Hastings

([TQ 831 095]–[TQ 887 129]) (Potential GCR site)

Highlights

The Early Cretaceous sandstones and shales that crop out along the East Sussex coast and foreshore east of Hastings have been famous for 100 years for specimens of fossil selachians and bony fishes. More recent discoveries include rare microvertebrate remains concentrated in the Cliff End Bone Bed, one of the richest bone accumulations in the Weald.

Introduction

The Hastings Beds (Early Cretaceous: Valanginian; (Figure 13.3)A) of the south Weald contain fossil fishes, reptiles and their footprints (Benton and Spencer, 1995) sporadically throughout the sequence. Hastings is the type locality for the hybodont shark *Hybodus parvidens* Woodward, 1889, and two species of the pycnodont fish *Coelodus,* recovered from the Wadhurst Clay beds. A primitive actinopterygian (possibly *Coccolepis*)has been recovered from the Wadhurst Clay at Hastings. This species was one of the last of the early actinopterygians species to evolve.

In the Hastings area, vertebrate-rich levels also occur within the thin sandstones and conglomeratic horizons. One such accumulation, the Cliff End Bone Bed, is particularly well known and the faunal assemblage, which includes abundant fish remains in association with rarer reptilian and mammalian material, has formed the basis of several reports on Wealden palaeoecology and taphonomy (e.g. Allen, 1949; Cook, 1995). The hybodont, '*Lonchidium*' *rhizion* (Patterson, 1966), was described from the Cliff End Bone Bed. At the type locality at Cliff End ([TQ 887 129]; (Figure 13.4)) some 7 km north-east of Hastings, the bone-bearing level occurs at the top of the cliff and is not easily accessible. However, the coast is subject to continuous crosion, and slabs of the bone bed arc frequently recovered from beach gravel at the foot of the cliff, following major storms and rock falls. Parts of the section are obscured by landslips and coastal erosion, but access to the beach is fairly good.

The stratigraphy of the Wealden of Hastings has been described by several authors (e.g. Beckles, 1856; Topley, 1875; White, 1928; Allen, 1976; Lake and Shephard-Thorn, 1987). The palaeoecological implications of the Cliff End Bone Bed have been described by Allen (1949, 1967), Clemens and Lees (1971) and Cook (1995).

Description

The geology of the coastal cliff sections around Hastings (Figure 13.4) has been described by Allen (1962), Stewart (1981b) and Lake and Shephard-Thorn (1987). The general succcession in the cliffs is presented below, and the position of the bone bed indicated, based on sections in Lake and Shephard-Thorn (1987; pp. 67–9):

	Thickness (m)
Hastings Beds	up to 50
Tunbridge Wells Sand	
Fine grained, yellowish sandstones and silts with impersistent seams of mottled silty clay	
Wadhurst Clay	50–57
Grey-green calcareous shales interlaminated with thin siltstones. Also: calcareous sandstone bed (Tilgate Stone), sandstone channel fills, soils and near the base	
Cliff End Bone Bed	
Cliff End Sandstone	
Top Ashdown Pebble Bed	10
Ashdown Beds	

The upper 30–50 m are chiefly sandstone, while the strata below are dominantly massive mottled sphaerosiderite sandstone beds Near the base:	180–200
Lee Ness Sandstone	1–2

Most of the fish finds have been made from the Wadhurst Clay at Hastings, East Cliff and Cliff End. However, some remains, including specimens of *Lepidotes* spp. and *Hybodus* spp., have also been found in the underlying Ashdown Beds exposed in the cliffs at East Cliff Hastings, Cliff End and Fairlight Cove (White, 1928). The Wadhurst Clay comprises a thick succession of clays, with interbeds of siltstone, sandstone, shelly limestone and thin conglomerates. The sequence becomes more arenaceous around Hastings and the coastal sections in this region are characterized by the thick and prominent Cliff End Sandstone, capped by the Cliff End Pebble Bed conglomerate. The Cliff End Bone Bed is laterally impersistent along the coastal section and may be equivalent to the pebble bed (Figure 13.5). In the type locality the bone bed occurs some 2.5 m above the Cliff End Sandstone, within the vegetated and land-slipped upper part of the cliffs ((Figure 13.4); Allen, 1967; Lake and Shephard-Thorn, 1987).

Vertebrate material is generally common throughout the Wadhurst Clay sequence, but specific bone beds are confined to east Sussex and parts of Kent (Allen, 1949). Two types of bone-rich accumulations are recognized in the Wadhurst Clay (Allen, 1949): the first are lenticular units of muddy sandstone (e.g. Brede Bone Bed); the other typically poorly sorted, cross-bedded conglomerates and pebbly sandstones, to which the Cliff End accumulation belongs. The Cliff End Bone Bed has been noted in inland sections, around Hastings, Rye and Guestling (White, 1928), and is thought to correspond with the Telham Bone Bed horizon exposed near Battle (e.g. Topley, 1875; Lake and Shephard-Thorn, 1987). Allen (1949) regarded the bone bed as a correlatable event horizon, restricted to the most eastern part of East Sussex and neighbouring parts of Kent, and lying on top of the 'Tilgate Stone' horizon (Lake and Shephard-Thorn, 1987, p. 28).

The Cliff End Bone Bed is a pale grey, coarse quartzose sandstone with a calcareous cement, about 0.2 m thick in its type locality. The unit is poorly sorted and contains sub-angular to well-rounded pebbles (up to 2 mm in diameter). Approximately 97% of the clasts are quartz. The remainder are sandstone pebbles and ferruginous claystone nodules, vertebrate debris and fossilized wood (Cook, 1995). Vertebrate material has been recovered by acid separation techniques and includes actinopterygian scales and teeth, shark teeth, along with rarer reptilian remains and mammalian teeth. The fauna and sampling methods are reviewed by Clemens (1963), Clemens and Lees (1971) and Cook (1995).

Dissociated vertebrate remains are scattered throughout the fossiliferous unit and all specimens show some fragmentation (Cook, 1995). Much of the material is heavily abraded and the bone bed is thought to have accumulated under a high-energy flow regime, and represents a winnowed channel lag deposit (Cook, 1995).

Fauna

The Hastings fish fauna (Figure 13.6) has been reviewed by Woodward (1915–1919), and the sharks in particular have received a more detailed study by Patterson (1966). Most of the specimens reside in the NHM and the SM.

Chondrichthyes: Elasmobranchii: Euselachii: Hybodontoidea

Hybodus ensis Woodward, 1911

H. basanus Egerton, 1845

H. parvidens Woodward, 1889

H. brevicostatus Patterson, 1966

Hybodus sp.

Hylaeobatis ornata (Woodward, 1889)

'*Lonchidion*' *rhizion* (Patterson, 1966) *nomen dubium*

Lissodus breve breve Patterson, 1966

L. (*L.*) *beterodon* Patterson, 1966

Osteichthyes: Actinopterygii: Neopterygii

Coccolepis sp.

Osteichthyes: Actinopterygii: Neopterygii: Halecostomi

Lepidotes mantelli Agassiz, 1833–1837

Coelodus mantelli (Agassiz, 1839–1844)

C. hirudo (Agassiz, 1839)

Interpretation

The palaeoenvironment of the Wadhurst Clay has been interpreted as pro-deltaic or lagoonal (Lake and Shephard-Thorn, 1987). The deposition of the Wealden of the Weald had formerly been interpreted as largely deltaic (e.g. Allen, 1959, 1962; Taylor, 1963), but P. Allen (1976, 1981a) revised his former theory in favour of a model in which the normal Wealden environment was a variable-salinity mudplain, periodically transformed into a sandy braidplain by powerful overloaded streams, the salinity changes being controlled by the rate of freshwater runoff. Allen (1981a) argued that many of the rivers were braided in their proximal portions, whereas Stewart (1981a, 1981b, 1983) emphasized evidence for meandering streams.

Allen (1976) interpreted the Wadhurst Clay pebble bed facies in terms of reworking of fluvial lags by non-marine transgressions across the low-lying Wealden floodplain. The Cliff End Bone Bed was interpreted as a high-energy lag deposit by Allen (1949) and Cook (1995), in which the vertebrate elements suffered several cycles of reworking and transportation.

The fish fauna from the Hastings district is largely represented by isolated skeletal elements and teeth of hybodont sharks and holostean-grade bony fish. The hybodonts are represented by at least four species of *Hybodus,* and Hastings is the type locality for one of these, *H. parvidens* Woodward, 1889 (Figure 13.6). This species was diagnosed from isolated teeth, and the holotype is from the Wadhurst Clay of Hastings. Teeth of a small freshwater hybodont shark found in the accumulation were assigned to the genus *Lonchidion* by Patterson (1966). Species pertaining to *Lonchidion* have recently been reassigned to the Mesozoic taxon, *Lissodus,* by Duffin (1985), but the specific determinations of Patterson (*L. breve* and *L. beterodon*) still stand. *Lissodus* is known only from isolated teeth, cephalic spines and fin spines, and is represented in the Wealden of Hastings by three species ((Figure 13.6)A,B). The strongly heterodont dentition comprises low-crowned, unicuspid or tricuspid teeth of a crushing or grinding type (Patterson, 1966). However, the type and associated specimens of *lonchidion*' *rhizion* Patterson, 1966, which were recovered from the Cliff End Bone Bed at Cliff End, lack enameloid and several authors have disputed the validity of the species (e.g. Herman, 1977, p. 42; Duffin, 1985, p. 112). Both Herman (1977) and Duffin (1985) concluded that the specimens comprising '*Lonchidion*' *rhizion* are not teeth, but hybodontoid dermal denticles. As *Lonchidion* has been synomized with *Lissodus,* Duffin (1985, p. 113) suggested that they might represent the dermal denticles of a species of that genus. The last hybodont shark in the Hastings fish fauna is the ptychodont shark, *Hylaeobatis ornata* (Woodward, 1889a), diagnosed from material from the Brook–Atherfield Point section (q.v.) in the Wealden of the Isle of Wight.

The bony fish assemblage is largely composed of halecostomids, including teeth and scales of the ubiquitous *Lepidotes mantelli* Agassiz, 1833–1837, and type material of two species of the pycnodont *Coelodus. Coelodus mantelli* (Agassiz, 1839–1844) is represented by dentition and jaws and *C. hirudo* (Agassiz, 1839–1844) by isolated teeth, from the Wadhurst Clay of the Hastings area (Woodward, 1915–19). The crush ing dentition of the former species is a common

find in the Wealden of Sussex, comprising five rows of teeth on the vomer and three rows on the splenial, representing a moderate-sized form.

An imperfect maxilla, possibly representing that of a species of *Coccolepis,* one of the last known members of the primitive actinopterygians first encountered in the Scottish Upper Devonian and Carboniferous localities, has been recovered from the Wadhurst Clay succession at Hastings (Woodward, 1915–19).

Comparison with other localities

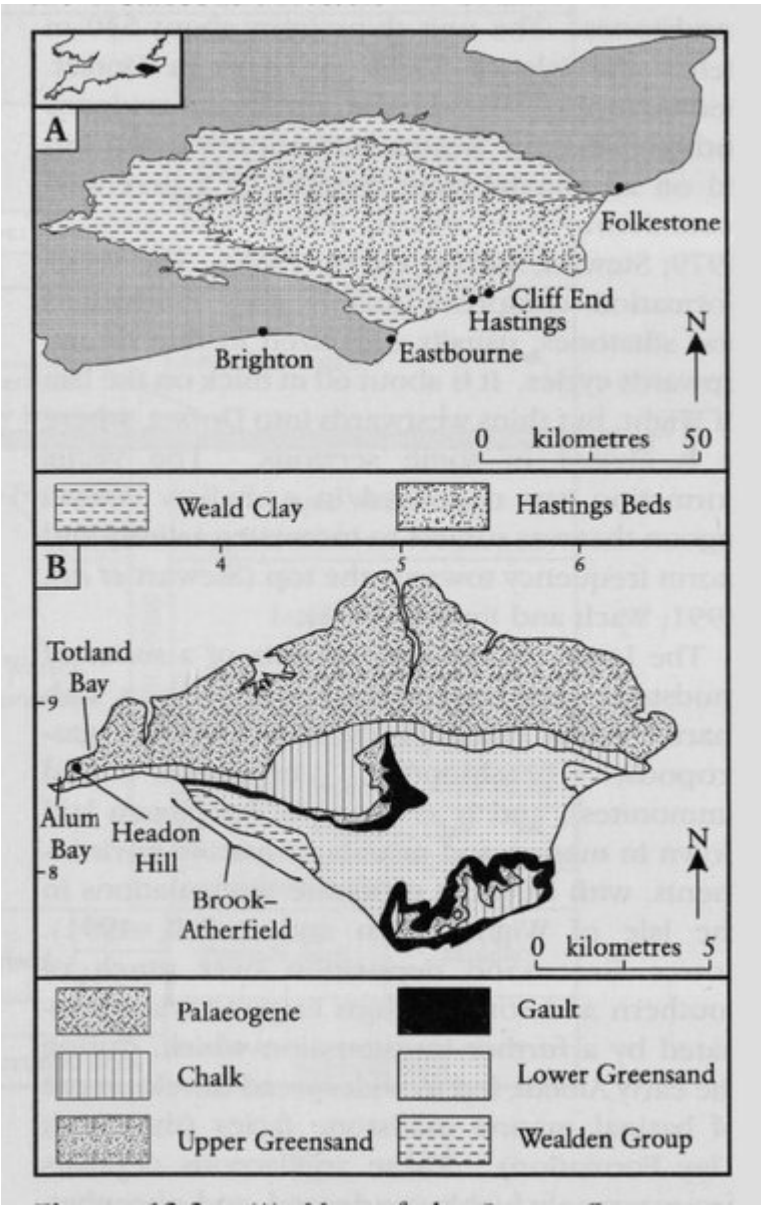
The Cliff End Bone Bed is exposed (Lake and Shephard-Thorn, 1987) near the steps from the Undercliff to Watchbell Street, Rye [TQ 91 95 2018], and formerly in a brickpit near Baldslow [TQ 810 133]. Bone beds with a similar fish fauna and which may be equivalent to the Cliff End Bone Bed are seen at Reyson's Farm, near Brede ([TQ 832 192]; Allen, 1949), Stubb Lane, Brede ([TQ 8212 1853]; Lake and Shephard-Thorn, 1987), Hare Lane, Brede ([TQ 8314 1844]; Benton and Spencer, 1995), and West Ascent, St Leonards ([TQ 7982 0885]; Lake and Shephard-Thorn, 1987), where they are known as the 'Brede Bone Bed'. The Brede Bone Bed is also exposed at Ludley Hill, Beckley [TQ 85 21], and possibly also at Oxenbridge Hill, Iden (?[TQ 92 25]; Allen, 1949). The Telham Bone Bed is also apparently equivalent to the Cliff End Bone Bed, and has yielded a similar fauna. This bone-rich horizon is exposed in small inland quarries, including the Black Horse Quarry, Telham ([TQ 769 142]; Benton and Spencer, 1995), Rackwell Wood, Crowhurst ([TQ 764 124]; Sweeting, 1925; White, 1928; Lake and Shephard-Thorn, 1987), Maplehurst Wood ([TQ 8100 1307]; Lake and Shephard-Thorn, 1987), Baldslow ([TQ 80 13]; Allen, 1949), Brede (several exposures around [TQ 83 20]; Allen, 1949), Peamarsh ([TQ 86 21]; Allen, 1949), Udimore ([TQ 88 19]; Allen, 1949), Stone Hole Quarry, Stone ([TQ 94 28]; Allen, 1949), and Tighe (Teigh) Farm ([TQ 936 266]; Allen, 1949).

Many nearly complete fossil fish specimens were recovered from the foreshore and beach along the coast between Bexhill-on-Sea and Cooden, East Sussex ([TQ 715 062]–[TQ 750 070]), in the 19th century by S.H. Beckles, and form a major part of the Wealden fish collection in the Natural History Museum (Beckles Collection). Some of these finds were erroneously ascribed to the Wadhurst Clay of Hastings (e.g. Woodward, 1895a, 1915–19; White, 1928), and these include the type specimens of the caturid halecomorphs *Caturus* (*Callopterus*) *latidens* and *Neorhombolepis valdensis.* The incorrect locality information seems to have been perpetuated by Beckles himself, who wished to keep the true provenance of his specimens a secret (D. Ward, pers. comm., 1995). In recent years several uncrushed specimens of *Lepidotes* and hybodont shark species have been recovered. The fossils occur as isolated bones, scales, spines and teeth, and as near-complete fish or parts of fish in ironstone nodules within the Weald Clay, which crops out in a narrow coastal strip at Cooden. However, in the past ten years the foreshore between Bexhill and Cooden has been subjected to extensive coastal protection schemes that have limited the usefulness of the lower section. More finds can be made after cliff falls and the site has SSSI status for fossil reptiles (Benton and Spencer, 1995).

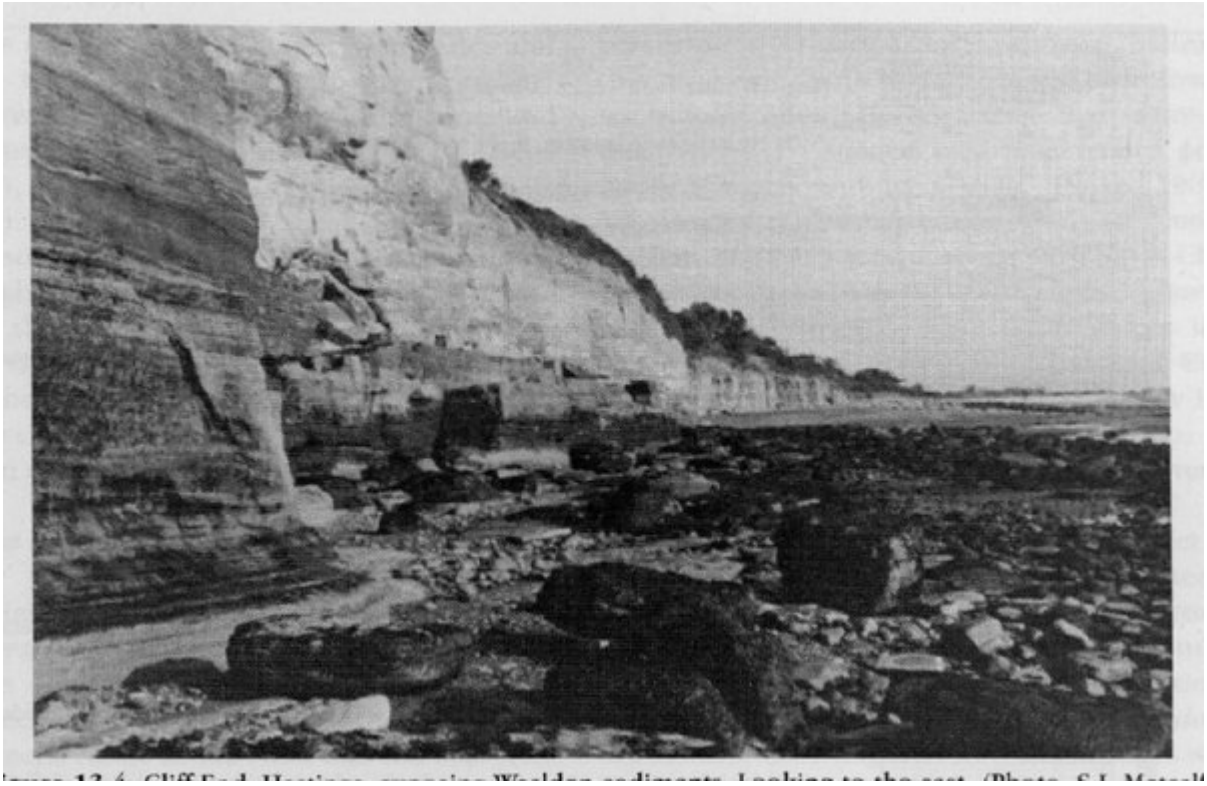
Conclusion

The Hastings succession is the only extensive coastal setting in the non-marine strata of the Hastings Beds undergoing active erosion, and therefore has considerable potential for future finds. The conservation value of the site is derived from the wealth of fossil fishes obtained from the section over the last 100 years, including two type specimens of hybodont sharks and two of the pycnodont *Coelodus.* One of the last basal actinopterygians, *Coccolepis,* has also been recovered from these beds. The fish debris rich horizons — such as the Cliff End Bone Bed — may yield new microvertebrates.

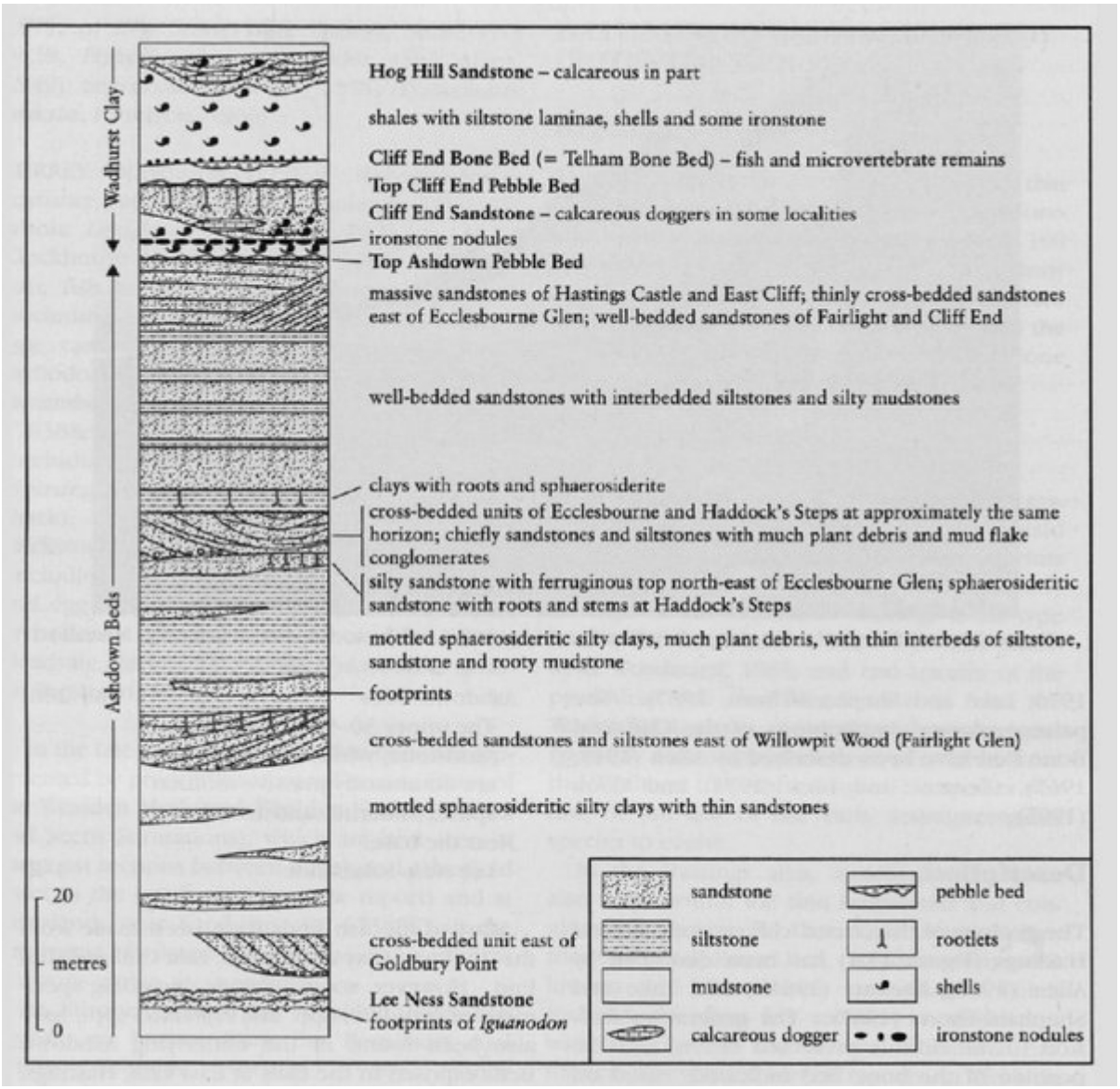
References



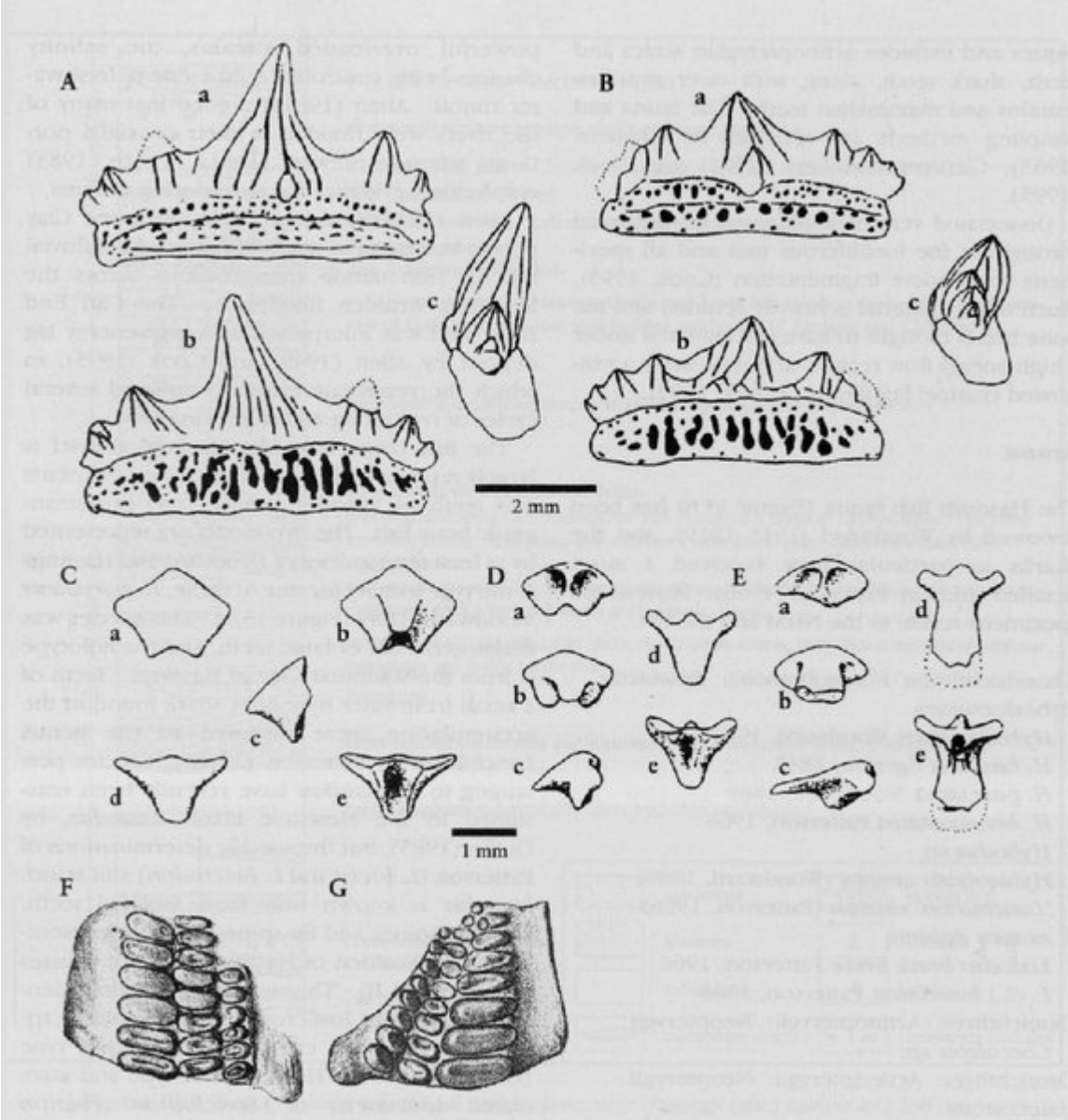
(Figure 13.3) (A) Map of the Lower Cretaceous Hastings Formation (Beds) and Weald Clay Formation of the Weald area of southeast England (after Cook, 1995); (B) geological map of Isle of Wight.



(Figure 13.4) Cliff End, Hastings, exposing Wealden sediments. Looking to the east. (Photo: S.J. Metcalf.)



(Figure 13.5) Stratigraphical log of Cliff End section, near Hastings (after Lake et al., 1987).



(Figure 13.6) Wealden fossil fish: (A), (B) Hybodus parvidens Woodward anterior and posterior teeth in (a) labial, (b) lingual and (c) medial view, NHM P 46930 31; (C)–(E) Lissodus rhizion 'teeth' in (a) lingual, (b) labial, (c) medial, (d) occlusal and (e) basal view: (D) the holotype NHM P 47144 (from Patterson, 1966); (F) Coelodus mantelli Agassiz, oral view of the right splenial bone with teeth, x 1, Wealdon, Hastings; (G) Coelodus mantelli left splenial, x 1, Wealdon, Hastings. Figures from Woodward (1889–1901) © The Natural History Museum, London.