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LATE PLIOCENE (BLANCAN) *SCAPANUS (SCAPANUS)* (TALPIDAE: MAMMALIA) FROM THE GLENNS FERRY FORMATION OF IDAHO

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ABSTRACT

***Scapanus hagermanensis* n. sp. from the Hagerman fauna of the Glenns Ferry Formation of central Idaho is the first fossil species that shows a close and suggested ancestral relationship to the extant species *S. orarius* and *S. townsendii*. It indicates that the differentiation of these species is younger than 3.4 Ma (middle Blancan age). A tooth from the Grand View fauna, high in the Glenns Ferry Formation, indicates the presence of a larger mole about the size of *S. townsendii* in the late Blancan (about 1.9-2.6 Ma).**

INTRODUCTION

Close relatives of the modern species of the subgenus *Scapanus* are rare (Hutchison, 1968, 1987). Little is known of the nature or timing of the divergence of the extant species; thus, the discovery of even meager material of these lineages is of interest. In the middle 1960's, C. W. Hibbard and parties collected a dentary fragment and a few limb bones of a mole from the Hagerman fauna of the Pliocene (Blancan) of the Glenns Ferry Formation of Twin Falls County, Idaho. Shotwell (1970:12) listed *Scapanus* from the Grand View fauna of Owyhee County, Idaho, and high in the Hagerman Formation. The fossils appear to represent the earliest definable species of a lineage related to *S. orarius* (True) and *S. townsendii* (Backman).

MATERIALS AND METHODS

All the fossil material is deposited in either the University of Michigan Museum of Paleontology (UMMP) or the University of Oregon Museum of Natural History (UO). Recent material is based upon specimens in the collections of the University of California Museum of Paleontology (UCMP) and Museum of Vertebrate Zoology (MVZ). Measurements and tooth terminology follows that in Hutchison (1972). K/A dates greater than 10 million years (Ma) in the cited literature were corrected to the new constants using the tables in Dalrymple (1979).

TAXONOMY

Family **TALPIDAE** Vicq d'Azyr, 1792
Genus *Scapanus* Pomel, 1848
Subgenus *Scapanus* Pomel, 1848
Scapanus hagermanensis new species

Holotype: UMMP V53272, anterior moiety of dentary with heavily worn P_4, trigonid of M_1, alveoli of I_1-P_3 and anterior alveolus of M_2. Collected by C. W. Hibbard, summer 1965.

Type locality: UMMP locality UM-IDA 3-65, Peters Gulch, T. 7 S., R. 13 E., 671m N and 671m E of SW corner Sec. 32, Twin Falls Co., Idaho. Latitude 42° 46' 29" N; longitude 115° 57' 0" W. Elevation 948m. Glenns Ferry Formation. Blancan Land Mammal Age.

Referred material: Idaho, Twin Falls Co., UMMP locality UM-IDA 48-65, T. 7 S., R. 13 E., NE 1/4, NE 1/4, Sec. 32 - UMMP V54560, ulna lacking much of olecranon process; USGS Cenozoic locality 20765 (D. W. Taylor loc. 540), T. 7 S., R. 13 E., 107m E and 640m N of SW corner Sec. 28, - UMMP V53167, two fragmentary humeri.

Diagnosis: Smaller than or in the size range of *S. orarius*; lower dental formula complete, P_1-P_3

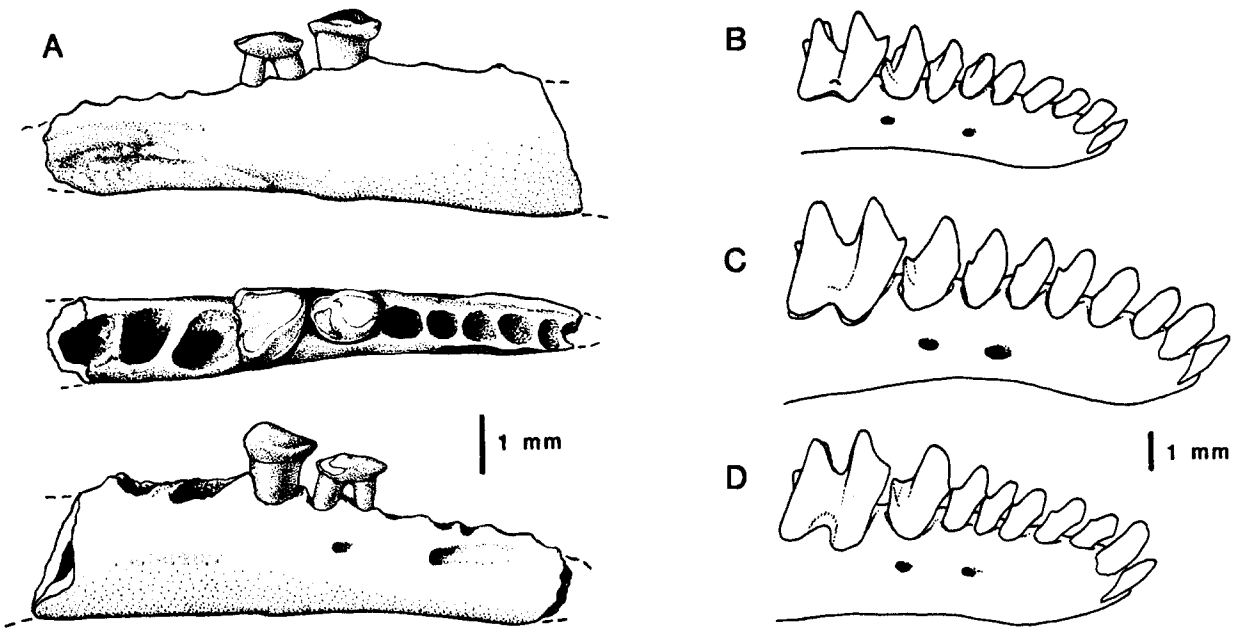

Fig. 1. - (A) *Scapanus (Scapanus) hagermanensis*, n. sp., UMMP V53272 (type), right dentary fragment with P_4 and trigonid of M_1, lingual, occlusal, and labial, views. (B-D) Labial views of anterior part of dentary. (B) *S. orarius*, UCMP 131169. (C) *S. townsendii*, JHH 675. (D) *S. latimanus*, MVZ 99494.

single-rooted, P_4 with two distinctly separate roots, M_1 with precingulum, no enamel excursion down root of M_1, M_1 trigonid not anteroposteriorly compressed.

Description: The type (Fig. 1A) is broken off through the posterior alveolus of M_2 and the alveolar rims of I_1-I_2 are sheared off. Well developed mental foramina lie below and labial to the middle of the P_4 and P_1. The mandibular symphysis extends posteriorly to the level of the anterior root of P_4. The size of the I_1-I_2 alveoli is not preserved due to breakage but they do not appear to have been unusually large or small. The roots of all the antemolars are progressively more procumbent anteriorly. The alveoli of I_3-C_1 and P_3 are subcircular and about equal in diameter. The alveolus of P_1 is also circular but smaller than the latter. The P_3 alveolus is elongate and larger than the preceding. The P_4 has two distinctly divergent and longitudinally aligned roots separated by an alveolar wall. The posterior root is about twice the volume of the anterior root. The crown is longer than broad (1.80 mm long, 0.84 mm wide) and, although heavily worn, retains the talonid shelf and vestige of hypoconid. A short cingulid appears along the anterolabial base of the protoconid.

Only the trigonid of the M_1 is preserved and is heavily worn; nevertheless, narrow but distinct precingulid and entocingulid are present. Labially the ventral margin of the enamel is horizontal with no tendency to follow the root down. The trigonid is open and about as long as broad (1.33 mm long, 1.27 mm wide).

The humeri are incomplete and small (Table 1) but resemble other *Scapanus*. The ulna lacks the end of the olecranon crest but resembles *S. townsendii* and *S. latimanus* as preserved. The shaft is robust compared to that of *S. orarius orarius* (Fig. 2).

Remarks: The Hagerman moles are rare and no jaws and limb bones have been found associated from the same site. As all the known specimens from the Hagerman fauna are referable to *Scapanus* and agree in relative size, there seems little reason presently to suggest that more than one species is present. *S. hagermanensis* is readily distinguished from the species of the subgenus *S. (Xeroscapheus)*

TABLE 1.
Length of humerus of modern and fossil species of *Scapanus (Scapanus)*

Species	n	Observed range
*S. hagermanensis**	1	12.4 mm
*S. malatinus**	1	12.2
S. orarius	8	13.4-14.0
S. latimanus	7	613.1-16.5
S. townsendii	3	616.4-19.8

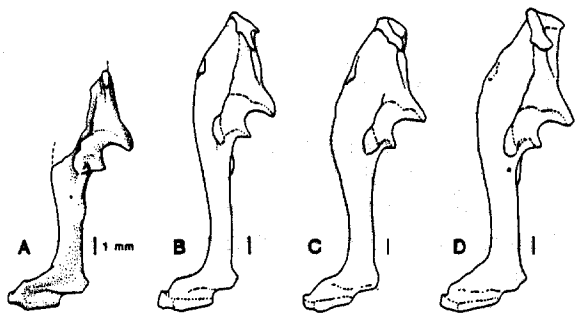

Fig. 2. - Lateral views of ulna. (A) *S. hagermanensis*, n. sp., UMMP V54560. (B) *S. orarius*, JHH "A". (C) *S. townsendii*, (after Hutchison, 1968, Fig. 13F). (D) *S. latimanus*, UCMP 131165.

Hutchison by its low-crowned teeth, long antemolar region, M_1 precingulum, lack of fusion of P_4 roots, unreduced dental formula, apparent lack of I_2 hypertrophy, and open M_1 trigonid. It differs from all well known *Scapanus (Scapanus)* in the presence of double-rooted P_4. It resembles *S. orarius* and *S. townsendii* in the presence of a long antemolar region, full dentition and non-hypsodont molars (Fig. 1). *S. latimanus* has hypsodont molars (Hutchison, 1968, 1987), hypertrophied I_2, and shortened dentary with crowding or reduction of antemolars (Palmer, 1937).

Scapanus (Scapanus) aff. *S. townsendii?*
Scapanus sp., Shotwell, 1970:12.

Material: UO 24826, right P^4 from UO locality 2393, Castle Butte locality, Owyhee Co., Idaho (see locality map in Shotwell, 1970, Fig. 8).

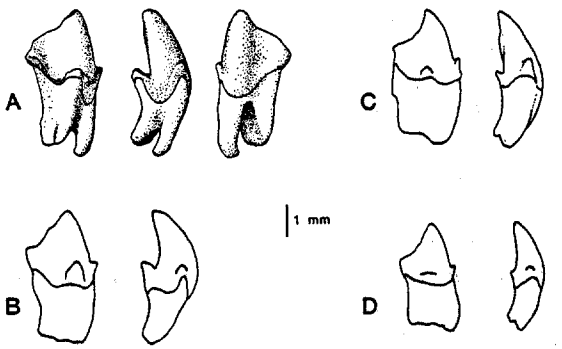

Fig. 3. - Right P^4, (A) *S. aff. S. townsendii?*, UO 24826, medial, anterior, and lateral views. (B-D) Right P^4 of extant species, medial, and anterior views. (B) *S. townsendii*, JHH "E". (C) *S. latimanus*, UCMP 131165. (D) *S. orarius*, JHH "A".

Remarks: An isolated P^4 (length - 2.35 mm, width - 1.75 mm) appears to represent a mole about the size range of *S. townsendii* and larger *S. latimanus*. The tooth differs from all the extant forms in retaining a largely separate anterolateral root (Fig. 3A); the protoconal and posterior roots are confluent throughout their length as in the extant forms (Fig. 3B-D). The protoconal part of this root is more medially situated than in extant species. In the extant species, all three P^4 roots are confluent and form one transversely compressed root. Unlike extant forms, the fossil retains a narrow cingulum between the protocone and posterior part of the crown. Prominence of the protocone in UO 24826 closely resembles that of *S. townsendii*. *S. orarius* and *S.latimanus* have more reduced or vestigial protocones.

AGE OF THE LOCALITIES

The sediments of the Glenns Ferry Formation were laid down in lacustrine and alluvial deposits of the Snake River Plain. Bjork (1970), Neville *et al.* (1979), and Taylor (1966) provide a summary of the fauna and geology. The three localities containing specimens assigned to *Scapanus hagermanensis* lie within a 37m stratigraphic interval (Bjork, 1970). Using the two estimated rates of deposition mentioned by Bjork (1970:11), the mole-bearing sites could

differ in maximum age from about 18,000 to 80,000 years. Hagerman faunas and beds are faunally dated as Blancan and late Pliocene by Bjork (1970) and middle Blancan (Blancan III) by Repenning (1980, in press). The highest site (the type locality) lies less than 6m above the level of the Fossil Gulch ash dated by Evernden *et al.*, 1964, KA 831) at 3.3 Ma by the potassium argon (K/A) method. The other two localities lie below this ash level and above the Peters Gulch ash. The Peters Gulch ash postdates the Cochiti magnetic event dated at 3.79 Ma (Neville *et al.*, 1979). Obradovich, in Neville *et al.* (1979), provided a mineral date of 3.1 $\pm$ 0.21 Ma for the Shoestring Road lava that lies above the level of the localities and immediately below the Deer Gulch lava. Evernden *et al.* (1964) consider their date of 3.48 $\pm$ 0.27 Ma (KA 1173) from the Deer Gulch lava to be more reliable than their ash dates. Whereas Armstrong *et al.* (1975) presented conflicting K/A dates of 5.9 $\pm$ 1.0 Ma and 6.2 $\pm$ 0.7 Ma for whole rock samples from these lavas, I follow subsequent authors (Neville *et al.*, 1979; Repenning, in press) in rejecting these dates on the grounds of their anomalously old age and lack of concordance with faunal and paleomagnetic correlations. The Hagerman mole sites thus lie within the Gilbert magnetic epoch, above the Cochiti event, and within a 3.36 - 3.79 Ma interval based upon direct or correlated radiometric dates. Repenning (in press) provided a similar estimate for the Hagerman faunas of 3.4 - 3.7 Ma based on faunal and external controls (radiometric, paleomagnetic, stratigraphic).

Shotwell (1970:12) listed but did not describe the *Scapanus* from the Grand View fauna high in the Glenns Ferry Formation. The Grand View fauna which includes the Castle Butte locality is later than the Hagerman sites and placed in the late Blancan (Bjork, 1970; Neville *et al.*, 1979; Repenning, 1980, in press). In a detailed rodent chronology (Repenning, in press), the Grand View fauna lies in the lower part of the Matuyama magnetic epoch and in his Blancan V (1.9-2.6 Ma).

Scapanus is the only mole here recognized from the Glenns Ferry Fm. The previous record of a *Desmana moschata* listed by Littleton and Crosthwaite (1957) and repeated by Taylor (1966) was examined and identified as a fish tooth (Hutchison, 1968:117).

RELATIONSHIPS

Scapanus hagermanensis is assigned to the Orarius group on the basis of its open trigonids. I have elsewhere (1987) interpreted the open trigonids as a derived character in *S. orarius* and *S. townsendii* and used it as one of the criteria for recognizing an Orarius group (*S. orarius* and *S. townsendii*). Fusion of the roots of P_4 appears to have happened independently in the Latimanus and Orarius groups. Precingulids are also lost independently in these groups and in *Xeroscapheus* (Hutchison, 1968, 1987).

The Hagerman sites lie about 150 km E and 130 km S of the nearest extant record of *S. orarius schefferi* Jackson (Caswell, 1953). Whereas the size range of the *S. hagermanensis* dentary and its location suggest a close relationship to *S. orarius orarius*, the ulnae (if properly associated) are relatively stout compared to the small sample of *S. orarius* readily available to me. I suggested elsewhere (1987) that stout forearms are primitive for *S. (Scapanus)* and that the relatively gracile limbs of *S. orarius* are derived. The Hagerman species would appear to corroborate this. *S. hagermanensis* is primitive in several other features and provides clues to the timing of the acquisition of several features. If the open molar trigonids are shared derived features of *S. orarius, S. townsendii*, and *S. hagermanensis*, the latter would provide a good morphological and temporal ancestral species for the Orarius group with *S. orarius* developing more gracile limbs and remaining small while *S. townsendii* retained stout limbs and increased in size.

In the Grand View mole, the presence of a large protocone, separate roots, and medial cingulum are considered as primitive character states. The size of the protocone, general size of the tooth and geographic (northern) situation suggest affinities to *S. townsendii*. The morphological resemblances to *S. townsendii* are based on resemblances in primitive character states and thus of low relational value.

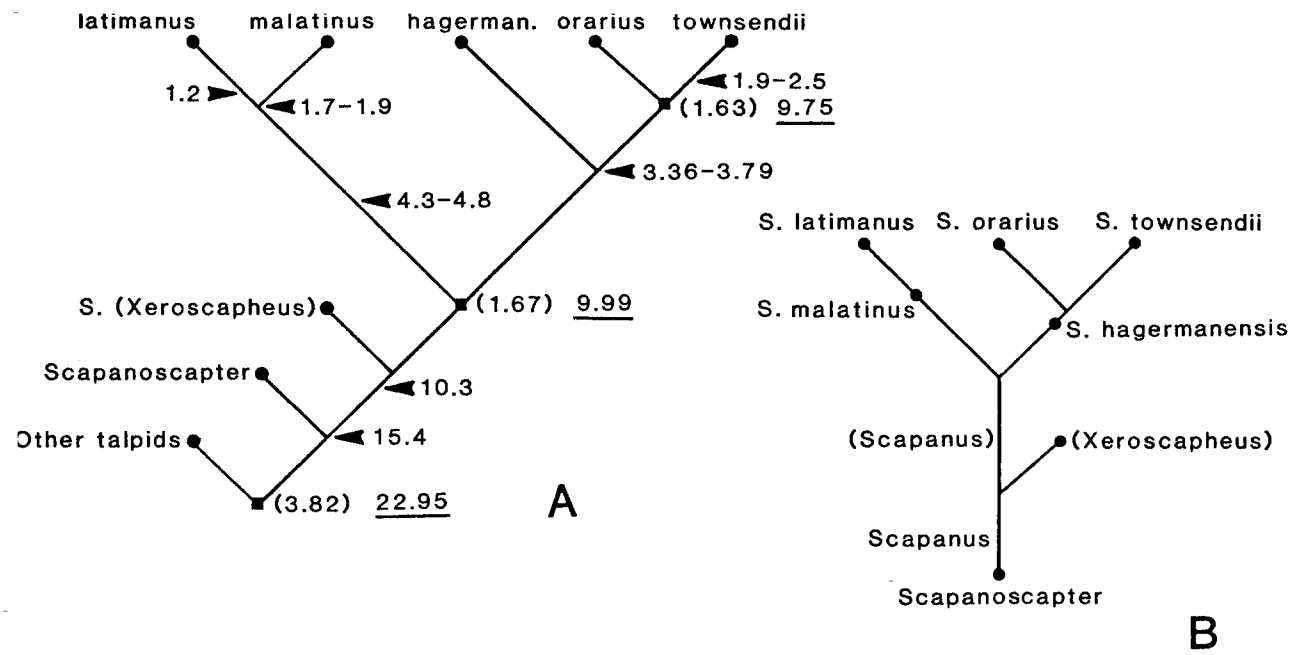

Fig. 4. - (A) Proposed cladistic relationships of the species of *Scapanus (Scapanus)* modified from Hutchison (1987). Numbers in parentheses and underlined indicate temporal divergence times in millions of years calculated by Yates and Greenbaum (1982) using the methods of Nei (1971) and Sarich (1977) respectively. Ages indicated by arrows indicate K/A and/or faunal correlation dates (<10 Ma derived from Repenning, in press; >10 Ma from Evernden et al., 1964). (B) Proposed phylogeny of same taxa as in (A).

Fusion of all three roots is apparently derived independently in at least *S. latimanus* and possibly in the other two extant species.

The presence of a large *Scapanus* in the Grand View may indicate that the *S. townsendii* lineage was differentiated from the *S. orarius* lineage by about 2.6 Ma or less and possibly sets an upper limit of the divergence time. The differentiation of the modern species of the Orarius group would thus lie between middle and late Blancan (1.9 - 3.8 Ma). Figure 4 represents the suggested relationships of the fossil and recent species of *Scapanus (Scapanus)* modified from Hutchison (1987).

Yates and Greenbaum (1982) analyzed the genetic variation of the recent North American species of *Scapanus* biochemically. They provided a genetic similarity tree and used two rather strikingly different estimates of the times of divergence based upon allozymic data and using calculations of Nei (1971) and Sarich (1977). The fossil record is not dense enough to provide a narrow time of divergence but does provide indications of minimal or maximal times. Hutchison (1968) proposed that *Scapanoscapter* is a good morphological ancestor for *Scapanus* and is from rocks dated at 15.1 Ma (Evernden *et al.*, 1964, KA 1029). *S. shultzi* Tedford is the earliest known species of *Scapanus* and lies above from rocks dated at about 10.3 Ma (Evernden *et al.*, 1964, KA 453). *S. shultzi*, however, is already more specialized than the modern forms and belongs to a different lineage (subgenus *Xeroscapheus*) (Hutchison, 1987). Divergence time of the two subgenera is thus older than 10 Ma. Evidence of early members of the *S. latimanus* lineage (Hutchison, 1987) extend that lineage back to at least 4-5 Ma. The divergence times of the two modern groups is thus older than 4 Ma. As noted above the divergence times of *S. orarius* and *S. townsendii* may lie between about two and four million years.

If the proposed cladistic relationships and

phylogeny (Fig. 4) are correct, then conflicts arise with the temporal estimates calculated by Yates and Greenbaum (1982) using both the Nei and Sarich methods (Fig. 4A). As they noted, the Nei methods evidently yield dates too young for the divergence times of *Scapanus*. Conversely, the estimate calculated by the Sarich method for the *S. orarius* - *S. townsendii* divergence appears to be too old under the relationships proposed here whereas the estimates at the other nodes remain viable pending further paleontological data. The possibility that *S. hagermanensis* is a member of the Orarius lineage after its divergence from *S. townsendii* can not be excluded but would require still more convergence of morphologies and is thus less parsimonious. If the latter were true, the divergence of the *S. townsendii* and *S. orarius* lineages would be pushed back to or beyond 3 - 4 Ma mark.

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