DURLSTON BAY

OS Grid Reference: SZ035772–SZ039786

Highlights

The fish fauna from the Purbeck Limestone Group of Durlston Bay, Swanage is of special interest as it represents the latest occurrence in Britain of typical Jurassic fish assemblages. The fish remains are mostly fairly well preserved and 32 species have been described from this locality.

Introduction

The 2 km stretch of coastal sea cliffs between Peveril Point and Durlston Head near Swanage, Dorset, displays the finest sections of the Purbeck Limestone Group in Britain and comprise the type locality for the Formation (Figures 12.24 and 12.25). The strata of the Purbeck Limestone Formation here are famous for their exceptionally diverse fauna, which includes mammal remains unique to the early Cretaceous of Britain, and important reptilian material. The remarkable fish fauna has been known since 1816 (Webster, 1816). Museum collections made in the mid- and late 19th century formed part of A.S. Woodward's monograph upon the fossil fishes of the late Jurassic and early Cretaceous succession of the south coast of England (Woodward, 1915–1919). Both freshwater and marine forms occur, including abundant holostean material and teleost fishes. Durlston Bay is the type and only locality for two species of early teleost, *Thrissops molossus* and *Pachythrissops laevis*. It is also the type location for the coelacanth *Holophagus purbeckensis*.

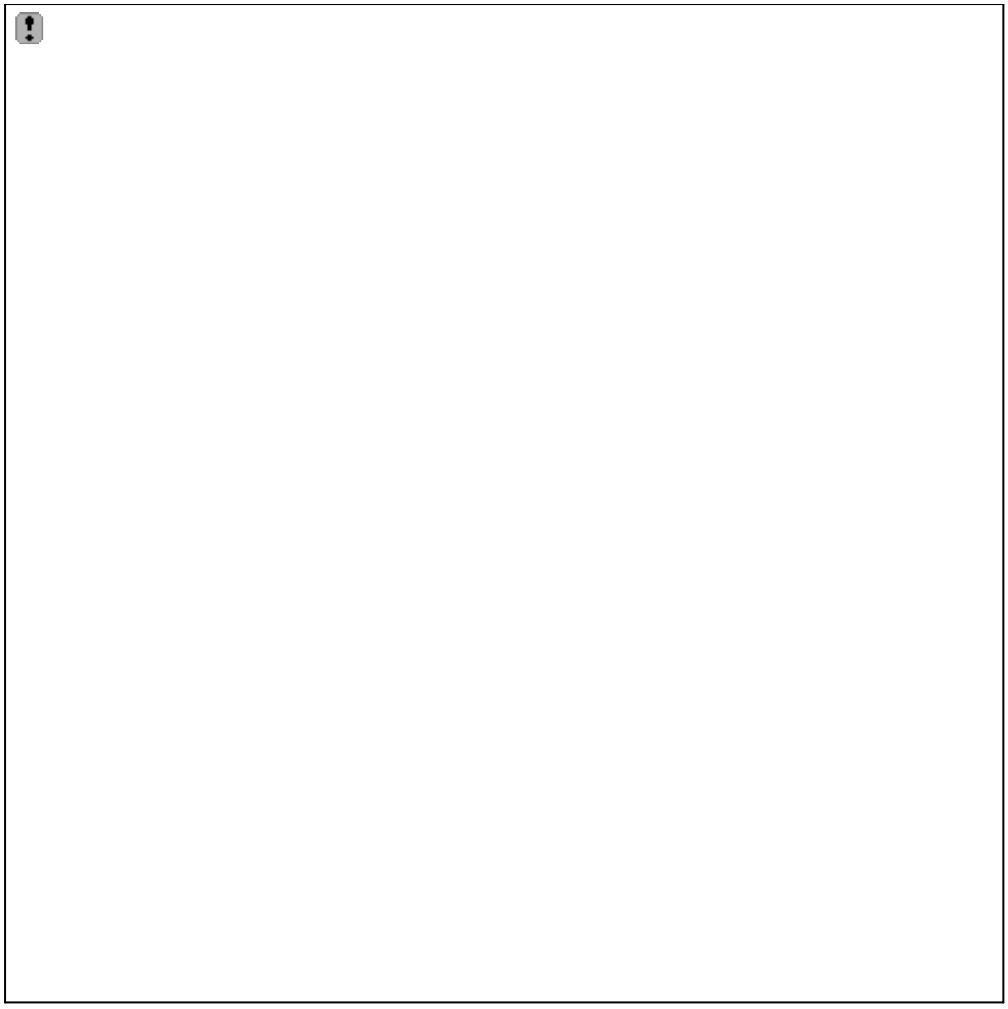


Figure 12.24: The uppermost Jurassic and Lower Cretaceous shales and limestones in the northern part of cliff section at Durlston Bay (photo: J.L. Wright).

Most of the vertebrates from Durlston have been obtained from the natural cliff exposures, but some of the more complete fish remains came from underground workings for the Purbeck ‘Building Stones'. Although the latter source for fish material is no longer available, the extensive cliff exposures continue to yield new specimens. Many finds were made in the early 19th century by S.H. Beckles, in the course of his excavation of the cliff in an area, just north of the ‘Zigzag path', that is, well south of the outcrop of the mammal bed at beach level.

The Purbeck section at Durlston Bay (Figure 12.26) has been described with varying degrees of accuracy by many authors (Austen, 1852, pp. 9–16; Bristow and Fisher, 1857, pp. 245–54; Strahan, 1898, pp. 91–6; Arkell, 1933, pp. 521–9; Clements, *in*Torrens, 1969a, figs A35–37, 1993). Cope and Clements (*in*Torrens, 1969a, pp. A57–A64), and MacFadyen (1970, pp. 134–52) gave a history of research on the stratigraphy and palaeontology of the Durlston section.

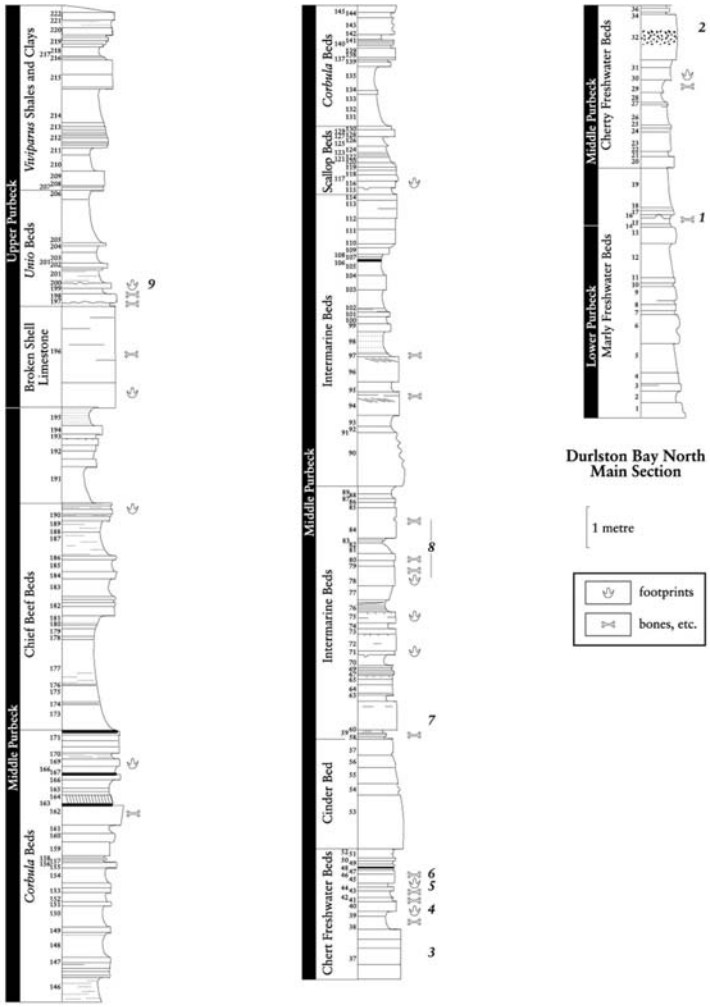


Figure 12.26: Stratigraphical section through the Purbeckian at Durlston Bay (after Benton and Spencer, 1995, and based on Wimbledon and Hunt, 1993). Numbers are those of Clements (in Torrens, 1969a).

Description

The section of the Purbeck Limestone Group at Durlston Bay is based on the annotated stratigraphical logs of Clements (*in*Torrens, 1969a; 1993), where bed numbers are prefixed DB (Figure 12.25 and 12.26, Table 12.1). Clements' reappraisal of the stratigraphy provided a bed-by-bed account of the succession (1993, pp. 183–203). Other sections are given by Wimbledon and Hunt (1983, p. 270) and Wimbledon (*in*Benton and Spencer, 1995, p. 205, fig. 7.14). Figure 12.25A details the northern part of Durlston Bay (between Peveril Point and the 'Zig-zag' path), showing the occurrence of numbered Purbeck beds based upon those byNunn (1992) and Clements (1989a, 1993). The succession in the southern part of Durlston Bay ('Zig-zag' path to Durlston Head) was sketched by Strahan (1898; Figure 12.25B).

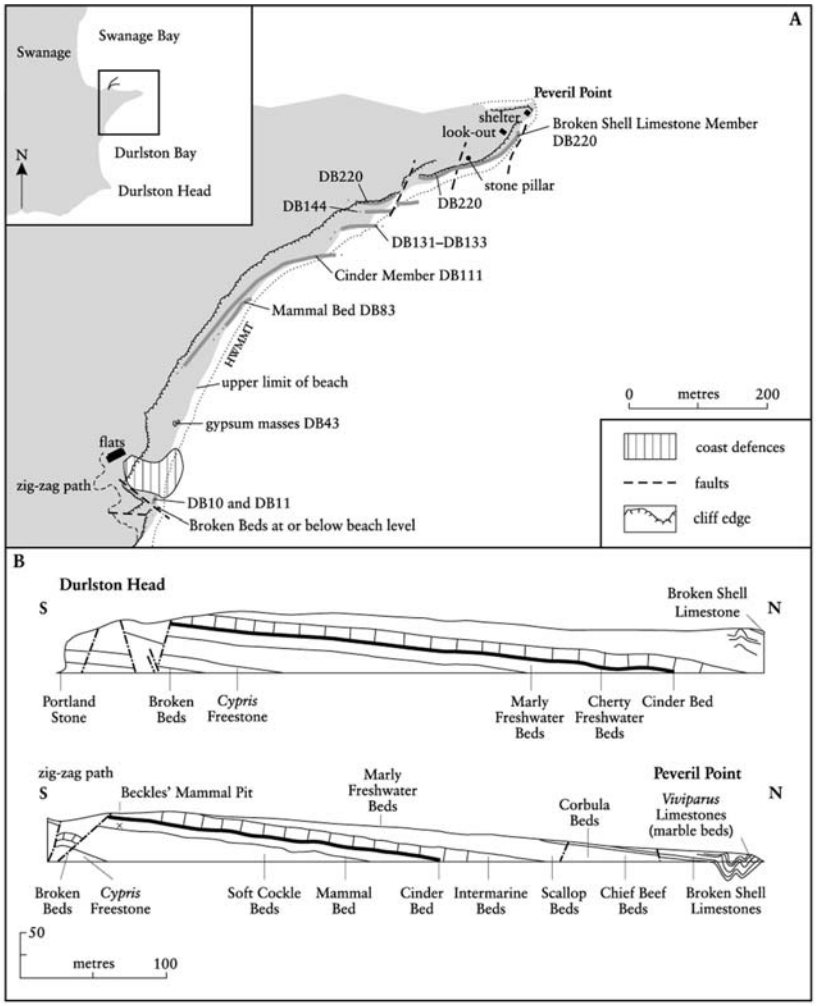


Figure 12.25: (A) Sketch map of the northern part of Durlston Bay (after Clements, 1993); letters and numbers refer to Clements' labelling of the beds. (B) Cliff profile at Durlston Bay (after Clements, 1993; Benton and Spencer, 1995).

The Purbeck beds of Durlston Bay were formerly united in the lithostratigraphical Purbeck Limestone Group by Townson (1975), Melville and Freshney (1982) and Clements (1993), although other authors (e.g. Ensom, 1985; Allen and Wimbledon, 1991) have treated them as a formation. Traditionally the beds are divided into three informal units, the 'Upper', 'Middle' and 'Lower' divisions, and the group as a whole has been split into two formal lithostratigraphical formations, the Durlston Formation above, and the lower, Lulworth Formation (Townson, 1975; Clements, 1993). Ensom (1985) formalized the minor lithostratigraphical divisions of Bristow (Bristow and Fisher, 1857, and *in* Damon, 1884) as members (Figure 12.26 and Table 12.1, modified after Clements, 1993, and Benton and Spencer, 1995). Individual beds within the members of the Purbeck Limestone Group are often informally named; this nomenclature is ingrained in the literature and was not dropped during the formal definition of the section by Clements (1993).

The Purbeck Limestone Group is generally taken to span the Jurassic–Cretaceous (Portlandian–Berriasian) boundary. However, ammonites have not been found in these beds, and the stratigraphy is based on palynomorphs, ostracods and gastropods. The position of the boundary between the Cretaceous and Jurassic has been in dispute (Birkelund *et al.*, 1978), but an integrated approach to correlation has made it possible to determine the base of the Berriasian in the section. Recent opinion places the system boundary within the *Cypris*' Freestone Member (Beds DB10–DB33; Figure 12.26; Table 12.1), quite low in the formation (Allen and Wimbledon, 1992).

Fossil fishes have been recorded from several levels in the sequence, between the Mammal Bed (Bed DB83 of the Marly Freshwater Member) at the base of the 'Middle Purbeck Beds' and the Upper '*Cypris*' Clays and Shales Member (Beds DB224–DB245), found in the highest part of

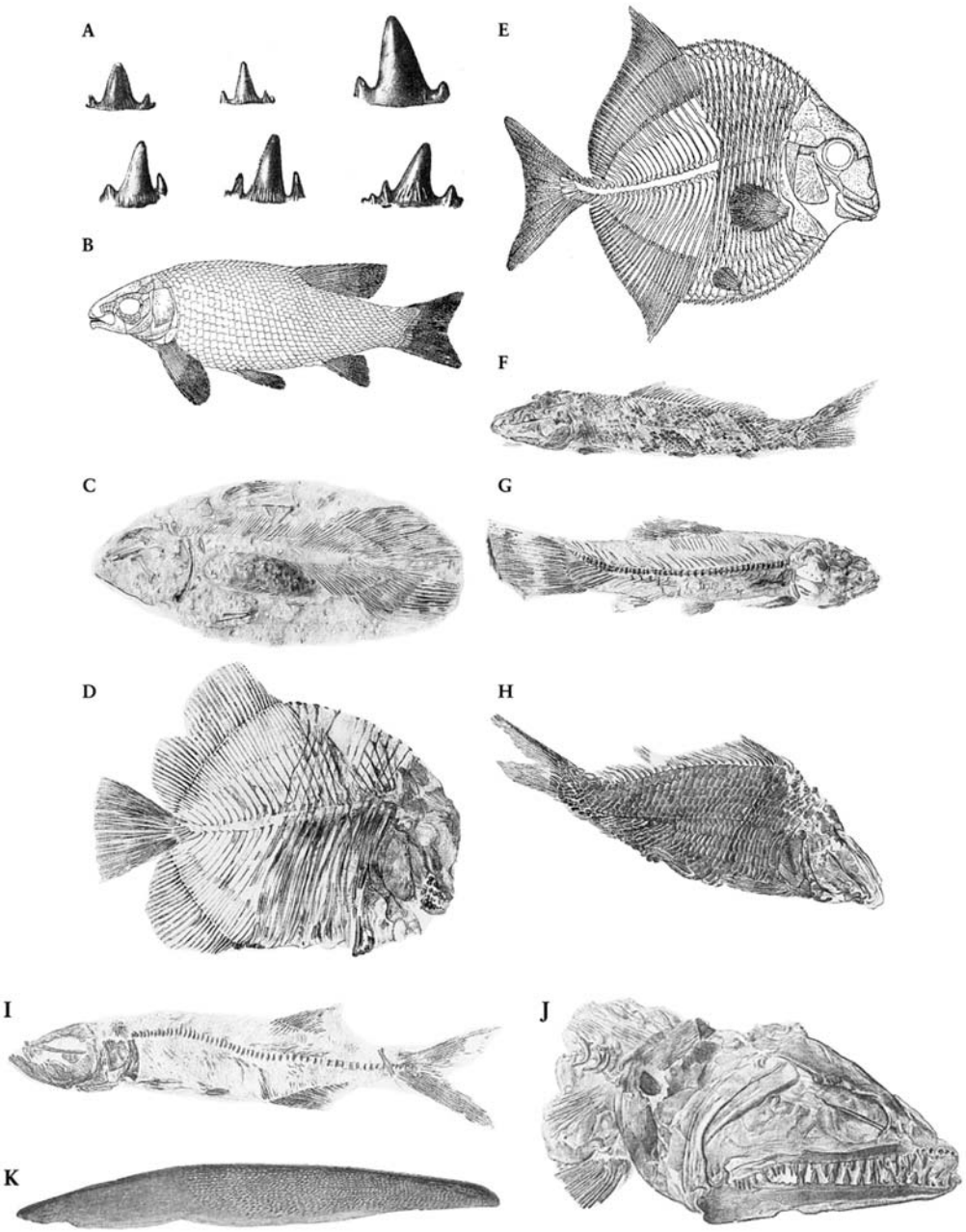
the ‘Upper Purbeck Beds' succession:

		Thickness (m)
DB221	Crocodile Bed (Bed 6 of Austen; Bed 81 of Bristow; Bed 200 of Allen and Wimbledon): plants, coprolites, fish, turtles, crocodiles	0.15
DB220	Broken Shell Limestone Member (Soft Burr) (Bed 9 of Austen; Bed 78 of Bristow; Bed 196 of Allen and Wimbledon): fishes and turtles	0.15
DB154–DB188/189	*Corbula* Member (Beds 22–44 (in part) of Austen; Beds 59–70 of Bristow; Beds 131–174 of Allen and Wimbledon): insects, fishes, turtles and footprints (West and El-Shahat, 1985	7.6
DB112–DB145	Intermarine Member or Upper Building Stones (Beds 45–70, Turtle Beds of Austen; Beds 45–57, Intermarine Beds of Bristow; Beds 58–114 of Allen and Wimbledon): DB133, Red Rag (Bed 52 of Austen; Bed 54 of Bristow) yields fishes, turtles and coprolites	0.1
DB113	(Bed 69 of Austen; Bed 45d of Bristow; Bed 61 of Allen and Wimbledon) contains the remains of fishes and reptiles	0.5
DB87–DB110	Cherty Freshwater Member (Beds 72–88 of Austen; Beds 25–42 of Bristow; Beds 20–52 of Allen and Wimbledon): DB102 has yielded a diverse microvertebrate assemblage including fish (Ensom, 1988), amphibians, reptiles (Ensom *et al.*, 1991) and mammals (Ensom, 1987, 1988)	0.05
DB83	The Mammal Bed (‘Dirt Bed') of Beckles excavations (Bed 93 of Austen; Bed 22 of Bristow; Beds 14–16 of Allen and Wimbledon): has yielded plant remains, ostracods, gastropods, bivalves, fish, reptiles (Benton and Spencer, 1995) and mammals	0.1

Although fish remains are found throughout the sequence, the best specimens are concentrated within the Intermarine Member or Upper Building Stones (DB112–DB145) of the ‘Middle Purbeck Beds' (Woodward, 1915–1919). Many of the bony fishes in these limestone units are represented by whole or partial skeletons. However, many specimens have been crushed during lithification and details are lost (Woodward, 1915–1919).

Fauna

Thirty-two species of fish have been recorded here (Figure12.27). Many specimens, however, are labelled merely ‘Middle Purbeck Beds: Swanage' (e.g. Woodward, 1915–1919), and they could have come from some of the inland quarries. Fish collections in the following institutions were examined: NHM, BGS(GSM), CAMMZ, CAMSM, DORCM and OUM. References include Davies (1887) and A.S. Woodward (1890, 1895a, 1915–1919).



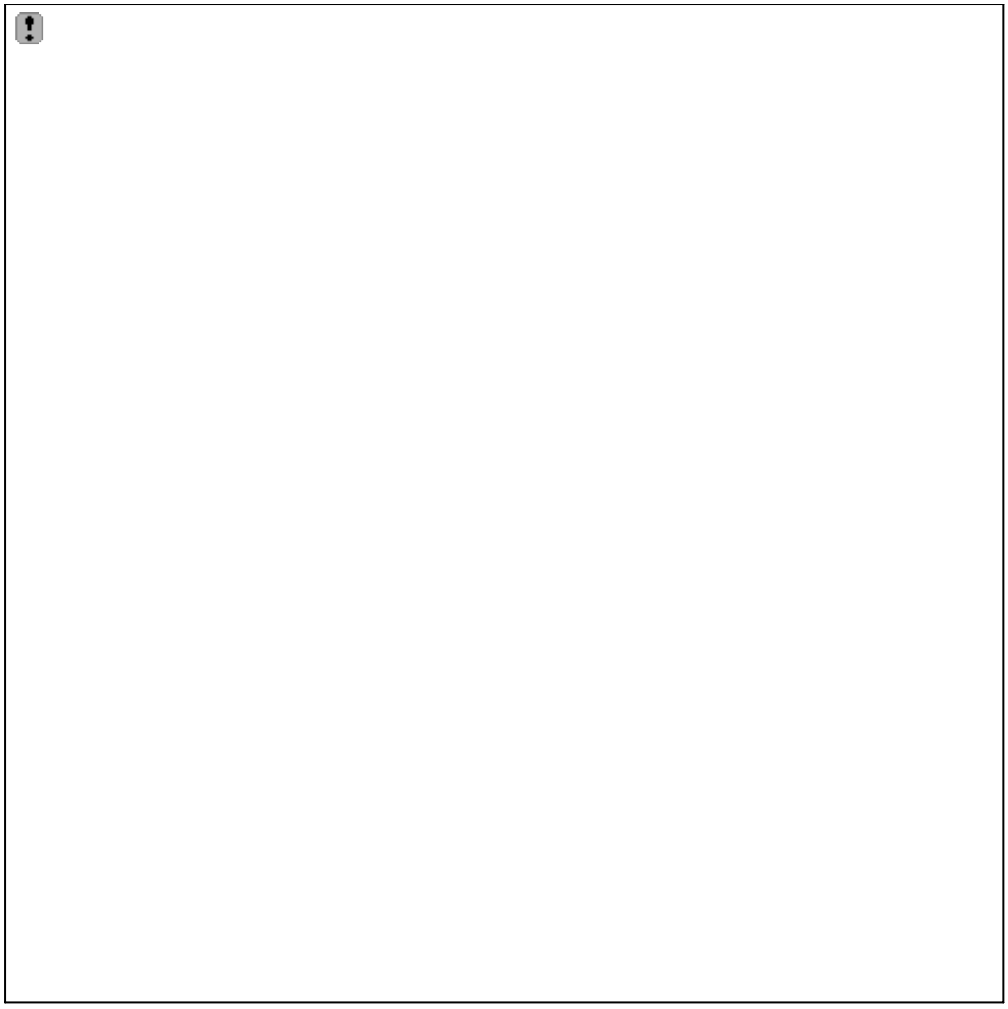


Figure 12.27: Fossil fishes from the Middle Purbeck Beds of Durlston Bay. (A) Hybodus ensis Woodward, teeth × 1; (B) Lepidotes minor Agassiz, × 0.3; (C) Holophagus purbeckensis Woodward, × 0.2; (D) Macromesodon daviesi (Woodward), × 0.5; (E) Proscinates (Microdon) radiatus Agassiz, × 0.5; (F) Ophiopsis dorsalis Agassiz × 0.3; (G) Amiopsis damoni (Egerton), × 0.3; (H) Histionotus angularis Egerton × 0.5. Figures from Woodward (1889–1901) © The Natural History Museum, London. (I) Pachythrissops laevis Woodward, × 0.25; (J) Caturus purbeckensis Woodward, head × 0.5; (K) Asteracanthus verrucosus Egerton fin spine × 0.5; (L) Lepidotes sp. × 0.5 (Photo: courtesy The Natural History Museum, London, T00562/A).

Chondrichthyes: Elasmobranchii: Euselachii: Hybodontoidea

Asteracanthus verrucosus Egerton, 1854

A. semiverrucosus Egerton, 1854

Hybodus ensis Woodward, 1915–1919

H. strictus Woodward, 1915–1919

Hybodont cephalic spines

Osteichthyes: Actinopterygii: Neopterygii: Halecostomi

Lepidotes minor Agassiz, 1833–1837

L. notopterus Agassiz, 1835–1837

Lepidotes sp.

Macromesodon daviesi Woodward, 1890

Macromesodon sp.

Eomesodon barnesi Woodward, 1906

E. depressus Woodward, 1915–1919

Eomesodon sp.

Proscinates (Microdon) radiatus Agassiz,

1839–1844

Ophiopsis dorsalis Agassiz, 1844

Histionotus angularis Egerton, 1855

Osteichthyes: Actinopterygii: Neopterygii: Halecomorphi

Caturus (Strobilodus) purbeckensis (A.S.

Woodward, 1890)

C. tenuidens A.S. Woodward, 1895

Amiopsis (Megalurus) austeni (Egerton,

1858a)

A. damoni Egerton, 1858

Aspidorhynchus fisheri Egerton, 1854

Osteichthyes: Actinopterygii: Neopterygii: Teleostei

Pholidophoristion ornatus Agassiz,

1843–1844

Pholidophorus granulatus Egerton, 1855

Ichthyokentema purbeckensis Davies, 1887

Pleuropholis crassicauda (Egerton, 1858a)

P. longicauda (Egerton, 1858a)

Leptolepis sp.

Pachythrissops laevis Woodward, 1915–1919

Thrissops molossus Woodward, 1915–1919

Osteichthyes: Sarcopterygii: Actinistia *Holophagus (Undina) purbeckensis* Woodward, 1915–1919

Interpretation

The shark fauna of the Purbeck Limestone Group at Durlston Bay is similar to other Jurassic selachian assemblages, being composed largely of the isolated teeth, fin and cephalic spines of hybodonts. Four hybodont species have been described from the ‘Middle Purbeck Beds' of the Swanage region. *Hybodus ensis* Woodward, 1915–1919 is a tooth genus (Figure 12.27A), although Woodward referred fin spines from the same bed to the same species. *H. strictus* Agassiz, 1837 was named from a large dorsal fin spine from the Purbeck Limestone of

Swanage. Spines have also been referred to *Asteracanthus* (Egerton, 1854; Woodward, 1915–1919). Both *A. verrucosus* Egerton (Figure 12.27K) and *A. semiverrucosus* Egerton were named from distinctive large ornamented dorsal fin spines recovered from the 'Middle Purbeck Beds' and housed in the DORCM.

An exceptional primitive neopterygian fish fauna (Figure 12.27) was recovered from the 'Middle Purbeck Beds' of Swanage in the 19th century. Primitive actinopterygians such as those at Lyme Regis or Whitby are not known from the Purbeck Limestone Group of Dorset, though they have been reported from the Lower Purbeck of Teffont, Wiltshire (Woodward, 1891a). The Durlston Bay fauna is dominated by the semionotids and pycnodontid neopterygians. Two species of the semionotid *Lepidotes* occur at Swanage, including the type of *L. minor* Agassiz. This large species (up to 0.4 m in length), represented by numerous near complete specimens (Figure 12.27B), varies between a deep-bodied form with a rounded back (e.g. BGS(GSM) 27975) and a slim-bodied fish (Woodward, 1915–1919). *Lepidotes notopterus* Agassiz, a more delicate species known from the Lithographic Limestone of Solnhöfen, Germany, also occurs. Jaws and common isolated teeth of pycnodonts in the Purbeck Limestone Formation of Durlston Bay are mostly specifically indeterminate. However, more complete and rare specifically diagnostic specimens have been found at this and other Purbeck localities in Dorset and Wilstshire. *Macromesodon (Meso-don) daviesi* (Woodward, 1890), named upon a nearly complete fish (Figure 12.27D) from the 'Middle Purbeck' of Swanage, is a small (up to 0.25 m in length) deep-bodied pycnodont, with saddle-shaped scales ornamented with a row of four or five denticles (Woodward, 1890). The similar pycnodont, *Eomesodon*, is also present in the Purbeck Limestone Formation of Swanage and the Portland Stone of the Isle of Portland (Woodward, 1915–1919). *Eomesodon* had a much deeper body than *Mesodon* and possessed a prominant dorsal 'hump' which overhung the pectoral girdle and head. The head of *Eomesodon* is also more triangular in profile (Woodward, 1915–1919). Two species from the 'Middle Purbeck Beds' of Swanage are *E. barnesi* and *E. depressus* Woodward. The latter species is based upon a poor specimen from the Purbeck Formation of Durlston (Woodward, 1915–1919). *Proscinates radiatus* Agassiz (Figure 12.27E) was also named from a partial skeleton recovered from the 'Middle Purbeck' of the Swanage area. The species is represented by several specimens better preserved of features than the type (Woodward, 1915–1919). *Proscinates* possessed a deep and almost disc-shaped body in which the body depth almost equalled the length from the head to the base of the tail. The semionotid and pycnodonts had a specialized dentition of strong, stud-like palatine teeth and chisel-shaped premaxillary teeth, and are thought to have eaten a durophagous diet of molluscs and crustaceans.

The halecostomids are also represented in the Purbeck Limestone Group of Durlston Bay by the macrosemiids, which usually possessed a large and elegant dorsal fin (Bartram, 1977; Frickhinger, 1991) such as *Ophiopsis dorsalis* Agassiz and *Histionotus angularis* Egerton (Figure 12.27H). The type species of the macrosemiid genus *Histionotus* was based on a partial specimen from the 'Middle Purbeck Beds' of Swanage described by Egerton (1855) as *Histionotus angularis*. *Histionotus* was a medium-sized fish with a large head and pronounced dorsal hump, known from the Swanage species, two or three other species from the (Solnhöfen) Lithographic Limestone of Germany and France (Woodward, 1915–1919) and *H. angularis* Egerton from Tisbury, Wiltshire (Woodward, 1915–1919).

The halecomorphs are represented in the Purbeckian fish fauna by several species of the order Amiiformes, with caturids, amiids and aspidorhynchids present in the Durlston Bay sections (Woodward, 1915–1919). The ubiquitous Jurassic genus *Caturus* is known from fragments in the Purbeck Limestone Group of Dorset, with two species, *C. purbeckensis* Woodward and *C. tenuidens* A.S. Woodward named from fragmentary specimens (mostly jaws) from the 'Middle Purbeck Beds' of Swanage (Figure 12.27J). *Caturus* is a medium-sized fish with an elongate, fusiform trunk, robust head and deeply incised forked tail. *C. purbeckensis* was a much stouter and larger form than *C. tenuidens*.

The amiid *Amiopsis austeni* (Egerton) was also first described from a specimen from the 'Middle Purbeck' of Swanage and was assigned the genus *Megalurus* by Egerton (1858a). It was tentatively distinguished from the contemporaneous species *Amiopsis damoni* Egerton, but should be considered to be a *nomen dubium*. *Amiopsis* is a typical amiid with a large head, small, stout, styliform teeth and powerful jaws. It had an elongate, laterally compressed body covered in large oval scales, and a convex border to the caudal fin; it is known widely from the

Lower Cretaceous of Europe (Figure 12.27G).

Ophiopsis dorsalis Agassiz is a robust (up to 0.2 m) form which possesses a fusiform body and deeply forked caudal fin (Figure 12.27F; Woodward, 1915–1919). The genus is represented by *O. penicillata* Agassiz in the 'Lower Purbeck' of Weymouth, Dorset, and the Purbeck Beds of the Isle of Portland and the Purbeck of Wockley, near Tisbury, Wiltshire (represented by *O. breviceps* Egerton). Species are diagnosed on their scale types, cranial anatomy and fin morphology (Woodward, 1915–1919).

The aspidorhynchids had a long, thin, fusiform body with robust, smooth rectangular scales and an elongated, slender rostrum, which projected out in front and overhung the mandible. They are also characterized by their symmetrically forked tail and relatively tiny paired and unpaired fins. The aspidorhynchids are represented in the Purbeck Limestone of Dorset by *Aspidorhynchus fisheri* Egerton. This is a species attaining a length of approximately 0.4 m, the head tapering to an acute rostrum, which projected a total of one-third of the length of the cranium (Woodward, 1915–1919). *Aspidorhynchus fisheri* is the last representative of this important Jurassic genus.

Primitive teleosts are fairly abundant in the rocks of the Purbeck Limestone Group of Dorset and include representatives of the orders Pholidophoriformes, Leptolepiformes and Ichthyodectiformes. Both pectinate-scaled and smooth-scaled forms of *Pholidophorous* occur in the Purbeck Limestone, and *P. ornatus* Agassiz and *P. granulatus* Egerton have been described from the 'Middle Purbeck' of Swanage (Woodward, 1915–1919). *Pholidophorus* is also known from the Purbeck Group of Weymouth, Isle of Portland, and Teffont, Wiltshire. The pholidophorids of the Purbeck Group are the last occurrence of this primitive teleost group. The Pleuropholidae are only known from one genus, *Pleuropholis*, which was originally described by Egerton (1854) for a small (<0.1 m) sprat-like form with a tiny mouth, from the 'Middle Purbeck' of Sutton Mandeville, Wiltshire. Other species were later named from the Purbeck Limestone Group of Wiltshire and Dorset. The small and rare *Ichthyokentema* has been described by Griffith and Patterson (1963).

The leptolepids are only represented at Durlston Bay by undiagnostic fragments of the form genus *Leptolepis*, but there are two species of ichthyodectids and Durlston Bay is the type and only locality for both (Figure 12.26). The first, *Pachythrissops laevis* Woodward, is a large (0.5 m in length) species with a fusiform body, deeply forked tail and small head. The second, *Thrissops molosus* Woodward, is similarly a large form, attaining lengths up to 0.35 m, with a short, deep head and stout body. It also had a strongly incised forked caudal fin, with very delicate lobes. Both genera were covered in very thin and delicate cycloidal scales that are not often preserved as fossils, and had large bony gill-rakers (Woodward, 1915–1919). *Thrissops curtus* Woodward is distinguished from *T. molosus* on the basis of smaller size. Nybelin (1966, 1974a) and Forey (1973a) have suggested that *Pachythrissops* may be an early megalopid elopiform, as it shares osteological characters with Cretaceous forms and the modern-day tarpon *Megalops*.

The coelacanth *Holophagus purbeckensis* Woodward is only known from a single incomplete specimen from the 'Middle Purbeck Beds' of Swanage. The specimen lacks a head, but sufficient of the posterior portion of the body and the dorsal and caudal fins was preserved (Figure 12.27C) for Woodward (1915–1919) to erect the species. *Holophagus purbeckensis* is a stout fish which may have reached lengths of up to 0.4 m, and it possessed scales ornamented with coarse elongated tubercles (Woodward, 1915–1919).

Fossil amphibians have been recovered from bulk sampling two microvertebrate-rich clay horizons in the Cherty Freshwater Member (?Lower Cretaceous) at several localities on the Isle of Purbeck, Dorset (Ensom, 1987, 1988; Ensom *et al.*, 1991). The material includes abundant albanerpetontid salamander remains, and some discoglossid frog material which represent families known from the Middle and Upper Jurassic of Europe. However, more significant are the (as yet) undescribed jaw fragments representing the earliest record of a bactrachosauroidid salamander (Ensom *et al.*, 1991). The initial discoveries were made at Sunnydown Farm, near Langton Matravers (SY 982788), in two horizons correlated with DB102 and DB101 in Durlston Bay (Clements, 1993). DB102 has also been sampled at three other localties along a 6 km outcrop, including Durlston Bay, and at all these sites microvertebrates

were recovered (Ensom *et al*., 1991). However, so far, no amphibian material has been recovered from the Durlston Bay section, although P.C. Ensom (pers. comm., 1995) considers this to be partly due to collection failure.

Comparison with other localities

Similar Purbeck Limestone Formation faunas have been recovered from many localities in Dorset and Wiltshire, and these have been documented above. Specifically, these include the microvertebrate-rich beds at Sunnydown Farm (SY 982788), Suttle's Quarry (SZ 020777) and Lovell's Quarry (SY 980790), Dorset (Ensom *et al*., 1991), and an unconfirmed report of a fossil frog from the Purbeck of Swindon, Wiltshire (Hudleston, 1876). Purbeck fish faunas have been recovered from the 'Lower' and 'Middle Purbeck Beds' in the Vale of Wardour, Wiltshire, the Isle of Portland and Weymouth, Dorset, and from localities in Buckinghamshire (Woodward, 1915–1919).

Farther afield, elements of the Purbeck fish faunas are known in the Late Jurassic of Germany and France (Woodward, 1915–1919). The English Wealden (Early Cretaceous) fish assemblages and those from other parts of western and central Europe also contain remnants of the late Jurassic fauna.

Conclusions

The Purbeck beds of Durlston Bay have yielded one of the most important Late Jurassic fossil fish faunas in the world from which the site derives its conservation value. The Durlston fauna occurs in marine and non-marine rocks that occupy a unique position at the Jurassic–Cretaceous boundary; it includes amphibians and a diverse fish assemblage, including exceptionally preserved early teleosts.

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