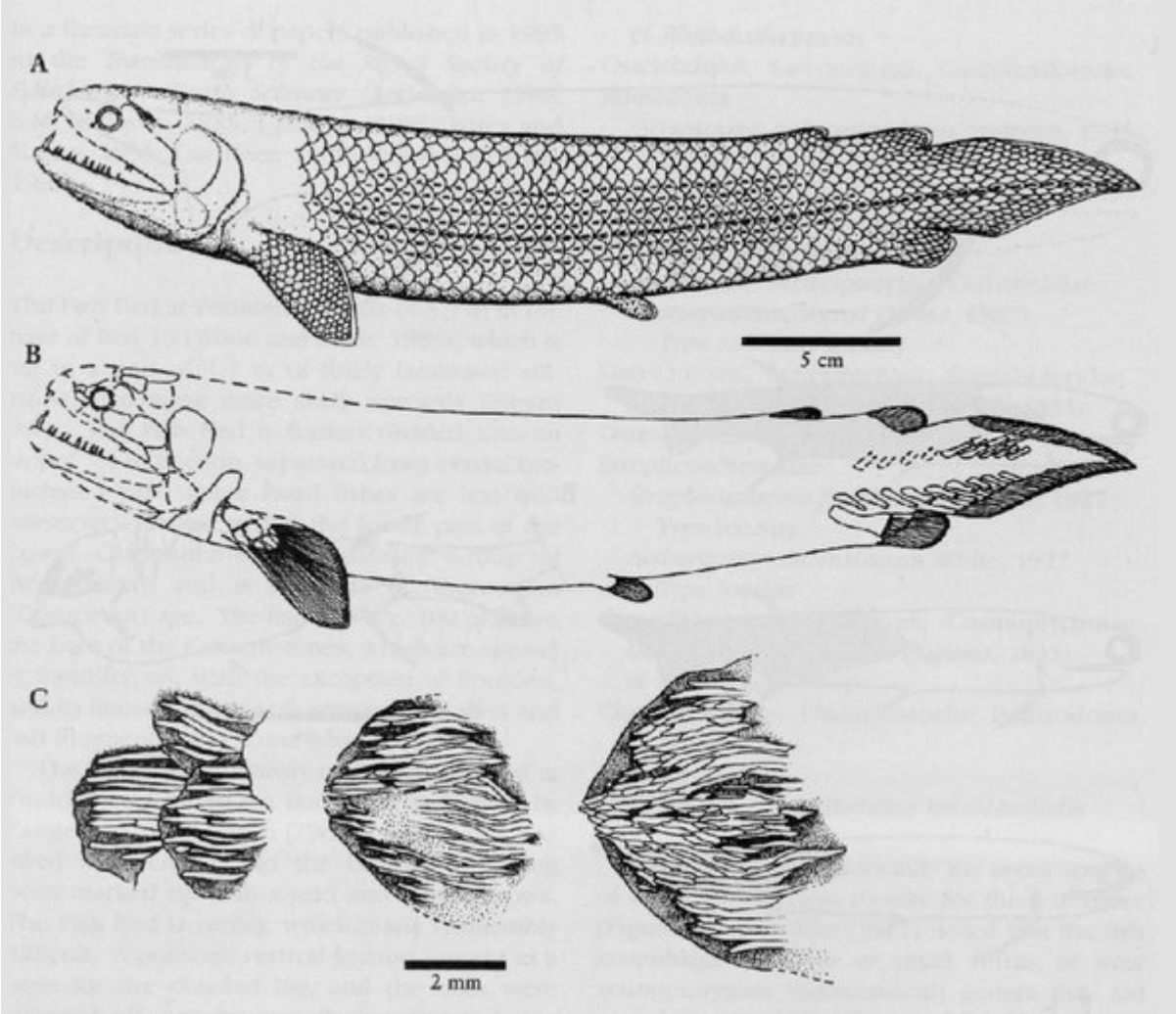
WHIMS, Whitby Museum.

YORMS, York Museum.

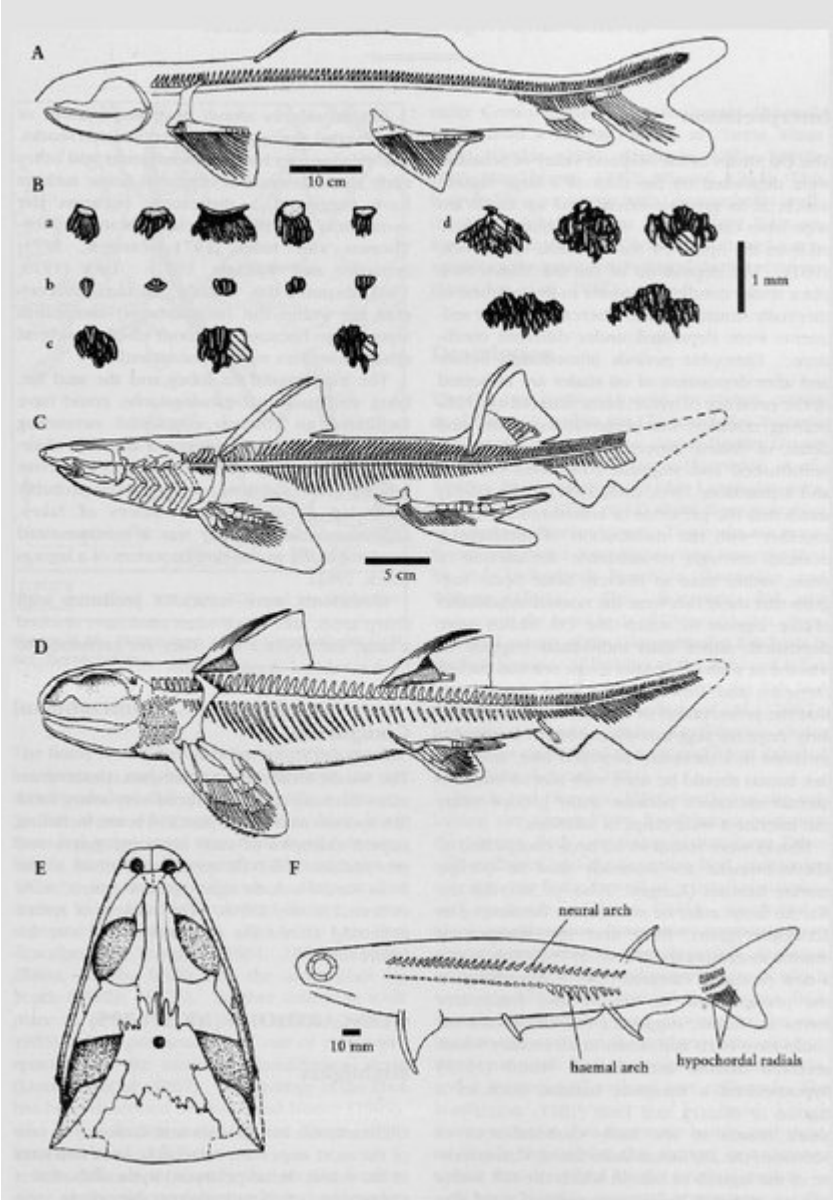
References



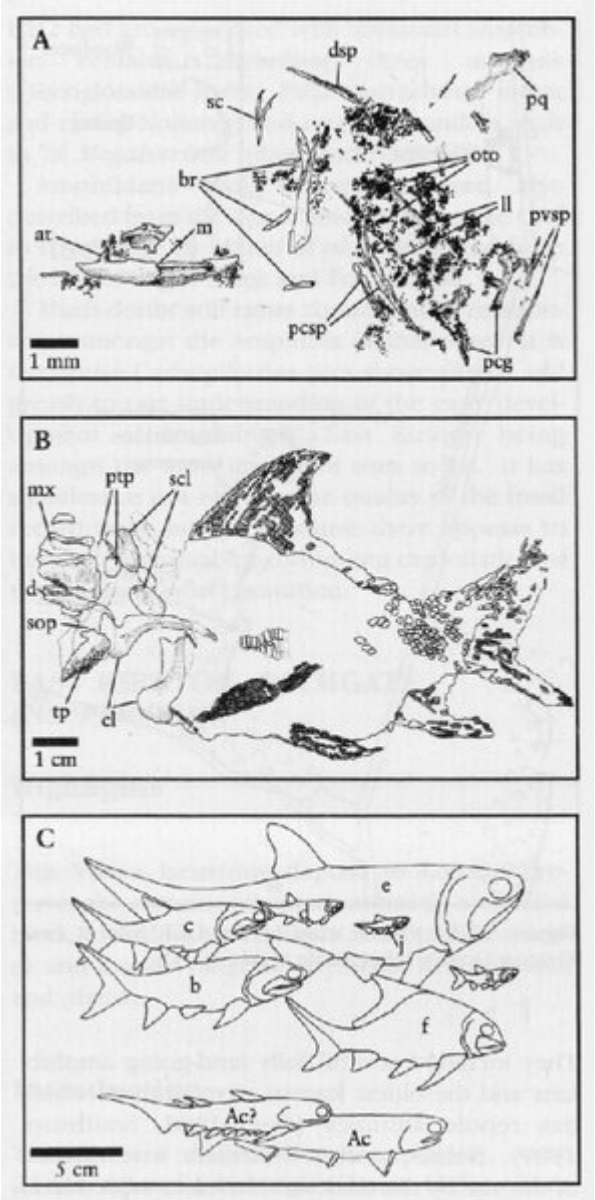
(Figure 6.18) Fishes from the Den of Findon. (A), (B) Cheirolepis trailli Agassiz, restorations of lateral and ventral views respectively (from Pearson and Westoll, 1979). (C)–(E), Coccosteus cuspidatus Agassiz: (C) restoration of the fish head in lateral view; (D) restoration of the head and trunk shields in dorsal view; (E) restoration of the skull in anterior view (after Miles and Westoll, 1968). Fishes from the Den of Findon. (F) Cheirolepis trailli Agassiz, a more or less complete specimen in lateral view, T00382/A, x 0.75 (Photo: courtesy The Natural History Museum, London).



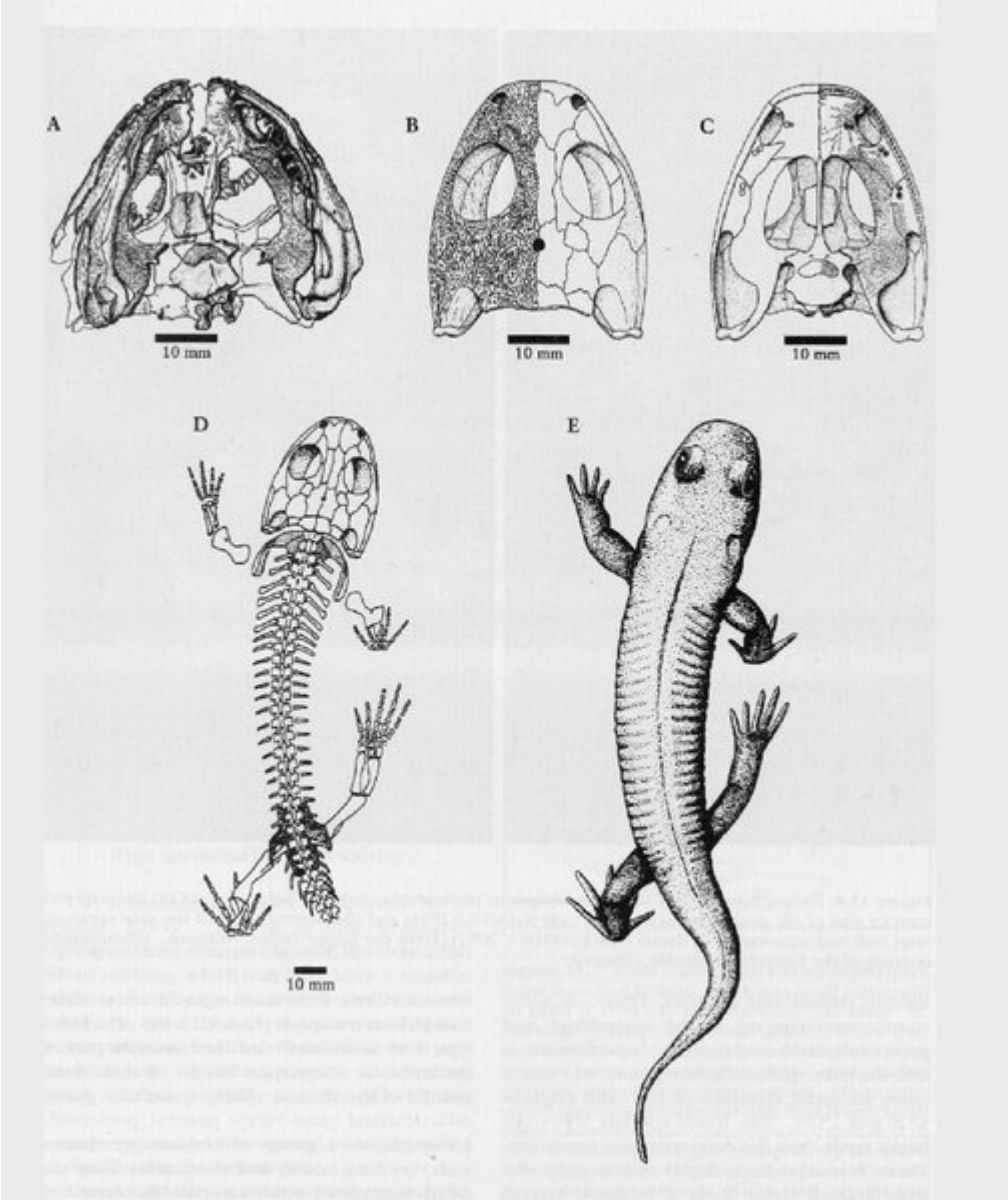
(Figure 9.11) Foulden sarcopterygians: (A) preliminary reconstruction of ?Strepsodus aulaconamensis sp. with scale cover; (B) ?Strepsodus aulaconamensis Andrews, with scales omitted to show lepidotrichia and axial skeleton (after S.M. Andrews, 1985) Many of the head and axial skeleton bones are largely conjectural. (C) Coelacanth flank scales (from Forey and Young, 1985).



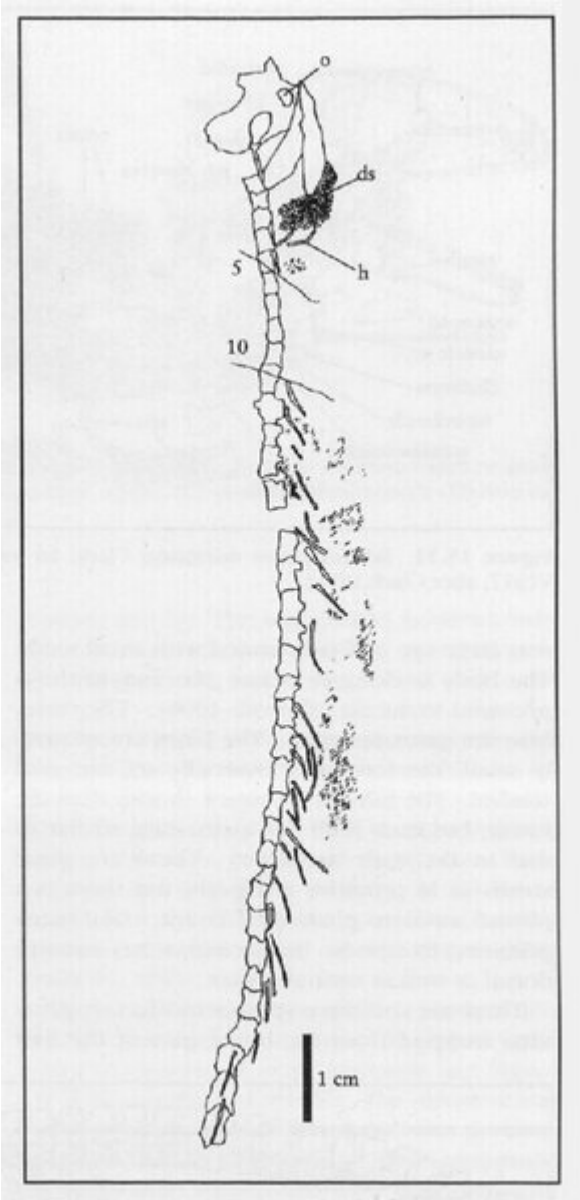
(Figure 9.15) Wardie elasmobranchs; (A) Diplodoselache woodi Dick, restoration of the skeleton, after Dick (1981); (B,a) scales from the anterior part of the trunk; (B,b) scales from the anal fin; (B,c) flank scales; (B,d) scales from head, body and tail; (C) Tristychius arcuatus Agassiz restoration of the skeleton (after Dick, 1978); (D) Onychoselache traquairi Dick, restoration (after Dick, 1978); (E) The Wardie tetrapod Lethiscus stocki Wellstead, a restoration of the dorsal surface of the skull (after Wellstead, 1982); (F) the Acanthodes sulcatus Agassiz restoration after Moy-Thomas and Miles (1971).



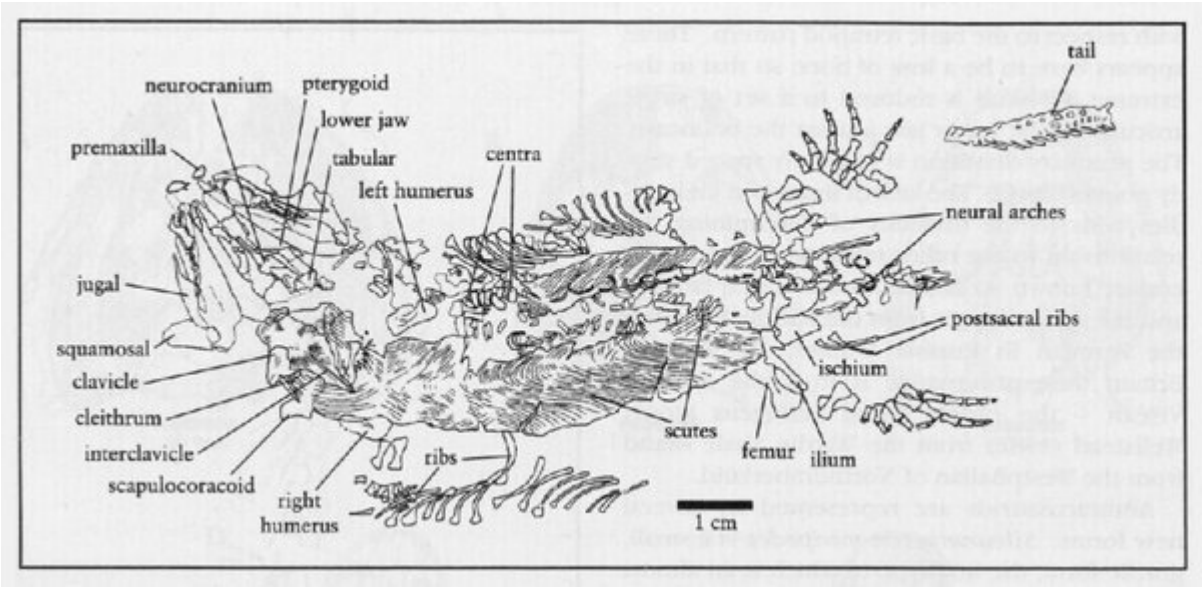
(Figure 15.7) Fossil acanthodian and actinopterygian fishes from East Kirkton. (A) A very small acanthodian (RSM G 1993.6.1) from the Little Cliff Shale: Br, branchiostegal rays; dsp, dorsal spine; 11, lateral line; m, mandible; oto, otoliths; pcg, pectoral girdle; pcsp, pectoral spine; pq, palatoquadrate; pvsp, pelvic spine; sc, scapula; at, anchylosed tooth. (B) An articulated specimen of Eurynotus with head bones, tooth plates and scales (after Coates, 1994): cl, cleithrum; d, dentary; mx, maxillary; ptp, pterygoid; scl, supraclei-thrum; sop, suboperculum, tp, tooth plate. (C) a diagrammatic representation of the total acanthodian and actinopterygian fauna, based on scales and drawn to estimated proportional sizes: Ac, acanthodian material; Ac?, possible climatiid tesserae; a, actinopterygians; b, isolated scales; c, spp. of Elonichthys; d, spp. of Mesopoma; e, Cosmoptychius; f, eurynotid material; j, juvenile specimens.



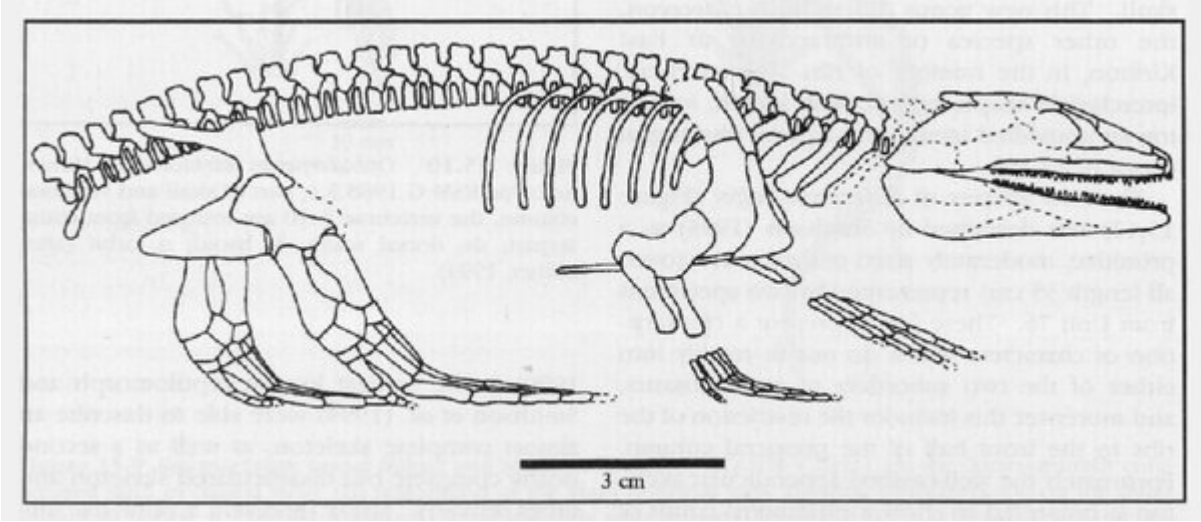
(Figure 15.9) Balanerpeton woodi Milner and Sequiera (based on GLAHM V 2051): (A) the dorso-ventrally compressed skull in palatal view; (B) restoration of the skull in dorsal view showing ornamentation on the outer surface of bones; (C) the skull restored in palatal view with marginal teeth and fangs and surface ornamentation indicated; (D) restoration of the incomplete skeleton in dorsal view; (E) the animal restored in dorsal view (after Milner and Sequiera, 1994).



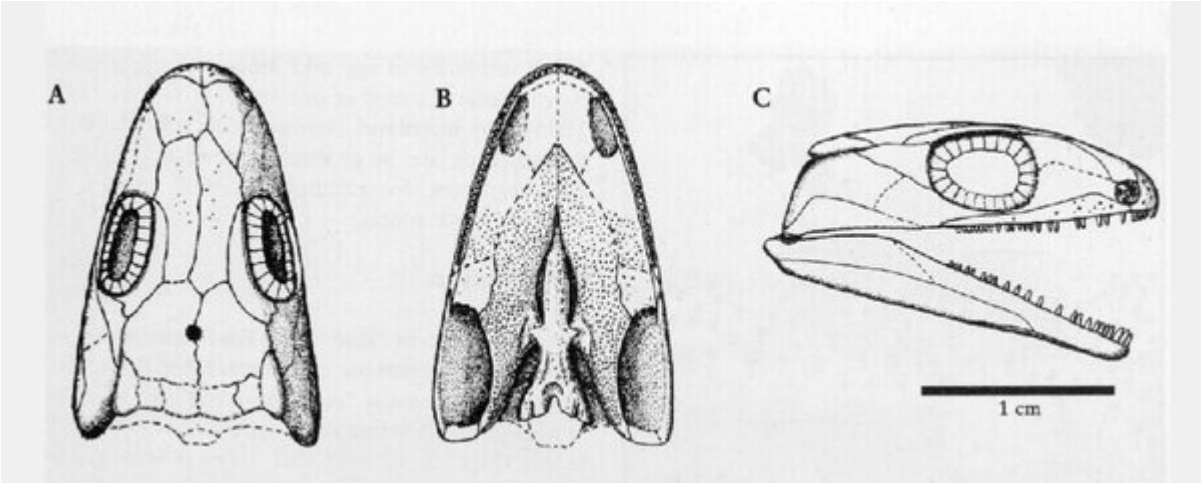
(Figure 15.10) Ophiderpeton kirktonense Milner, holotype RSM G 1988.3.1; part of skull and vertebral column, the vertebrae 5–10 are restored from counterpart; ds, dorsal scales; h, hyoid; o, orbit (after Milner, 1994).



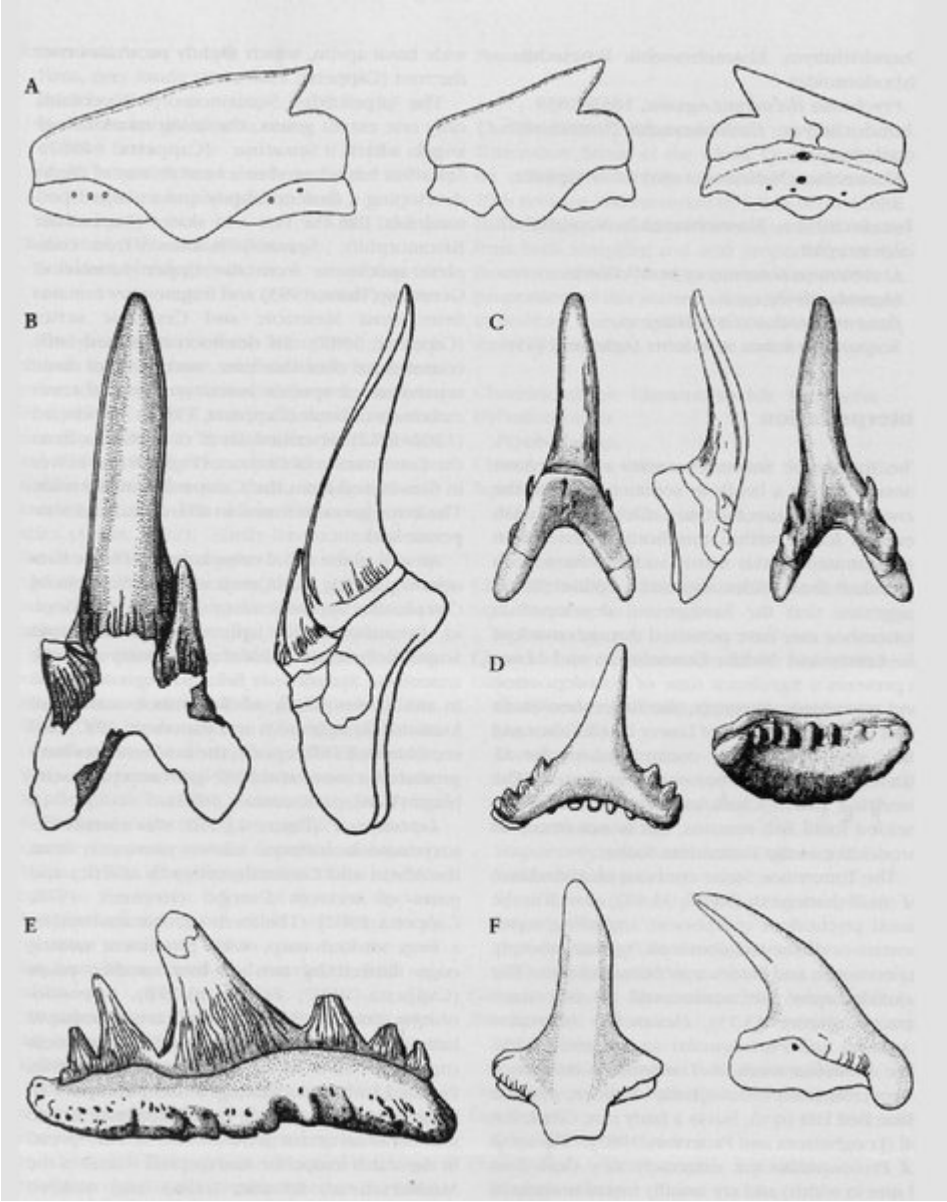
(Figure 15.11) Silvanerpeton miripedes Clack; an interpretative drawing of the skeleton (specimen UMXC V1317; after Clack, 1994).



(Figure 15.12) Eldeceeon rolfei Smithson; the skull and most of the post-cranial skeleton in a provisional restoration, based mainly on the holotype (RSM G 1990.7.1) from the East Kirkton Limestone (after Smithson, 1994).



(Figure 15.13) Westlothiana lizziae Smithson and Rolfe; reconstruction of the skull and skeleton based on both known specimens. (A) Skull in dorsal aspect; (B) skull in palatal aspect; (C) skull in lateral aspect; (D) restoration of incomplete skeleton (after Smithson et al., 1994.)



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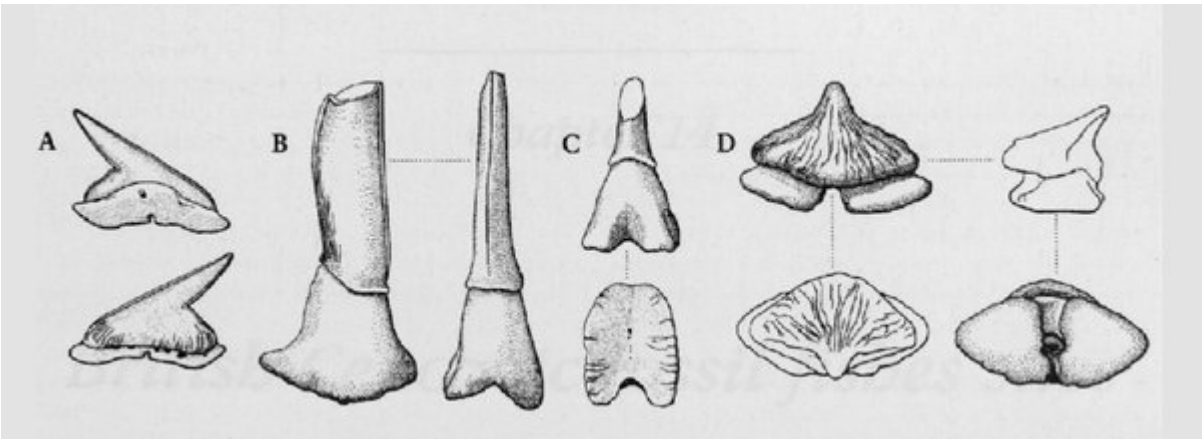
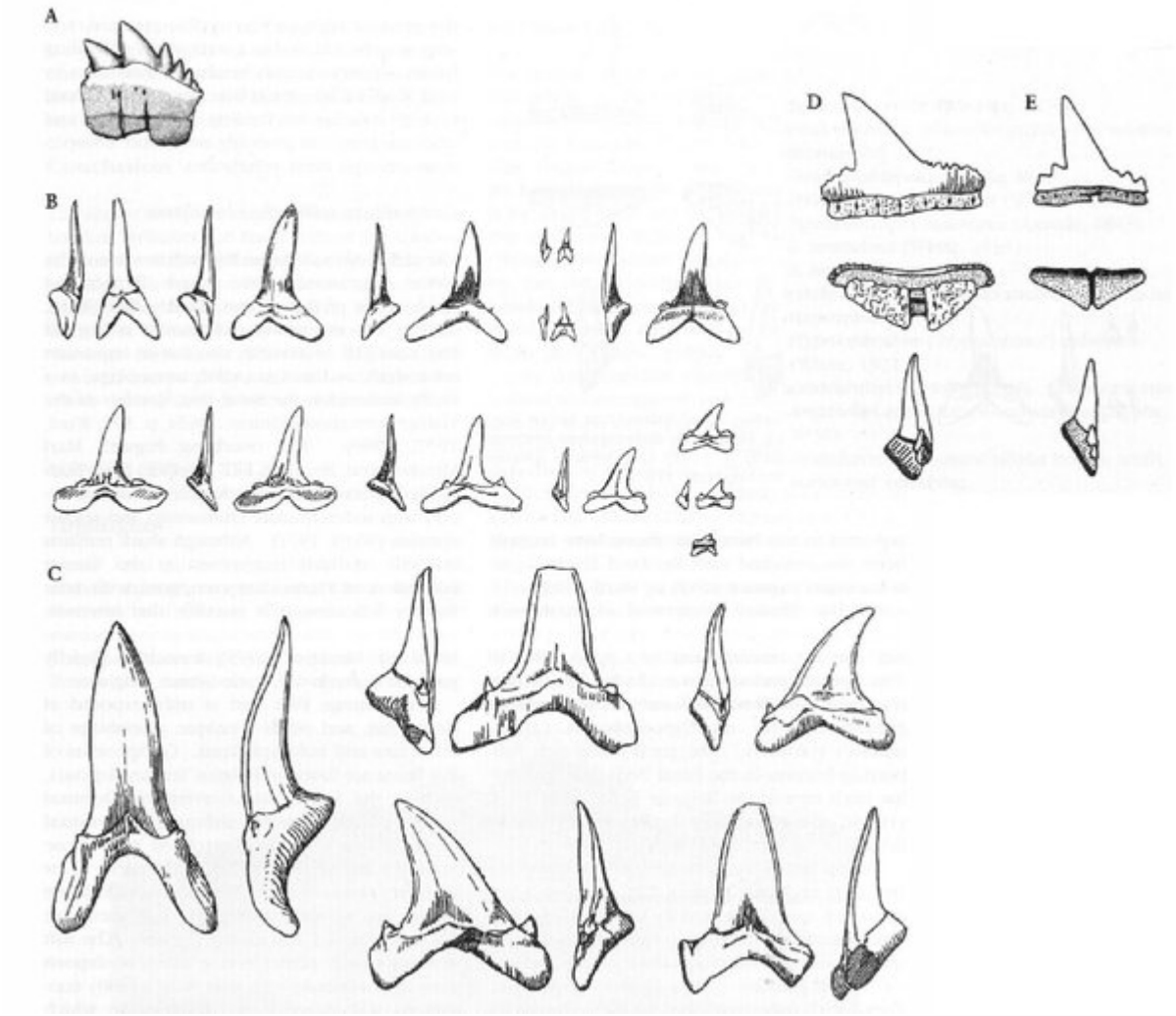


(Figure 13.24) Fossil elasmobranchs from the Chalk at Boxford Chalk Pit. (A) Pararhinocodon angustidens, X 16; (B), (C) Paratriakis sp., rostral teeth, x 2.5; (D) Ganopristis sp. (after Cappetta, 1987), oral tooth, x 10.



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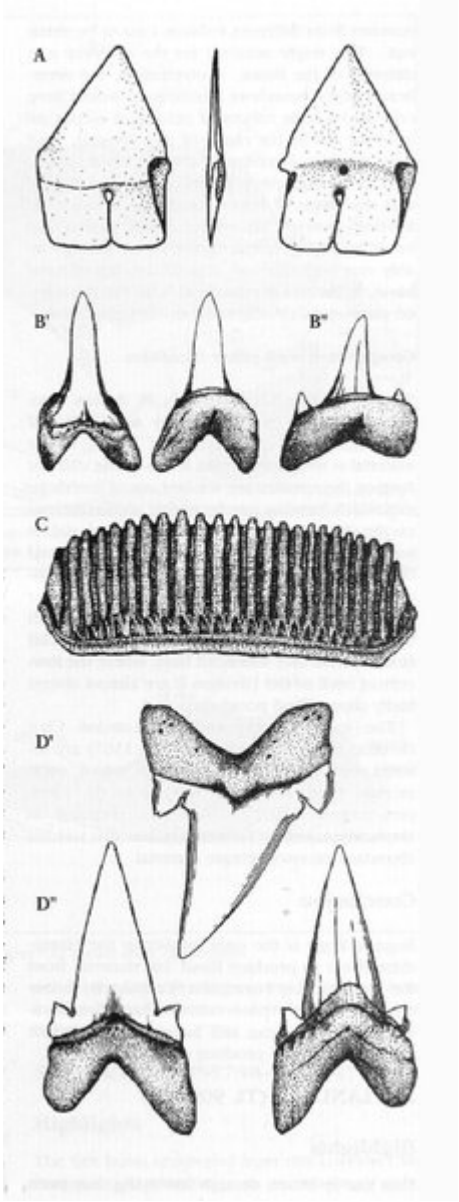
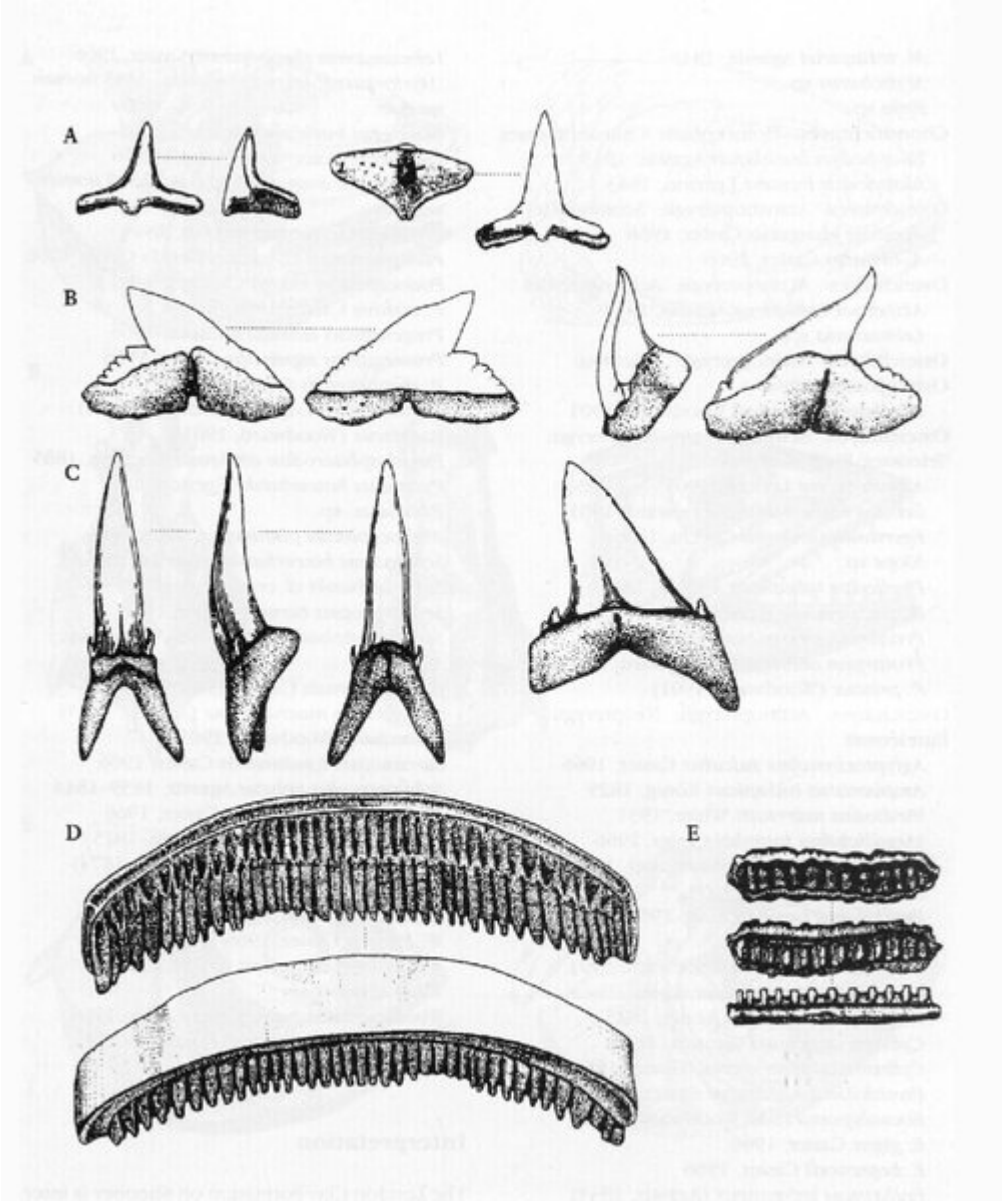
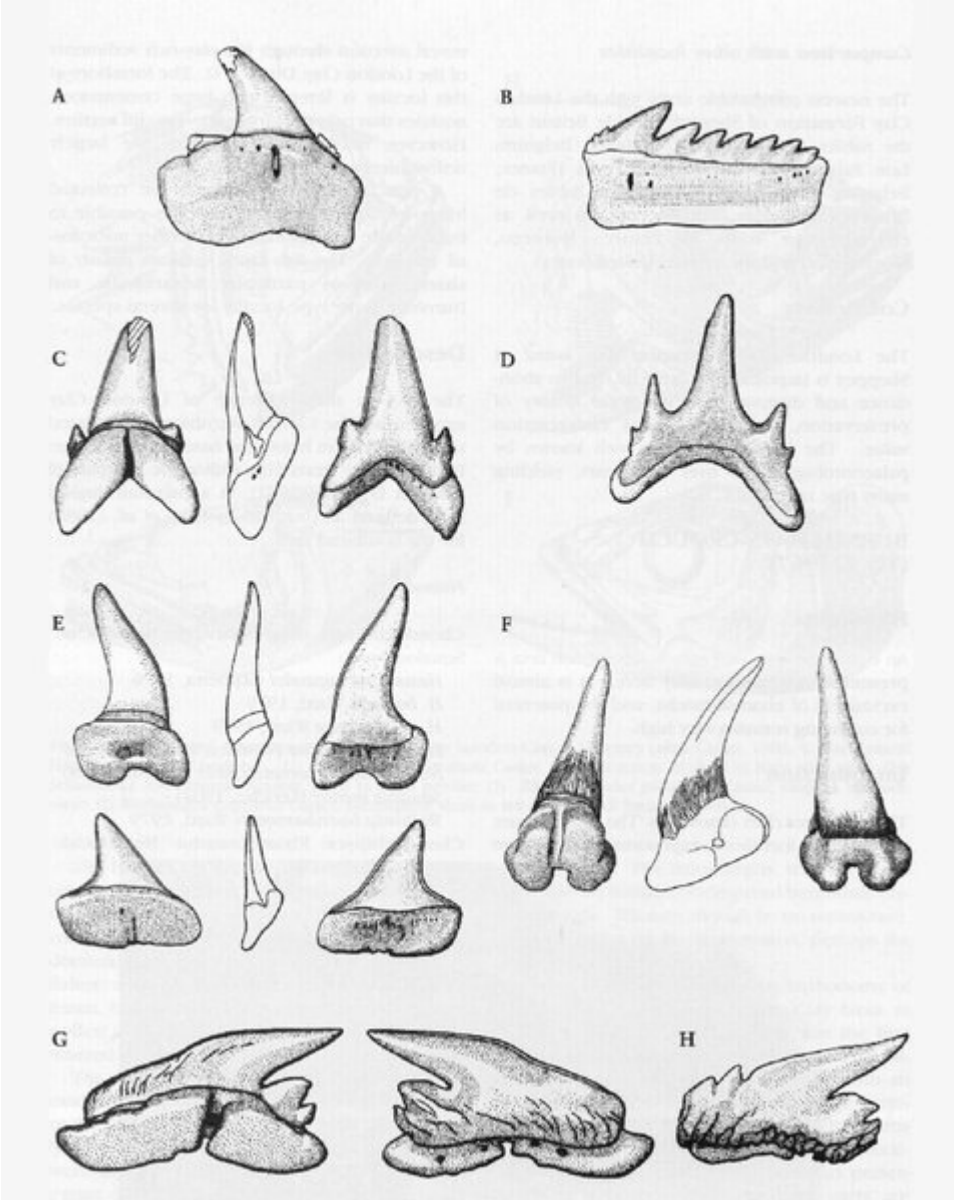


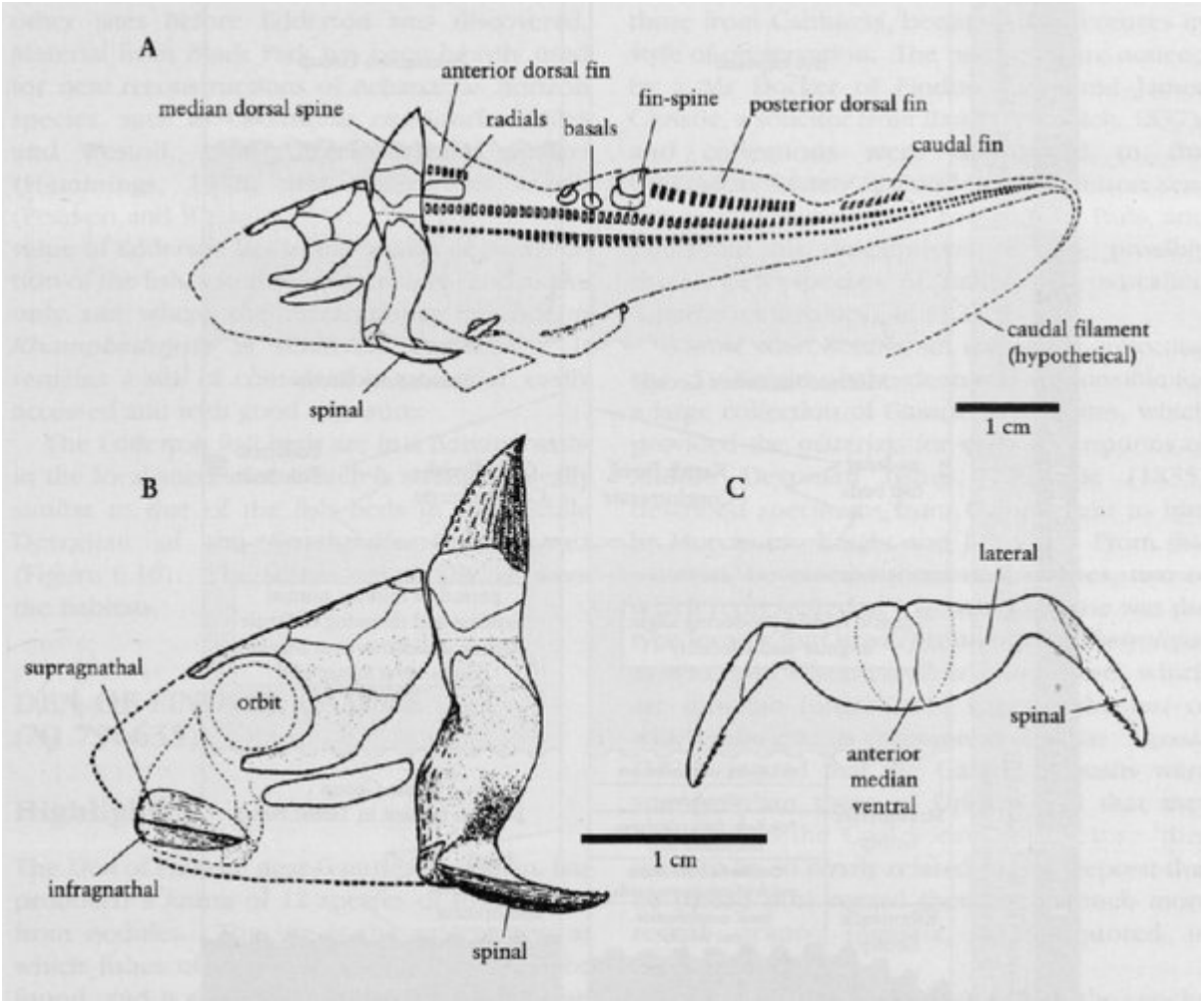
(Figure 14.7) Fossil fishes from the London Clay at Bognor Regis. (A) labial, mesial and lingual views of Isistius triangularis (Probst), lower lateral tooth (after Capetta, 1987), x 9; (B) Isurolamna affinis (Casier): (B') anterior tooth, labial and lingual views x 2; (B") antero-lateral tooth, labial view x 2; (C) Myliobatis dixoni Agassiz median tooth, basal view, x 2; (D) Otodus obliquus Agassiz: (D') upper lateral tooth labial view x 1; (D") lower anterior tooth, lingual and labial views, x 1. (B)-(D) from Kemp et al., 1990).



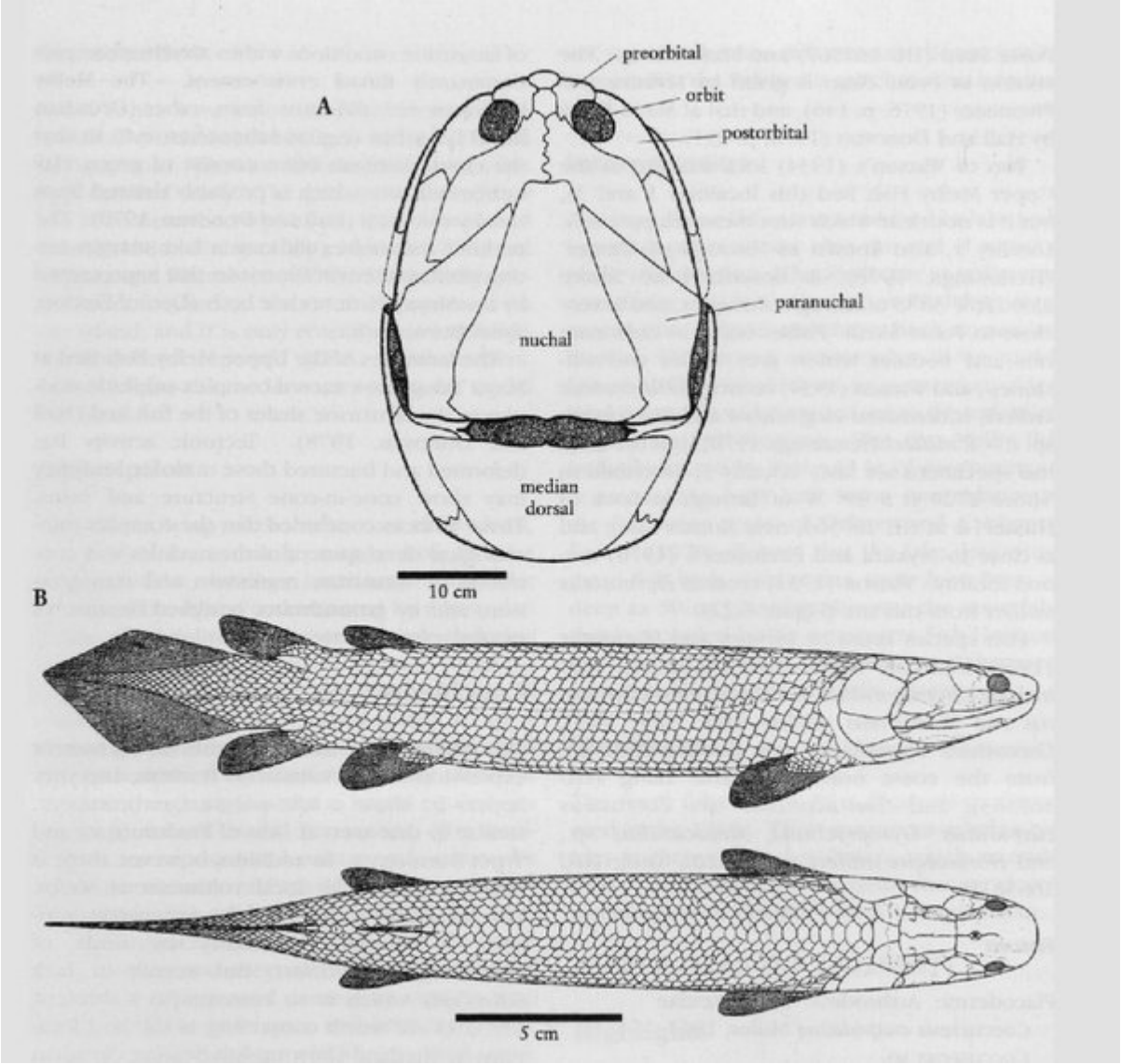
(Figure 14.9) Common elasmobranch fossils from the London Clay, as at the Isle of Sheppey (after Kemp et al., 1990). (A) Squatina prima (Winkler), lateral tooth (left) and anterior tooth (right), x 2.5. (B) Physogaleus secundus (Winkler) female antero-lateral tooth, x 2, lingual and labial views (left) and male antero-lateral tooth, lingual and labial views (right). (C) Carcharias hopei (Agassiz), lower anterior tooth, x 1.23, labial lateral and lingual views (left) and upper lateral tooth, lingual view (right). (D) Aetobatus irregularis (Agassiz), single tooth from lower dentition, x 1.2, basal and occlusal views. (E) Burnhamia daviesi (Woodward), tooth, x 1.25, occlusal, basal and lateral views.



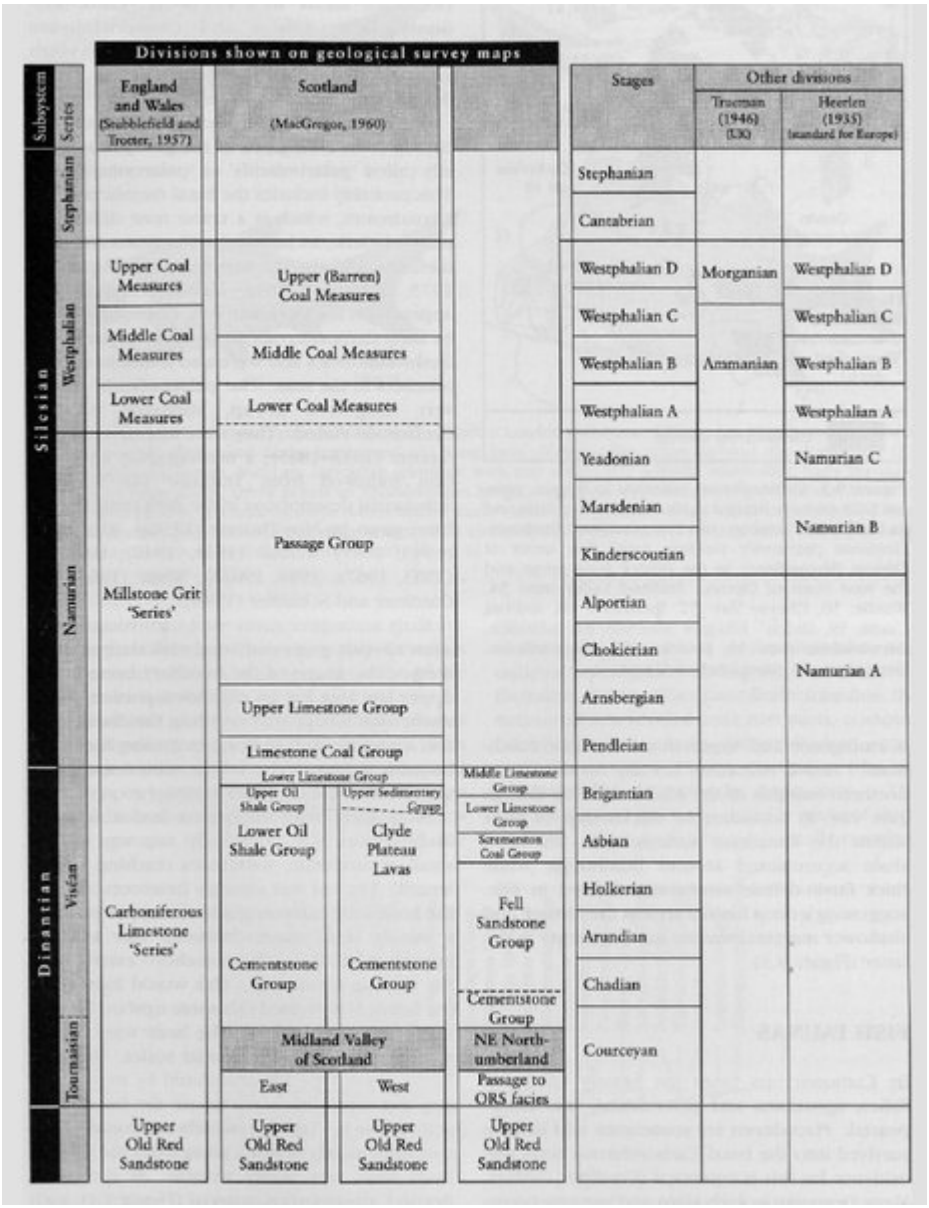
(Figure 14.12) Chondrichthyes from Sheppey and Burnham-on-Crouch. Sheppey: (A) Notorhynchus serratissimus upper anterolateral tooth, x 5. Burnham-on-Crouch: (B) Hexanchus agassizi, lower lateral tooth, x 5; (C) Hypotodus verticalis, lower anterior tooth, x 4; (D) Odontaspis winkleri, lower lateral tooth, x 4; (E) Xiphodlamia ecocaena, x 3; (F) Megascyliorhinus cooperi, x 10; (G) and (H) Triakis wardi: (G) lower lateral tooth, X 2; (H) upper lateral tooth, X 2. (All figures after Cappetta, 1987.)



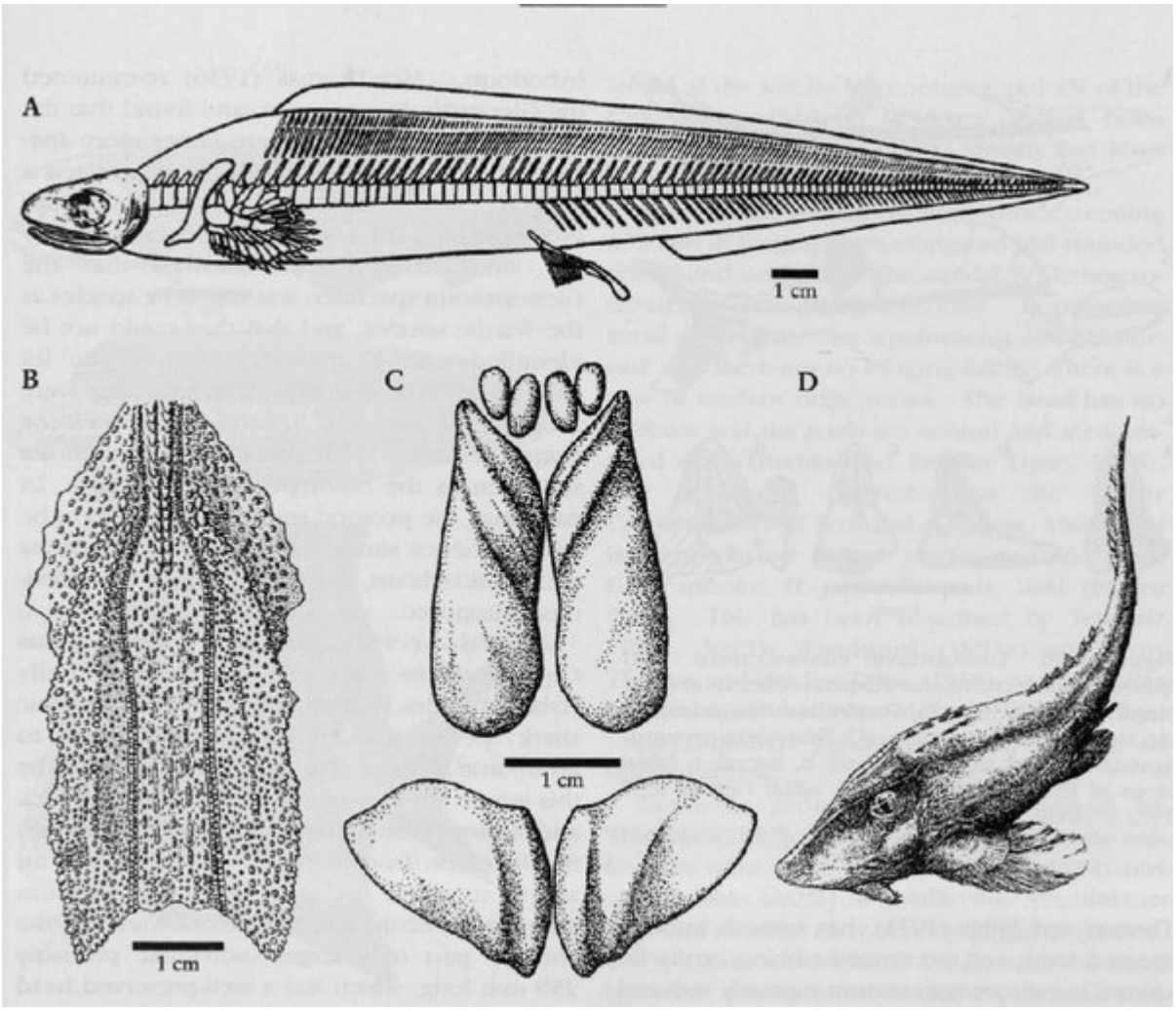
(Figure 6.15) The Edderton ptyctodont Rhamphodopsis threiplandi Watson. (A) restoration of the skeleton in lateral view; (B) restoration of the skull in lateral view; (C) restoration of pectoral girdle in ventral view (after Miles, 1967).



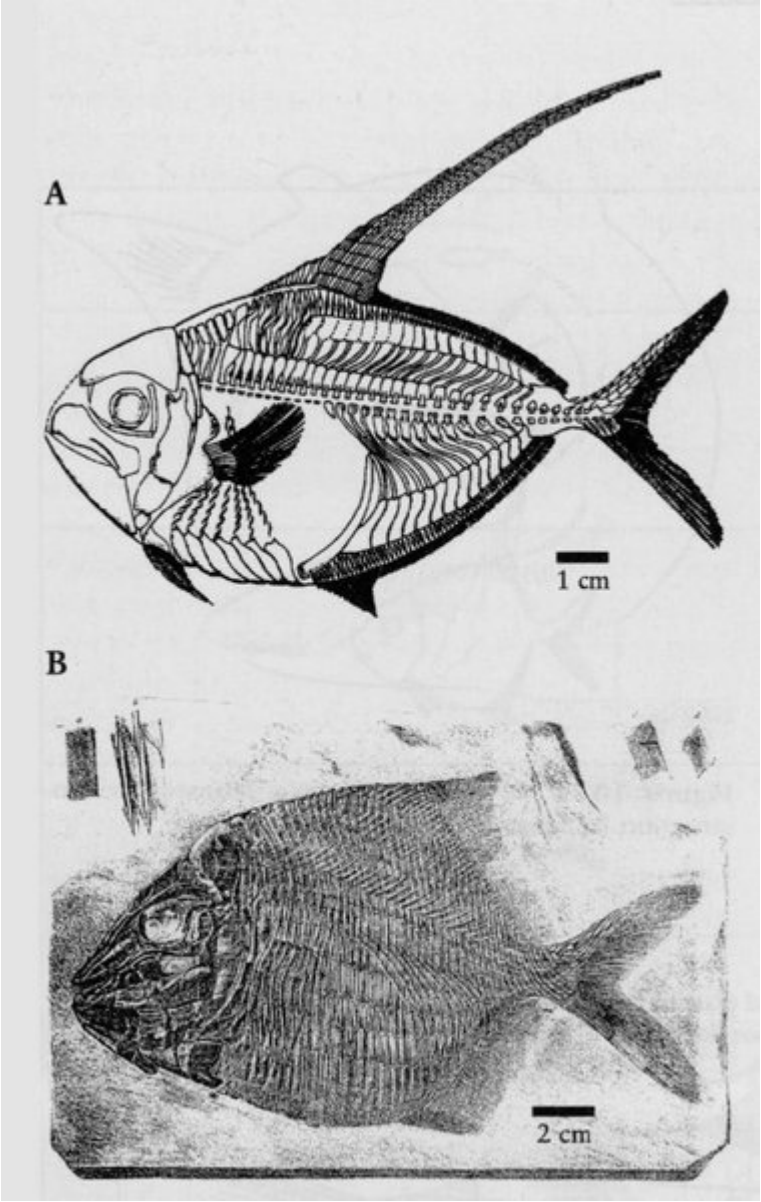
(Figure 6.22) Fishes from Melby: (A) dorsal view of the head and pectoral shield of the arthrodire Homosteus (after Moy-Thomas and Miles, 1971); (B) the osteichthyid Gyroptychius in dorsal and lateral view (after Jarvik, 1948a).



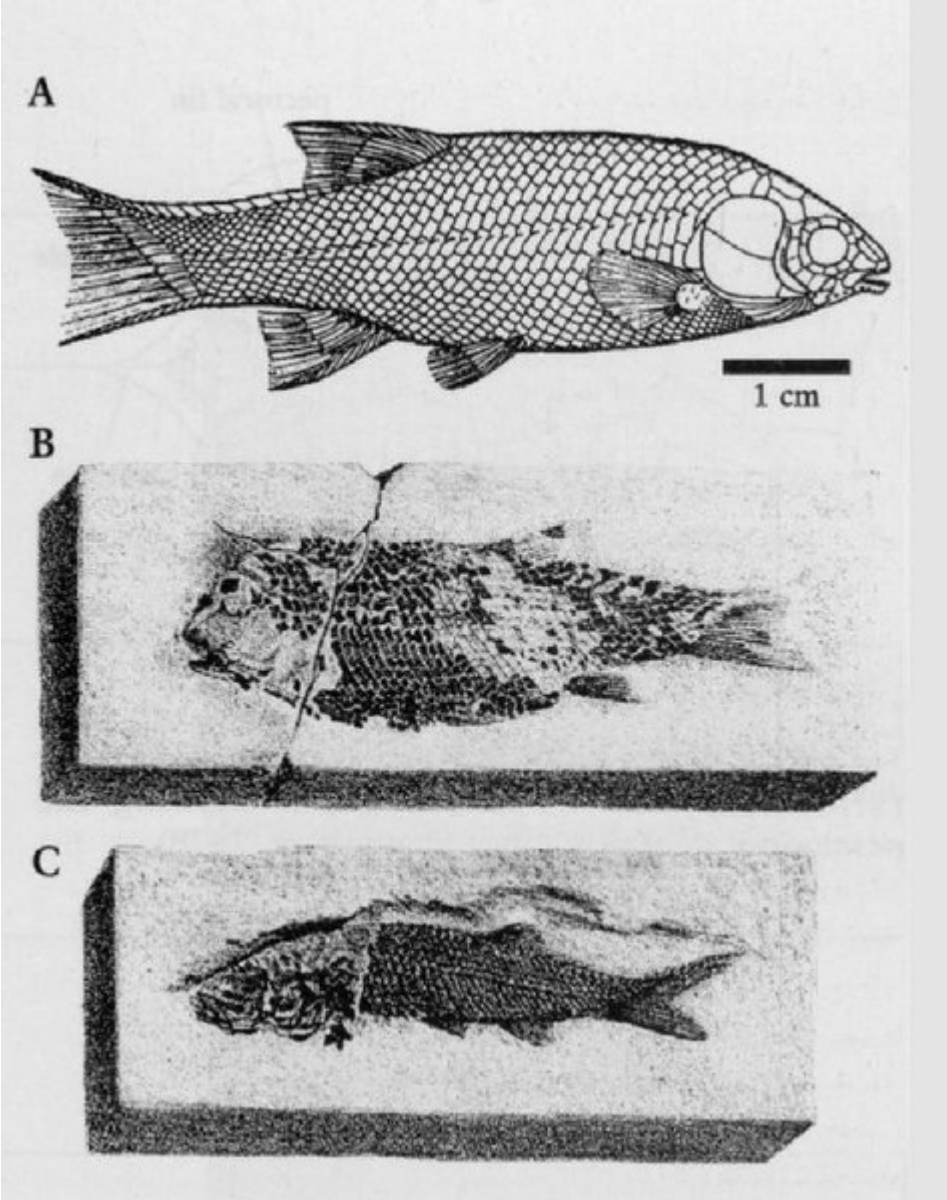
(Figure 9.2) Carboniferous stratigraphy and correlation (after MacGregor, 1960).



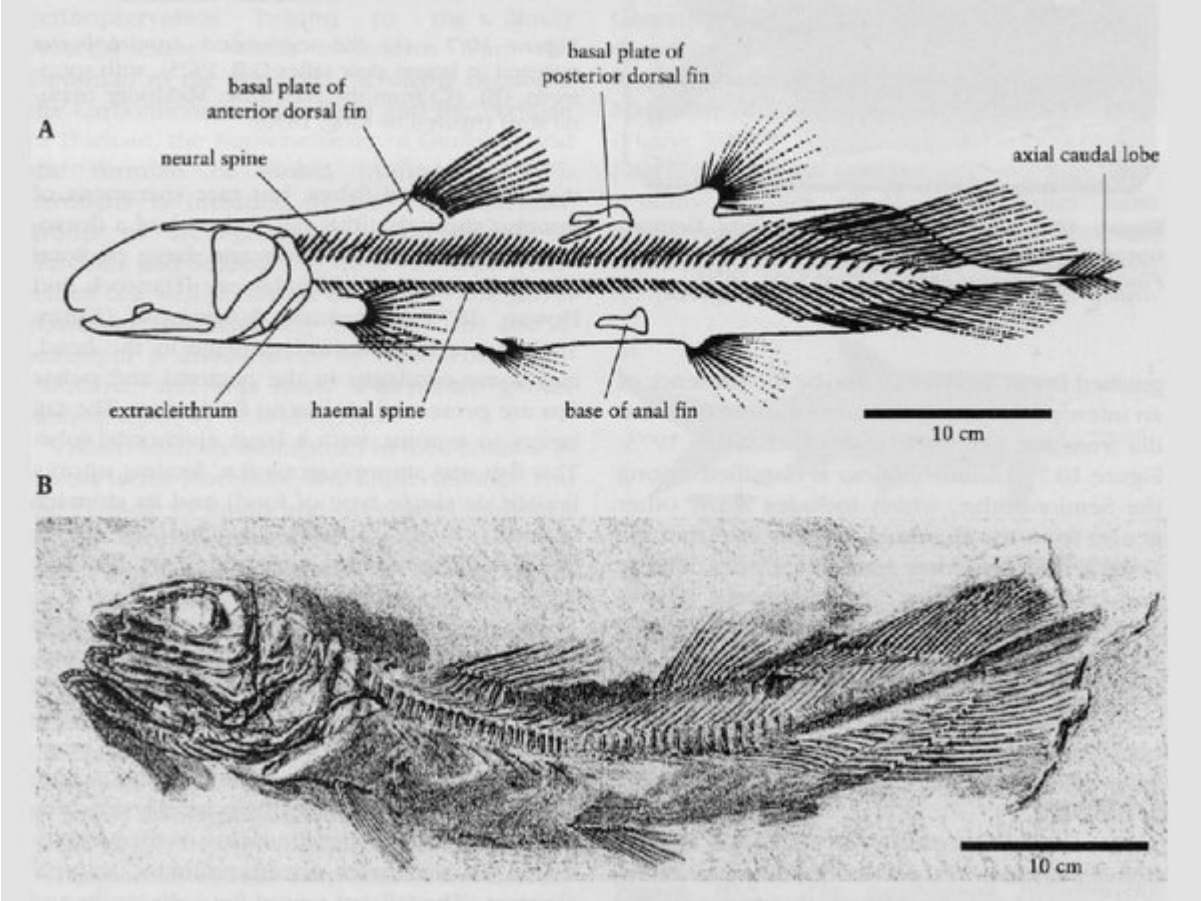
(Figure 9.21) Glencartholm holocephalians. (A) Chondrenchelys problematica Traquair in lateral restoration after Patterson (1965). (B) Deltoptychius armigerus Traquair, restoration of the headshield in dorsal view based on NHM P 11372 (after Patterson, 1966); anterior at top, incompletely fused tesserae make up the central part of the shield. (C) Dentition restored as if seen in front of wide-open mouth. (D) Deltoptychius, restoration of the fish courtesy of the Hunterian Museum, Glasgow; overall length of the specimen from Bearsden (q.v.) c. 60 cm.



(Figure 10.6) (A) Dorypterus hoffmanni Germar, restoration in lateral view (after Westoll, 1941); (B) Platysomus striatus Agassiz (from King, 1850).



(Figure 10.7) (A) the semionotid Acentrophorus restored in lateral view (after Gill, 1925), with specimens, (B), (C) from the Marl Slate, Middridge (natural size) (figured by King, 1850).



(Figure 10.9) (A) Coelacanthus granulatus Agassiz, a restoration in lateral view (after Moy-Thomas and Westoll, 1935); (B) specimen from the Marl Slate, Middridge, figured by King (1850).