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ENHYDRIODON SIVALENSIS, A GIANT FOSSIL OTTER FROM THE SAKETI FORMATION (UPPER PLIOCENE), SIWALIK GROUP, SIRMUR DISTRICT, HIMACHAL PRADESH

B.C. VERMA[1] and S.S. GUPTA[2]

1. GEOLOGICAL SURVEY OF INDIA, PALAEONTOLOGY DIVISION, ALIGANJ SCHEME, SECTOR-E, LUCKNOW - 226 020
2. GEOLOGICAL SURVEY OF INDIA, 25 C/C, GANDHINAGAR, JAMMU - 180 004

ABSTRACT

The paper records the find of a fossil skull of *Enhydriodon sivalensis* Falconer, the largest of the Mustelidae, from the upper part of Saketi Formation (Upper Pliocene), exposed 1 Km northeast of Siwalik Fossil Park-Saketi, Sirmur district, Himachal Pradesh.

The lutrines are useful ecological indicators, as such the present material has bearing on the palaeoecological aspects of the Saketi Formation. It is possibly only the third near-complete skull of this species of *Enhydriodon* in the vertebrate record. Systematic description of the specimen is given.

INTRODUCTION

Dr. Hugh Falconer made the first systematic observations on the Siwalik lutrines in 1868. He erected the Genus *Enhydriodon* on a solitary specimen of skull collected from the "Siwalik Hills". Subsequently Lydekker (1884) described two specimens under the name *Lutra sivalensis* Lydekker - (i) a partial skull (No. 777A, reposited in the Museum of the Royal College of Surgeons, London), collected by the Rev. R. Everest and (ii) a fragmentary right mandibular ramus (reposited in the Ipswich Museum) presented by Sir P.T. Cautley. Both these specimens also came from the "Siwalik Hills". Later when Pilgrim (1932) restudied the Siwalik lutrines, the number of specimens in the collection from Siwaliks, belonging to the Genus *Enhydriodon* had risen to seven. It enabled him to revise and ascribe the material, known till date, to two species, namely *Enhydriodon sivalensis* Falconer (British Museum - B.M. Nos. 37153 37154 and 37155) and *E. falconeri* Pilgrim (B.M. No. M4847 and G.S.I. No. D161). Unfortunately, all these specimens lacked in precise locality and stratigraphic details. Pilgrim (1932) concluded the *Enhydriodon sivalensis* to be an Upper Siwalik form and the *E. falconeri* as somewhat primitive in characters and Middle to Upper Siwalik in age.

The present skull material was collected by one of us (SSG), in an investigation in the Markanda Valley, Sirmur district, Himachal Pradesh, from a sandy clay bed exposed near Kheri village (Fig. 1) northeast to the Siwalik Fossil Park-Saketi. This clay bed is the northeastern extension of the upper horizons of Saketi Formation (Verma, 1989) developed in the park. The Saketi beds in this area have yielded a rich vertebrate fauna in the past (Falconer, 1868, Verma, 1972, 1989 and Gupta *et al., 1981) of Astian age.*

SYSTEMATIC DESCRIPTION

Family **Mustelidae**
Subfamily **Lutrinae** Baird, 1857
Genus ***Enhydriodon*** Falconer, 1868

Enhydriodon sivalensis Falconer
(Pl. I, figs. a-c)

Enhydriodon sivalensis Falconer, 1868. Pal. Mem,Vol, pp. 3310338, p.XXVII, figs. 1-5.
Enhydriodon ferox Falconer, 1868, Pal. Mem., Vol. 1, p. 552

Lectotype : British Museum No. 37153, a fairly complete skull. Matthew (1929) selected this specimen to be the holotype.

Cotypes : British Museum Nos. 37154, 37155, two skull fragments.

Referred specimens : Hypotypes - (i) Partial skull in the Royal College of Surgeons, London, described by Lydekker (1884), p. 196, pl. XXII, fig. 5).

(ii) Fragmentary right mandibular ramus in the Ipswich Museum described by Lydekker (1884, p. 351, pl. XIV, Figs. 3, 3a).

Diagnosis : An extremely large-sized lutrine; p^4 broad exceeding the antero-posterior diameter, protocone and hypocone on the inner half, the protocone has a subcusp on the lingual side; m^1 large and broader with a twinned protocone; cheek teeth relatively short; brain case swollen with contracted temporal region (Pilgrim, 1932, p.83 and Colbert, 1935, p. 98).

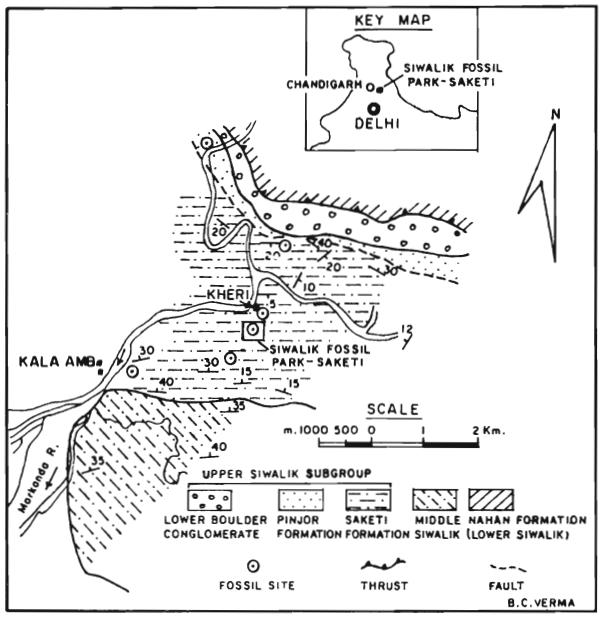

Fig. 1. Geological map around Siwalik Fossil Park-Saketi, showing fossil localities, Sirmur district, Himachal Pradesh.

Present material : Hypotype - A partial skull, GSI No. NRV2/468, pl. 1a, b, c and Fig. 2.

Repository : Palaeontology Division, Geological Survey of India, Northern Region, Lucknow.

Locality : Kheri village, 1 Km northeast of Siwalik Fossil Park-Saketi.

Horizon : Upper part of Saketi Formation.

STATE OF PRESERVATION

The skull contains the temporal crests, frontal, maxillae, premaxillae, nasal, muzzel and palatine parts. Outline of the orbits around the frontals, and dental series are well preserved. Right infra-orbital foramen present but the left one is broken. Narial opening is worn and filled with rock matrix. Parietals, supraoccipital and temporal bones on the dorsal side, and post palatal parts and jugals on the ventral and lateral sides respectively are missing.

The dental arcade is complete with the left M^1 missing. Most of the teeth are broken from their crowns but diagnostic characters of right P^4 and M^1 are preserved, although they are also partly damaged from their buccal sides. Left P^4 is present in its roots only. Right P^3 is broken above the cingulum boundary. Both the canines are also broken above their alveolar outline. The I^2 are intact. Right I^1 is also preserved but the left one is missing and only the interspace is present.

The specimen has suffered wear due to prolonged exposure causing obliteration of the morphological characters of dorsal side and tooth damage. It is also slightly twisted clockwise. The fragile bony parts are deeply impregnated with hard sandy matrix which is difficult to remove without damaging the specimen.

SKULL CHARACTERS

The skull belongs to a fully grown individual, evidently has a high brain case, distinct post orbital processes, a broad and short muzzel and a large narial opening. Maxillary region is heavier and stout due to the large and deep canine roots, temporal region evidently contracted, orbits of moderate size, a prominent infra-orbital foramen in a large depression in the maxillae infront of the orbits. Frontal is rather flat. The temporal crests meet almost at right angle.

DENTITION

The teeth, although damaged from the crowns, permit description of their diagnostic characters to a fair degree.

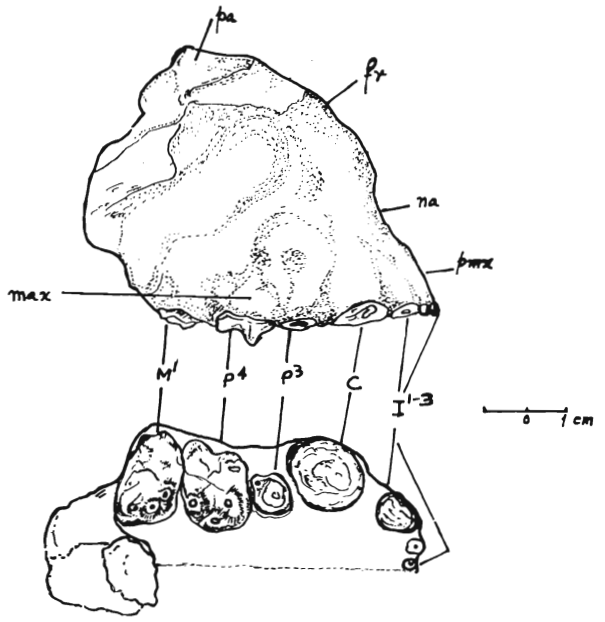

Fig. 2. *Enhydriodon sivalensis* Falconer. GSI No. NRV2/468. Lateral view above and right dentition below. pa; parietal, fr; frontal, na; narial opening, pmx; premaxilla, max; maxilla.

Incisors and canines

In the entire dentition I^1 is the smallest (antero-posterior diameter (APD) of RI^1, 3mm, transverse diameter (TD) - 4.5mm) and almost circular in shape. I^2 is medium sized (APD-of RI^2, 5.2mm, TD-5.5mm) and I^3 considerably large (ADP-of LI^3, 10.5mm, TD-

8mm). The canines are stout, deep rooted and circular in shape (APD of RC, 17.1mm, TD -13.8mm)

Premolars

P^1 and P^2 are absent in this form. RP^3 rather simple with a single main cusp, almost round in shape (APD of RP^3, 10.5mm, TD-10.0mm), a small isolated cuspule in the offing on the posterior labial margin of the tooth, a thin cingulum borders the posterior half of the premolar.

RP^4 extraordinary large, which has lost its carnassial character of the family Mustelidae, instead bunoid indicating a clear adaptation to aquatic food habit, broader than long, protocone prominent with an accessory small cusp on the lingual margin between it and the hypocone; the tooth much extended inwardly making the palate narrowest between the right and left P^4 (maximum width of the palate between the canines). The paracone and metacone are the base which is considerably extended towards the labial margin resulting in broadening of the tooth. Left P^3 and P^4 are preserved from their roots only and lack in morphological details.

DISCUSSION

The Genus *Enhydriodon* is distinguishable from all other genera of the family Mustelidae (including the present-day river otters - *Lutra* spp. and the giant otters-*Pteronura brasiliensis* by its extraordinary large size and structure of the P^4 (Pilgrim, 1932, p. 81). From the recent sea otter-*Latax* also, it differs in its more primitive tooth structure of the P^4 and M^1.

The present skull is comparable with a skull specimen (No. 777A) referred as *Enhydriodon sivalensis* in the Royal College of Surgeons (RCS), London, of which a cast (GSI No. D 103) is available in the Indian Museum, Calcutta. This specimen has the advantage of possessing well preserved P^4 and M^1 on both the maxillae. The P^4 in the RCS specimen has a strong paracone with a twin placed at the anterior end. In our specimen, the paracone is damaged at the crown and there is no evidence of an anterior twin. However, it is the strongest of the four as in the RCS skull. The M^1 is placed oblique (with paracone and the hypocone making the longer diagonal) to the buccal margin, whereas it is almost perpendicular in the present specimen. These varietal differences indicate a slightly progressive nature of the RCS skull. Other characters of the protocones in the P^4 and M^1 and those of palate, are remarkably alike in the two skulls. This leaves little doubt that the two specimens belong to the same species. The advanced characters of the RCS skull suggest it to be of younger stratigraphic level (Pinjor) against the present one which is from a relatively older (pre-Pinjor) horizon.

The holotype was not available for comparison, but it is smaller than the two skulls discussed above, as is evident from the following measurements. Dimensions of P^4 of the holotype are taken from Pilgrim (1932, p. 86).

Associated Fauna And Ecological Implications

The Saketi Formation, measuring 240m thick

Table 1 (All measurements in millimeters)

	Holotype B.M. No. 37153	Royal Coll. Surgeons No. 777A (GSI cast No. D 103)	Present specimen (GSI No. NRV2/668)
Antero-posterior diameter of P^4	15.4	17.6	16.5
Transverse diameter of P^4	17.2	19.4 (L) 18.5 (R)	20.0
Antero-posterior diameter of M^1	–	14.0 (L) 14.0 (R)	13.5
Transverse diameter of M^1	–	17.5 (proto. to paracone) 19.5 (hypo. to metacone)	19.2 19.5
Maximum width of palate between the canines	–	35.0	36.0
Width of skull between the superior post orbital processes	–	–	59.5
Maximum width of skull between the anterior margins of the orbits	–	–	71.0
Minimum width between the orbits	–	–	52.0
Length of the facial portion (from the anterior margin of the premaxillae to the anterior margin of the orbits	–	–	51.0

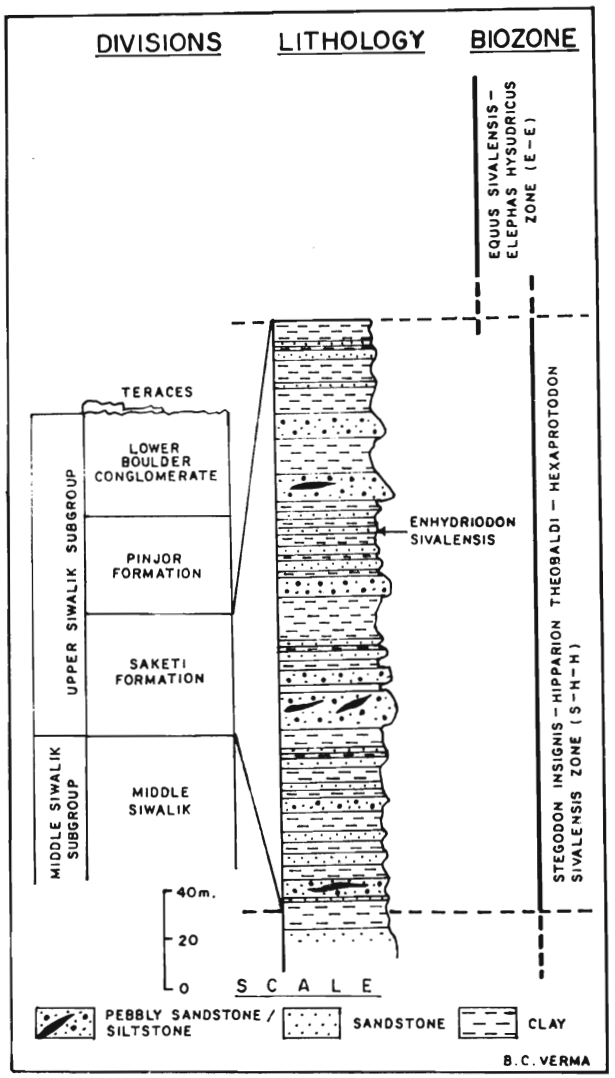

Fig. 3. Lithocolumn of Saketi Formation showing stratigraphic level of *Enhydriodon sivalensis*, GSI No. NRV2/468.

(Verma, 1989) is mainly made up of alternating layers of variegated clay, mudstone, siltstone and fine to coarse grained, occasionally pebbly, grey sandstone. The unit has yielded a rich vertebrate assemblage consisting of a conglomeration of both land and aquatic vertebrate groups. These include fishes, chelonians, snakes, crocodiles, insectivores, carnivores, gomphotheriids, elephants, equids (*Hipparion*), suids, hippopotamids, giraffids, numerous forms of bovids, rodents, lagomorphs etc. and comprise the *Stegodon insignis - Hexaprotodon sivalensis - Hipparion theobaldi* (S-H-H) Biozone (Verma, 1989). The topmost 100 m thick, variegated clay dominant facies of this formation is particularly rich in fossils as it yielded the bulk of the fossil material belonging to the above groups. The lutrine skull in question was also recovered from the same variegated clay unit (Fig. 3).

The lutrines lead a major part of their life in water hunting for aquatic animals like fishes, water voles, musk rats, aquatic birds, molluscs, etc. The animal prefers to live under boulders, rocks, self-dug dens in soft sediments, natural hidings in tree groves, reed growths or under decaying tree trunks which generally occur along the banks of meandering streams, marshes and limpid water lakes. A similar environment is adduced for the variegated clay beds exposed near Saketi from which the present skull was collected. The overall faunal content and the sedimentological characters of Saketi Formation indicate an ecological niche which supported a myriad of distal, stream bank and aquatic verebrate communities. It picturises a landscape which consisted of a peneplained terrain occupied by marshes, slack water streams and over-bank forest lands. Frequent flooding of the region is indicated by the pebble-cobble bearing sandstone intercalations in the variegated clay layers. Nearly 40 sedimentary cycles beginning with coarse sandstone and culminating in red, yellow and carbonaceous grey clay have been counted in the 240m thick sequence of the Saketi Formation. By implication, this palaeoenvironment is indicative of a tropical, warm humid and perhaps monsoonal climate during the Upper Pliocene (Piacenizian).

ACKNOWLEDGEMENTS

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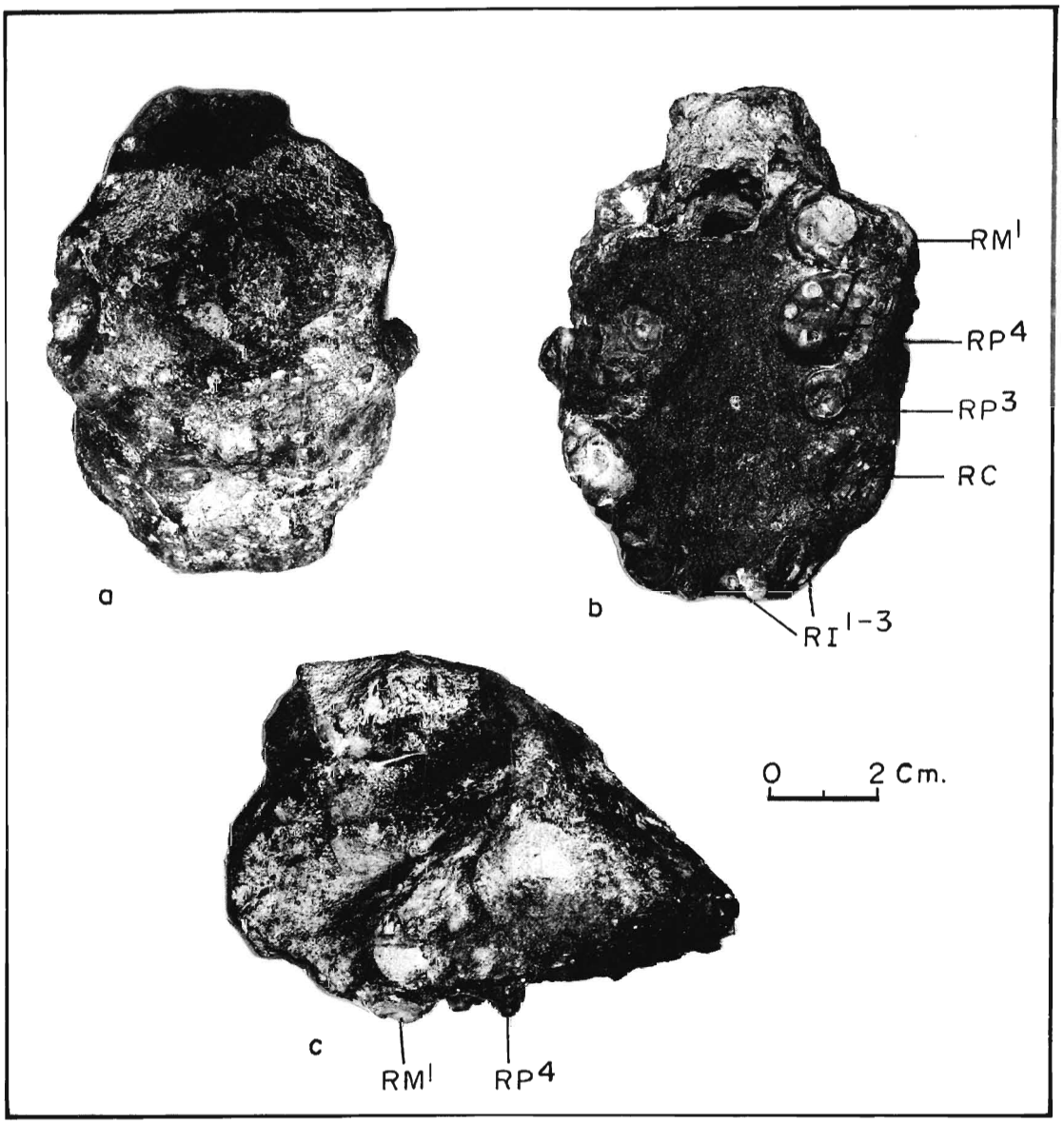
EXPLANATION OF PLATE

Plate I

Enhydriodon sivalensis Falconer, GSI No. NRV2/468 (a; dorsal, b; palatal and c; lateral views of the skull).


a
b
RM1
RP4
RP3
RC
RI1-3
0 2 Cm.
c
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