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The Muscles of the Forearm of Necturus

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Little of a completely satisfactory character has been published on the arm-myology of *Necturus*. Mivart (1869) dissected a single specimen, and described certain of the foreleg muscles. Ribbing (1906-07) dissected two specimens, and included some notes on the foreleg of *Necturus*, but most of his paper deals with *Siredon* and other forms. Wilder (1908, 1912) presented a good account of the muscles of the foreleg, and his descriptions will here be referred to many times. Howell (1936) and Straus (1942) discussed the anatomy of the flexor muscles of the forearm of *Necturus;* but they were interested in the broader problems of the homologies of flexor muscles. Francis (1934) tabulated the various synonyms used for the muscles of the forearm of *Salamandra.* His descriptions are so complete that I have used his terminology wherever it applies to the muscles of *Necturus.*

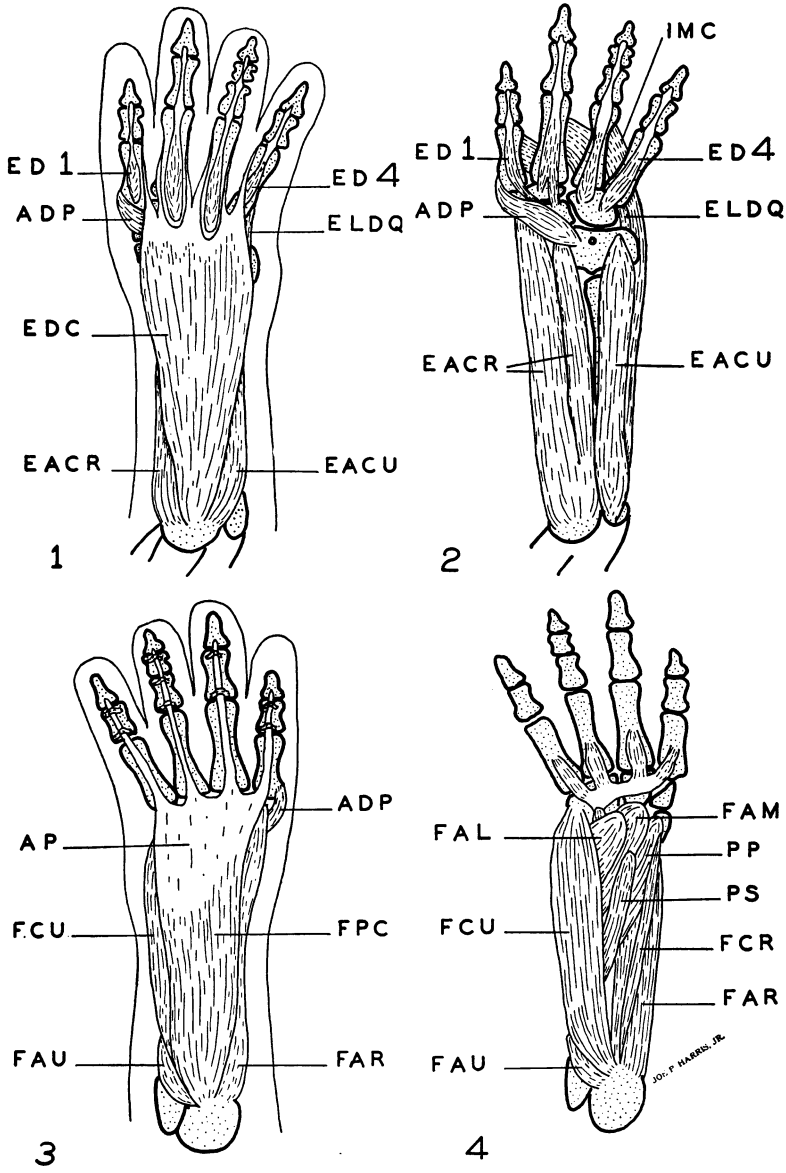
Extensor Muscles

Figs. 1 and 2

Extensor digitorum communis (EDC) ("humerometacarpalis" of Wilder)

Origin: lateral epicondyle of the humerus, in close association with the two muscles next described below. The mass of this muscle extends to the bases of the metacarpals. *Insertion:* by six slender tendons to the postaxial side of metacarpal 1, the preaxial side of metacarpal 4, and to both sides of metacarpals 2 and 3. Sometimes an additional slender tendon is present on the postaxial side of metacarpal 4. This differs slightly from the descriptions given by Francis for *Salamandra,* where the six tendons go to the three digits of the ulnar side, with an occasional seventh tendon to the postaxial side of the first digit.

Removal of the extensor digitorum communis exposes most of the following extensor muscles.


ED 1
ED 4
ADP
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1
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Extensor antibrachii et carpi radialis (EACR)

Origin: lateral epicondyle of humerus, in front of and in close association with the extensor digitorum communis, and along the proximal half of the radius. *Insertion:* by two slips. Distal on the preaxial surface of the forearm is the extensor antibrachii ("extensor radialis superficialis" of Wilder) which inserts along the radius, and on the radials. A very few fibers reach the prepollex. Wilder reports some fibers insert on carpale 2, but I did not find any such. The extensor carpi radialis ("extensor radialis profundus" of Wilder) is immediately posterior to the extensor antibrachii. It inserts on the intermedium of the intermedium-ulnare. A very few fibers insert on the centrale.

Extensor antebrachii et carpi ulnaris (EACU) ("extensor ulnaris" of Wilder)

Origin: lateral epicondyle of the humerus in back of the extensor digitorum communis, and on the olecranon process and the proximal half of the ulna. *Insertion:* On the ulnare of the fused intermedium-ulnare.

Abductor digiti primi (ADP) ("supinator" of Wilder)

Origin: distal portion of the intermedium, with a few fibers originating on the centrale. *Insertion:* on the proximal portion of the preaxial surface of metacarpal 1.

Extensor lateralis digiti quarti (ELDQ)

Origin: distal portion, postaxial angle of ulnare. *Insertion:* postaxial proximal end of metacarpal 4. This is a very weak muscle, and is commonly destroyed as the extensor digitorum communis muscle is removed to expose it. Wilder included this muscle as part of his "extensor ulnaris". I have seen one variant in which the extensor lateralis digiti quarti originated in part on the extensor antibrachii et carpi ulnaris, as described by Wilder.

Extensores breves digitorum (ED 1, ED 4) ("extensores breves" of Wilder)

This is a series of four muscles, one for each of the fingers. They originate on the carpale and insert on the metacarpal of each finger, except as noted below. Extensor of first digit originates on the radial side of carpale 1-2, and sometimes in part also on the centrale. Extensor of second digit originates on the ulnar portion of carpale 1-2, and sometimes in part also on the centrale. Extensors 3 and 4 originate on their

respective portions of fused carpale 3-4. Each of the four extensor muscles inserts along the metacarpal proper to it, and by a tendon along the dorsal surface of the digit to the last phalanx present.

Francis recognized in *Salamandra* both a superficial and a deep layer of extensor muscles for the digits. I cannot make out this separation in *Necturus*. Francis also included what is here described as the extensor of the first digit, as part of his abductor and extensor digiti primi.

Flexor Muscles

Figs. 3, 4, 5

Flexor primordialis communis (FPC) ("palmar fascia" and "palmaris superficialis" of Wilder)

Origin: medial epicondyle of humerus. *Insertion:* on each of the digits by a long tendon reaching to the most distal phalanx. The muscle is large and thick along the forearm, but is reduced to a flat palmar aponeurosis (AP) over the palm of the hand. The palmar aponeurosis forms a thick mat of tissue concealing all deeper parts. Superficially, the palmar aponeurosis divides into four tendons for insertion on the digits. The tendons are secured by transverse ligaments as shown in Fig. 3. The palmar aponeurosis is firmly fastened to the distal row of carpalia by a crescent-shaped ridge of cartilage and connective tissue. This ridge serves in part as attachment-point for the digital flexors, as well as certain other muscles.

Removal of the flexor primordialis communis and palmar aponeurosis will expose most of the following muscles.

Flexor carpi ulnaris (FCU) (part of "flexor ulnaris" of Wilder)

Origin: medial epicondyle of humerus, posterior to the flexor primordialis communis, and along the proximal portion of the ulna. *Insertion:* on the ulnare of the ulnare-intermedium, and on carpale 4 of fused carpale 3-4.

Flexor antibrachii ulnaris (FAU) (part of "flexor ulnaris" of Wilder)

Origin: medial epicondyle of humerus, closely associated with the preceding muscle. *Insertion:* Along the proximal half of the postaxial border of the ulna.

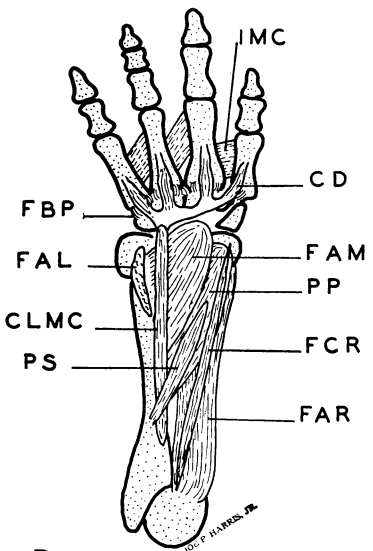
This muscle and the flexor carpi ulnaris constitute a single muscle in *Salamandra*.

Flexor carpi radialis ("flexor radialis" of Wilder)

Origin: medial epicondyle of humerus. *Insertion:* on the radiale and possibly also in part on the prepollex. This is a slender, weak muscle, easily destroyed by the removal of the flexor primordialis communis, which covers it.

Flexor antibrachii radialis (FAR) ("flexor radialis" of Wilder)

Origin: medial epicondyle of humerus. *Insertion:* along most of the radius, and on the radiale. This muscle and the flexor carpi radialis form a single muscle in *Salamandra.*



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Flexor accessorius lateralis (FAL) (part of the "palmaris profundus" of Wilder)

Origin: distal third of ulna, and on the ulnare. *Insertion:* dorsal surface of palmar aponeurosis. This muscle partly covers the flexor accessorius medialis.

Flexor accessorius medialis (FAM) (part of the "palmaris profundus" of Wilder)

Origin: dorsal to the flexor accessorius lateralis on the distal ⅓d of the preaxial border of the ulna. *Insertion:* on the dorsal surface of the palmar aponeurosis.

Caput longum musculorum contrahentium (CLMC) ("ulnaricarpalis" of Wilder)

Origin: proximal ventro-mesial border of ulna. *Insertion:*

on carpale 3-4, on the crescent-shaped ridge of cartilage and connective tissue that covers carpale 1-2 and 3-4, and sometimes also on a thin ligament that joins each of the flexors of the digits. The caput longum is slender. In its course down the arm, it runs between the flexor accessorius lateralis and the flexor accessorius medialis; more proximally it also separates the pronator superficialis and the pronator profundus.

Pronator superficialis (PS)

Origin: ulna near proximal end. *Insertion:* on dorsal surface of the palmar aponeurosis and on the pronator profundus. Francis does not list this muscle for *Salamandra*, nor did Wilder list it for *Necturus*.

Pronator profundus (PP) ("pronator" of Wilder)

Origin: mesial border of the distal ⅔ds of the length of the ulna, and on the intermedium; sometimes also on carpale 3. *Insertion:* on radial, radiale, carpale 1, with a few fibers inserting on the prepollex.

Wilder describes insertions for this muscle on the first metacarpal, and also says that it occupies (on the flexor surface of the forearm) the same position that his "supinator" muscle occupies on the extensor surface of the forearm. Certainly, the description of position is incorrect as given by Wilder.

Contrahentes digitorum (CD) ("flexores breves superficiales" of Wilder)

Origin: principally from the carpales and the palmar aponeurosis, but with some slight reinforcement from the thin ligament of the caput longum musculorum contrahentium, as follows: digit 1, carpale 1; digit 2, carpale 2; digit 3, mainly from carpale 3, but from carpale 2 in part; digit 4, carpale 4. *Insertion:* on the ventral surface of the metacarpals of the same number.

Both Ribbing and Francis describe the insertion of the contrahentes digitorum as on the proximal end of the phalanges.

Flexores breves profundi (FBP) ("carpo-metacarpale" of Wilder)

These muscles lie beneath the contrahentes digitorum. *Origin:* on the distal borders of the carpales. *Insertion:* on the proximal borders of the metacarpals. They are separated from the contrahentes digitorum by nerve branches. Typ-

ically, there are two of these muscles to each metacarpal; one muscle radial and the other ulnar in position. Also, the radial muscle for metacarpal 3 arises in part from carpale 2, and in part from carpale 3.

Intermetacarpales (IMC) ("intermetacarpales" of Wilder)

These short triangular muscles connect the metacarpals, and can be seen equally well from either the extensor or flexor surface of the hand. *Origin:* on the preaxial side of metacarpals 2, 3, and 4. *Insertion:* on the postaxial side of metacarpals 1, 2, and 3.

Flexores breves superficiales

These are described by Francis in *Salamandra* as weak muscles auxiliary to the flexor primordialis communis muscle. Wilder and Ribbing report them as definite muscles in *Necturus*. It appears, however, that Wilder includes in his description of these muscles part of the fibers which I list as the contrahentes digitorum. I do not recognize these muscles in *Necturus*.

Flexores digitorum minimi ("flexores breves profundi" of Wilder?)

These are described by Francis in *Salamandra* as narrow muscles arising from the mid-ventral surfaces of metacarpals 2, 3, and 4, and inserting on the proximal ends of the proximal phalanges of the same digits. Wilder's descriptions for *Necturus* are similar. I do not recognize these muscles in *Necturus*.

Interphalangeus digiti III.

This muscle arises from the ventral surface of the proximal phalanx of the third finger, and inserts on the second phalanx of the same finger. It is reported by Francis, Wilder, and Ribbing. I could not identify it certainly in *Necturus;* if it is present, it is very weakly developed.

Interosseus antibrachii

Under this name Francis and Ribbing describe a muscle which arises from almost the whole of the mesial surface of the ulna, and inserts on the distal $^3/_4$ths of the mesial surface of the radius. It is said to lie beneath the pronator profundus. I think parts of the extensor antibrachii et carpi radialis have mistakenly been described as this muscle, which otherwise, I cannot identify in *Necturus*.

SUMMARY

A brief description of each of the muscles of the forearm of *Necturus* is presented. The muscles are named in accordance with the terminology used by Francis (1934) in his descriptions of the muscles of *Salamandra*. Names used by Wilder (1912) in his descriptions of the muscles of *Necturus* are listed as synonyms of the names used by Francis.

The pronator superficialis muscle is described, apparently for the first time.

The flexores breves superficialis, flexores digitorum minimi, interphalangeus digiti III, and interosseus antibrachii, though occurring in *Salamandra*, and previously reported by Wilder in *Necturus*, are not here identified as part of the musculature of *Necturus*.

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The Texas Species of Palafoxia (Compositae)

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Taxonomically *Palafoxia* is one of the most perplexing genera of Texas Compositae; phylogenetically and geographically it is one of the most intriguing. It has been discussed by Gray (1884), Bush (1904), Rydberg (1910, 1914), Ammerman (1944), Cory (1946, 1948), and myself (1949), with varying degrees of inadequacy or inaccuracy. Since 1949 I have puzzled over the genus at intervals, working toward a fresh revision of the Texas species. The discovery of part of the vanished type material of *P. riograndensis*, and the accumulation of additional specimens, makes it possible to present as definitive a synopsis as may reasonably be expected from morthodox taxonomic methods, emphasizing morphology and geography. In addition to the collections in the Herbarium of Southern Methodist University (SMU), those in the Tracy Herbarium of Texas A. & M. College (TAM) were used in this study, and selected specimens were examined at the Philadelphia Academy and the Missouri Botanical Garden. In a note following the systematic treatment, some suggestions are ventured regarding phylogeny and geological history.

KEY TO TEXAS SPECIES OF PALAFOXIA

1a. Involucre strigose or glabrate, not glandular-pubescent, 3.5-8 mm. high in flower; pappus 0.1-5 mm. long
  2a. Middle and lower stem leaves compound