The earlier accounts of the myology of the paired fins pertain mostly to a study of the morphology and the disposition of the muscles in various fishes. Some workers in the past (Breeder 1926, Harris 1936 and Gray 1957 etc.) have made an attempt to describe only the specific roles of these fins. The study of the functional anatomy however has been hardly attempted save the work of Harris (1960). A study of the literature and even the casual observations reveal that the paired fins are called upon to perform different functions. Fishes such as Ophiocephalus, Anabas and Gobius use their fins for the terrestrial mode of locomotion also. Certain fishes like carps on the other hand, use their fins for equilibratory functions only. Looking to the specific function of a particular muscle as a component of the fin, it is logical to expect such muscle suitably adapted to perform the specific role it is called upon to play. Similarly, extending the same logic, one may also expect the muscles whose functions have become less important during the course of evolution, to be feebly developed or to have atrophied under selection pressure. From the phylegetic considerations also as envisaged by Howell (1933), one could reasonably expect structural and positional variations in the myology in relation to the changes in the functions of the paired fins in different fishes.
The present chapter deals with the detailed study of the nature and disposition of the different muscles operating the pectoral and the pelvic fins. Stress has been laid on an accurate study of the origin, the insertion, the tendinous structures and the arrangement of muscle fibres mainly in relation to the functional aspects. However it is felt necessary to give a general pattern of the musculature of the paired fins before giving an account of the fin muscles of the fishes under investigation.

The movements of the pectoral and the pelvic fins are generally brought about with the help of three sets of muscles viz. the abductors, adductors and the arrectors. The abductor muscles are normally situated on the ventral surface of the girdles whereas the adductor muscles occupy the dorsal surface of the girdles. The arrectors are generally placed in a lateral disposition. Depending upon the type and the degree of movements expected of the fins, all the three series of muscles exhibit variations in their size and disposition and may be subdivided into two or more components. The different modes of locomotion obviously demand movements of certain skeletal elements of the girdles and for bringing about these movements, the pectoral and the pelvic girdles are provided with certain additional muscles. Prominent among the accessory muscles of the pectoral girdle are the M. adductor radialis and the M. coraco-radialis which bring about the movements of the fin rays and the coraco-radial skeletal complex respectively. Similarly there are also a number of additional muscles on the pelvic girdle like the M.
extensor proprius and the M. retractor ventralis bringing about the protraction and the retraction of the pelvic fin respectively. Another set of muscles viz. the M. protractor ischii and the M. retractor ischii help to bring about the protraction and the retraction of the pelvic girdle itself.

Before giving an account of the muscles of the paired fins of the different fishes selected here, it is considered desirable to describe briefly the nomenclature and the synonyms used by other workers, to avoid any misconception.

STATEMENT OF SYNONYMS OF MUSCLES

A. PECTORAL FIN MUSCLES

**M. abductor superficialis**

Vorwart zieher - Cuvier (?).

M. superficialis abductor - Owen (1866).

M. anterior superficialis - Vogt & Yeung (?).

M. abductor superficialis - Shann (1921), Grenholm (1923), Eggert (1929).

M. external superficialis - Hamburger (1904).

M. flexor superficialis - Harris (1960).

M. abductor dorsalis - Howell (1933).

**M. abductor profundus**

M. external profundus - Cuvier (?), Hamburger (1904).

M. deep abductor - Owen (1866).
M. abductor profundus - M'murrich (1884), Shann (1921), Grenholm (1923), Eggert (1929).
M. anterior profundus - Vogt & Young (?).
M. abductor ventralis - Howell (1933).
M. depressor radiorum - Harris (1960).

M. arrector ventralis

M. innerster musk - Cuvier (?).
M. dilatator anterior - Vogt & Young (?), Shann (1921).
M. abductor accessorius - Howell (1933).
M. arrector ventralis - Grenholm (1923).

M. adductor superficialis

M. superficialis adductor - Owen (1866).
M. posterior superficialis - Vogt & Young (?).
M. internal superficialis - Hamburger (1904).
M. adductor superficialis - M'murrich (1884), Shann (1921), Grenholm (1923), Eggert (1929).
M. adductor dorsalis - Howell (1933).
M. levator superficialis - Harris (1960).

M. adductor medialis

M. adductor medialis - Grenholm (1923), Eggert (1929).
M. extensor medialis - Harris (1960).

M. adductor profundus

Abaisseur - Cuvier (?).
M. deep adductor - Owen (1866).
M. posterior profundus - Vogt & Young (?).
M. internal profundus - Hamburger (1904).
M. adductor profundus - M'murrich (1884), Shann (1921),
Grenholm (1923), Eggert (1929).
M. extensor profundus - Harris (1960).

M. arrector dorsalis

M. dilatator posterior - Vogt & Young (?), Shann (1921).
M. adductor accessorius - Howell (1933).
M. arrector dorsalis - Grenholm (1923).

M. adductor radialis

M. adductor radialis - Grenholm (1923).

M. coraco-radialis

M. coraco-radialis - Grenholm (1923), Eggert (1929),
Harris (1960).

B. PELVIC FIN MUSCLES

M. protractor ischii

M. protractor ischii - Owen (1866), Green & Green (1914),
Dutta (1964).
M. pelvico cleithral - Shann (1921).
M. protractor pelvis - Harris (1960).
M. levator pelvis - Agrawal (1962).

M. retractor ventralis

M. retractor ventralis - Grenholm (1923), Harris (1960),
M. abductor superficialis I - Eggert (1929).

M. abductor superficialis

M. abductor ventralis superficialis - Green & Green (1914).
M. abductor superficialis - Grenholm (1923), Dutta (1964).
M. abductor superficialis II - Eggert (1929).
M. abductor medialis - Harris (1960), Agrawal (1962).

M. abductor profundus

M. abductor ventralis profundus - Green & Green (1914).
M. abductor profundus - Grenholm (1923), Eggert (1929), Harris (1960), Agrawal (1962) and Dutta (1964).

M. arrector ventralis

M. adductor ventralis profundus - Green & Green (1914).
M. arrector ventralis - Grenholm (1923) and Eggert (1929).
M. arrector internus - Harris (1960), Agrawal (1962) and Dutta (1964).

M. arrector dorsalis

M. arrector dorsalis - Grenholm (1921) and Eggert (1929).
M. arrector externus - Harris (1960), Agrawal (1962) and Dutta (1964).

M. adductor superficialis

M. adductor dorsalis superficialis - Green & Green (1914).
M. adductor superficialis - Grenholm (1921), Eggert (1929) and Dutta (1964).
Following is an account of the pectoral fin musculature of the fishes selected during the present work.

WALLAGO ATTU (Plate XII)

M. abductor superficialis

This is a huge massive muscle covering the entire ventral surface of the pectoral girdle, extending from the tip of the anterior arm of the cleithrum to the width of the fin base. The muscle is provided with a thin transparent aponeurotic tendon sheet on its entire surface. Embedded within the muscle mass are also present thin tendinous fasciae which form a number of pinnate units.
The muscle arises in a broad fleshy origin from the inner surface of the ventral lamina of the anterior cleithral arm and the ventral surface of the anterior process of the coracoid.

The pinnate units formed around the tendinous fasciae engulfed within the muscle mass, move downwards to form a compact muscle belly. The muscle is provided with a broad tendon sheet towards the insertion. The insertion is on all the rays excepting the first fin ray.

In addition to its function as a strong abductor, the muscle also slightly protracts the fin.

M. abductor profundus

The M. abd. prof. occupies a position deep to the M. abd. supf. and lies on the radials. The muscle is parallel in nature and is provided with small aponeurotic tendons towards the origin and the insertion.

The muscle arises from the ventral surface of the radials in a strong origin which is mainly fleshy but slightly tendinous. The tendinous part of the origin may extend to the coracoid as well.

The muscle runs backwards towards the fin and inserts on the knobs of all the fin rays excepting the first ray. The insertion is mainly fleshy but is partly tendinous towards the pre-axial rays.

By the contraction of the muscle the fin is abducted away from the body and the connected rays are slightly retracted.
Plate XII

Pectoral fin muscles of *Wallago attu*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)
4. Dorsal view (with most of the fin muscles and part of the coracoid removed to show Arr.Dor.II)

Abd.Prof. - Abductor profundus; Abd.Supf. - Abductor superficialis; Add. - Adductor; Arr.dor.I - Arrector dorsalis I; Arr.dor.II - Arrector dorsalis II; Arr.vent.I - Arrector ventralis I; Arr.vent.II - Arrector ventralis II.
M. arrector ventralis I

This is an elongate pinnate type of muscle extending all along the length of the anterior arm of the cleithrum on the dorsal side of the girdle. This highly fleshy muscle is comprised of compactly arranged muscle fibres which move from all the directions towards the middle of the muscle body so as to converge at the tendon present towards the posterior part of the muscle belly.

The muscle arises in a broad fleshy origin which covers the entire dorsal surface of the anterior arms of the cleithrum and the coracoid. As already described, the fibres converge towards the middle and in doing so in some specimens examined, they give a bipinnate look to the muscle.

As the muscle moves backwards towards the fin, it passes under the dorsal process of the coracoid to get inserted on the outer lateral surface of the first ray. The insertion lies just below the knob towards the ventral aspect of the ray. The insertion is tendinous.

By the contraction of this muscle the first ray is protracted and abducted away from the body. As a consequence of that the entire fin structure shows corresponding movement.

M. arrector ventralis II

It is a very feebly developed sheet-like muscle extending between the coracoid and the first fin ray on the ventral surface of the pectoral girdle. The muscle is parallel in nature.
The muscle arises in a weak fleshy origin which extends along the width of the ventral process of the coracoid.

As it moves along the ventral process of the coracoid towards the first fin ray, its thin sheet like muscle belly remains plastered to the bony base. The muscle gets inserted on the ventral surface of the nodule of the first fin ray in a weak tendinous insertion.

The muscle is a weak abductor of the first fin ray.

**M. adductor**

The M. add. is a well developed massive muscle lying posterior to the mesocoracoid on the dorsal surface of the girdle. It is a pinnate type of muscle.

The muscle arises in a broad origin which covers the entire dorsal arm of the cleithrum, the margin of the mesocoracoid and the radials. Towards the fin rays a large number of the muscle fibres take their origin from the connective tissue lining the body wall.

The fibres from all the directions converge towards the middle and a twisting of the muscle body takes place towards the fin. The muscle tends to divide into a number of muscle bundles before getting inserted on all the rays excepting the first. The insertion is mainly fleshy but slightly tendinous in nature.

The muscle acts as an adductor of the fin. It is observed that the degree of adduction is maximum towards the post-axial rays whereas it goes on decreasing towards the pre-axial rays. Thus an inward twisting of the fin is brought about.
M. arrector dorsalis I

This is a small but well developed palmate muscle lying obliquely across the posterior region of the M.arr.vent.I. in a superficial position. The two muscles are however separated from each other by the dorsal process of the coracoid.

The muscle arises from the dorsal process of the coracoid. The fibres towards the outer margin of the muscle take their origin from the tendon sheet extending over the M.arr.Vent. I. The origin of the muscle is mainly fleshy but partly tendinous in nature.

As the muscle moves backwards towards the fin, the belly becomes slightly broad before it tapers suddenly under the mesocoracoid arch. It gets inserted on the inner dorsal margin of the striated rim of the head of the first ray. The insertion is strong and tendinous in nature.

The muscle acts as an adductor of the first fin ray. A few adjacent rays are also adducted alongwith. However, the contraction of this muscle results in a slight retraction of the pre-axial rays.

M. arrector dorsalis II

The muscle lies deep in the canal-like concavity of the anterior arm of the cleithrum. The muscle is palmate in nature and has a broad muscle belly. It is flattened along the inner cleithral wall.

It arises in a broad and fleshy origin which is on the dorsal as well as on the ventral lamina of the cleithrum.
Plate XIII

Pectoral fin muscles of *Ompok macrophthalmus*

1. Ventral view (superficial)
2. Ventral view (Abd.Supf. removed to exhibit the deeper muscles)
3. Dorsal view (superficial)

Legends according to plate XII.
As it moves backwards in the cleithral canal, it becomes narrow and is supplied with a thin tendon. The tendinous insertion is in the middle of the rim of the head of the first fin ray.

The muscle acts as a protractor of the first ray and hence the neighbouring rays.

OMPOK MACROPHTHALMUS (Plate XIII)

In Ompok the musculature is very similar to that of Wallago attu excepting the minor differences in the relative size of the different muscles. Their nature and disposition remains essentially the same.

MYSTUS BLEEKERI (Plate XIV)

M. abductor

The M. abd. is a long pinnate muscle extending along the entire length of the girdle on its ventral side.

The muscle arises in a broad fleshy origin from the cleithro-coracoidal plate, the main part of the origin however lies on the cleithrum. The muscle belly tapers slightly towards the fin and is provided with a tendon which is embedded within the muscle mass.

The muscle gets inserted on all the rays excepting the spine. The insertion which is strong, is partly fleshy and partly tendinous.

The muscle acts as an abductor of the fin.
M. arrector ventralis I

This is a large fan-shaped bipinnate muscle extending between the pectoral symphysis and the fin. The muscle extends over almost the entire dorsal surface of the cleithro-coracoidal plate and is partly covered by the dorsal ridge of the cleithrum.

The muscle arises in a broad fleshy origin from the coracoid and the cleithrum. The fibres from both the sides travel towards the middle forming a compact tapering bipinnate muscle belly.

As the muscle moves towards the spine, it is provided with a thin tendon. The muscle gets inserted on the ventro-lateral surface of the head of the spine, slightly below the striated rim. The insertion is strong and tendinous.

The muscle acts mainly as a protractor of the spine but in addition to this, it may also abduct the spine to a small extent.

M. arrector ventralis II

This is a small muscle moving along the ventral ridge of the cleithrum. The muscle is of pinnate nature.

The muscle arises in a broad fleshy origin from the cleithrum and the inner wall of its ventral ridge. The muscle belly becomes narrow towards the middle and is provided with a thin tendon.

The muscle inserts on the nodule of the spine. The insertion is strong and tendinous in nature.

By its action the M. arr.vent. II abducts the spine.
Plate XIV

Pectoral fin muscles of *Mystus bleekeri*

1. Ventral view (superficial)
2. Ventral view (with Abd. removed to exost Arr. Dor. II)
3. Dorsal view (superficial)

Legends as in plate XII.
M. adductor

The M. adductor is a very well developed muscle lying between the cleithrum, mesocoracoid and the fin. It is a bipinnate muscle having a broad belly.

The muscle arises in a broad and fleshy origin which is on the crevice formed on the inner surface of the dorsal cleithral arm, mesocoracoid and the radials. The origin towards the margin of the radials is slightly tendinous. The fibres from all the directions tend to converge towards the post-axial side of the fin in a fan shaped manner and exhibit a bipinnate pattern.

Towards the insertion the muscle tends to divide into smaller bundles each of which is provided with a thin tendon. These bundles are seen distinctly in the upturn position of the muscle. The insertion is on all the rays excepting the spine.

The contraction of the muscle brings about the adduction of the related rays by producing a wave like margin of the fin.

M. arrector dorsalis I

It is a highly massive obovate muscle lying between the fin and the ventral surface of the coracoid. Its broad muscle belly takes a turn along the dorsal ridge of the coracoid and is provided with a broad aponeurotic tendon sheet towards its ventro-lateral surface.

The muscle takes a broad origin from the ventral surface of the coracoid towards the pectoral synphysis. The origin also
extends to the dorsal surface of the coracoid and the outer wall of its dorsal ridge. As the muscle fibres move posteriorwards towards the fin, they take a slight turn to form a broad and slightly twisted belly of the muscle.

The muscle towards the insertion is provided with an aponeurotic tendon sheet which forms a strong tendinous insertion on the inner-lateral surface of the rim of the head of the spine. The insertion is strongly tendinous though a few muscle fibres also seem to take part in it.

The muscle is a powerful retractor of the spine and it also slightly adducts the same.

M. arrector dorsalis II

This is a small feebly developed bipinnate muscle lying deep in the canal formed by the ventral ridge of the cleithrum.

The muscle arises from the cleithrum in a bipinnate fashion. The muscle fibres move inwards towards the middle where the muscle belly is provided with a thin but strong tendon.

The muscle gets inserted on the middle of the rim of the head of the spine in a strong tendinous insertion.

By its action, it is a protractor of the spine.

CLARIAS MAGUR (Plate XV)

M. abductor

This is a small muscle lying on the ventral surface
of the coracoid. It is a parallel type of muscle which becomes broad and massive as it moves towards the fin.

The muscle arises in a broad fleshy origin which is on the ventral surface of the coracoid and the radials.

As the muscle moves backwards and a little outwards towards the insertion the muscle belly is provided with a few tendinous strips towards the pre-axial insertion. The insertion is on all the rays excepting the spine and it is mainly fleshy and partly tendinous in nature.

The muscle acts as an abductor of the fin.

M. arrector ventralis I

This is a broad fan shaped muscle having an elongate bipinnate belly which covers the entire coracoid and a part of the cleithrum on the dorsal side of the girdle. The muscle is supplied with a median tendon and as it tapers towards the fin, it passes under the bony canal formed by the cleithrum and the coracoidal dorsal ridges.

The muscle arises in a broad fleshy origin along the margins of the coracoid. The origin also extends to a part of the anterior arm of the cleithrum adjoining the coracoid. The muscle fibres travel transversely inwards and attach themselves to the median tendon.

As the muscle moves towards the insertion, it becomes narrow and compact and passes through the muscle canal described above. The muscle gets inserted on the head of the spine in a strong tendinous insertion. The insertion lies on the lateral
Plate XV

Pectoral fin muscles of Clarias magur

1. Ventral view (superficial)
2. Dorsal view (superficial)
3. Dorsal view (with most of the fin muscles removed to show Arr.vent.II)

Legends according to plate XII.
surface of the head of the spine, in a notch formed below the striated rim.

The main function of this muscle seems to be the strong protraction of the spine.

**M. arrector ventralis II**

This is a small bipinnate muscle, lying completely hidden beneath the M.arr.vent.I. The muscle is provided with an aponeurotic tendon sheet which at times is broad enough to cover a major part of the muscle.

The muscle arises from the coracoid and the cleithrum in a broad but weak fleshy origin. The muscle fibres, as they move transversely inwards, they get inserted on the tendon.

The muscle travels backwards to pass through the foramen formed between the coracoid and the cleithrum. The muscle moves on the ventral surface of the girdle to get inserted on the lateral surface of the nodule of the spine.

The muscle acts as a feeble abductor of the spine.

**M. adductor**

This is a small but massive parallel type of muscle, placed in a juxta-posed position between the posterior process of the coracoid and the fin rays.

The muscle takes a broad fleshy origin from the ventral surface of the plate-like process of the coracoid and radials.

As the muscle travels backwards and a little inwards towards the fin, the muscle belly becomes broad. The muscle is
inserted on all the rays excepting the spine. The insertion is partly fleshy and partly tendinous in mature.

The contraction of the muscle results in the adduction of the fin excepting the spine.

**M. arrector dorsalis I**

This muscle covers the plate-like process of the coracoid, posterior to the dorsal ridge of the coracoid. The muscle exhibits a pinnate arrangement of the fibres and it is highly fleshy in mature.

The muscle arises in a broad and fleshy origin along the posterior margin of the dorsal coracoidal ridge and the posterior plate-like process of the coracoid.

The fibres from both the sides converge towards the middle so as to form a bipinnate structure. As the muscle travels towards the spine it becomes considerably narrow, before it passes through the muscle canal formed by the mesocoracoid arch. The insertion which is tendinous, is on the end of the striated rim of the head of the spine.

The muscle powerfully retracts the spine.

**M. arrector dorsalis II**

It is an elongate muscle, lying in an antero-lateral position to M.arr.vent.I. The muscle though of a pinnate nature appears to be parallel superficially. It is supplied with a thin tendon embedded deep within the muscle belly.

The muscle arises fleshily from the dorso-lateral ridge of the cleithrum, below the cleithro-coracoidal muscle canal.
As the muscle travels outwards towards the spine, it becomes narrow and gets inserted on the middle of the striated rim of the head of the spine. The insertion is narrow but strongly tendinous.

The muscle acts as a protractor of the fin and also adducts the spine.

**HETEROPNEUSTES FOSSILIS (Plate XVI)**

**M. abductor**

This muscle occupies most of the ventro-posterior crista of the coracoid. The muscle is parallel in nature and extends between the coracoid and the fin.

The muscle arises in a broad fleshy origin from the ventral surface of the coracoid. As the muscle fibres run towards the fin, they form a compact muscle belly.

The muscle is provided with thin strips of tendon towards the insertion. The insertion which is partly fleshy and partly tendinous, is on all the rays excepting the spine.

The muscle helps to abduct the fin.

**M. arrector ventralis I**

It is a large bipinnate muscle extending between the medial pectoral symphysis and the spine. The muscle though fan shaped in structure, is broad and thin towards the pectoral symphysis and becomes massive as it tapers towards the spine.

The muscle arises in a broad fleshy origin from the
coracoid and the cleithrum. The fibres move towards the middle giving a fan shaped bipinnate appearance to the muscle.

As the muscle moves towards the spine it becomes very narrow and towards the insertion it is provided with a strong tendon. The insertion of the muscle is on the outer-lateral side of the spine just below the striated rim.

The muscle acts as a powerful protractor of the spine and it also slightly abducts the spine.

**M. arrector ventralis II**

This is a feebly developed muscle lying deep below the M.arr.vent.I on the cleithro-coracoidal joint. It is a pinnate type of muscle.

The muscle arises from the coracoid and the cleithrum in a broad and weak origin. The origin is mostly fleshy but slightly tendinous.

As the muscle fibres move towards the middle, they give a fan shaped structure to the muscle belly which gradually narrows down towards the insertion. The muscle is provided with a thin tendinous sheet which serves as a narrow insertion on the nodule, on the ventro-lateral surface of the spine.

By its action, it slightly abducts the spine.

**M. adductor**

This is a short but massive parallel type of muscle extending between the inner surface of the dorsal cleithral arm and the fin. The muscle as stated already, is parallel in nature
but because of a slight change in the direction of the fibres arising from the mesocoracoidal side, the muscle exhibits a bipinnate pattern.

The muscle takes a broad and fleshy origin from the inner ventral wall of the crevice formed by the cleithrum, mesocoracoid and the radials.

As the muscle moves downwards towards the fin, the fibres from the cleithral side and that of the mesocoracoidal side run towards the post-axial rays of the fin to form a superficially bipinnate pattern in the middle. The muscle gets inserted on all the rays excepting the spine. The insertion is highly fleshy in nature.

The muscle adducts the fin excepting the spine.

**M. arrector dorsalis I**

The M. arr. dor. I lies on the postero-medial part of the coracoid, separated from the M. arr. vent. I by means of the dorsal coracoidal ridge. Moving towards the insertion, the broad belly of the muscle tapers while passing through the muscle canal formed by the 'Y' shaped mesocoracoid. The muscle belly which appears to be of parallel nature, forms pinnate pattern towards the insertion.

The muscle arises from the postero-medial part of the coracoid and the outer surface of the dorsal coracoidal ridge. The origin may however also extend to the ventral surface of the coracoid. The nature of the origin is broad and fleshy.

As the muscle travels towards the spine, it passes
through the mesocoracoidal canal as mentioned above and it becomes narrow. The muscle gets inserted on the head of the spine at the opposite end of the striated rim where the M. arr. vent. I is inserted. The insertion is tendinous in nature.

The contraction of the muscle results in a strong retraction of the spine.

M. arrector dorsalis II

This is a small unipinnate type of muscle lying under the dorsal ridge of the cleithrum. It has a broad massive muscle belly which tapers towards the insertion.

The muscle arises in a broad fleshy origin from the base of the dorsal cleithral ridge. The fibres which run inwards in a fan shaped pattern, form the tapering belly of the muscle. Some of the inner most fibres take a slightly different direction by moving under the main muscle mass.

Towards the insertion the muscle is provided with a thin but strong tendon by means of which it is inserted in the middle of the striated rim of the head of the spine.

The muscle acts as a protractor of the spine.

LABEO ROHITA (Plate XVII)

M. abductor superficialis

This is a well developed parallel type of muscle having the most superficial position on the ventral surface of the girdle. The muscle is thin towards the lateral margins as compared with its middle portion. It becomes gradually massive
Plate XVII

Pectoral fin muscles of *Labeo rohita*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)

and forms a highly elevated, curved wedge-like structure in the middle.

The muscle arises in a broad origin which is mostly fleshy and slightly tendinous. The origin covers the concavity formed by the ventral lamina of the anterior cleithral arm and the entire outer margin of the coracoid including its posterior process.

As the muscle moves backwards towards the fin, it becomes very massive and is supplied with a transparent tendinous sheet. The tendon sheet is divided into a number of thin ribbon-like projections which insert on each ray by strong tendinous insertion.

The muscle acts as a strong abductor of the pectoral fin. It is observed that the abduction is more pronounced towards the post-axial rays than towards the pre-axial rays. The action also results in a slight protraction of the post-axial rays.

\textit{M. abductor profundus}

It is a deeply situated muscle lying completely hidden beneath the M.\textit{abd. supf}. The muscle is of a pinnate nature and is well developed.

The muscle arises from the coracoid and the radials in a broad fleshy origin. The muscle fibres arising from the posterior process of the coracoid and the radial move in a parallel fashion whereas the fibres arising from the entire surface of the anterior coracoid process form a distinct bipinnate unit.
As the muscle moves backwards towards the insertion, it becomes broad and inserts on the knobs of all the fin rays. It is noted that the entire bipinnate unit is inserted on the knob of the first fin ray only in a strong tendinous insertion whereas the remaining muscle mass inserts fleshily on all the rays excepting the first.

The muscle acts as an abductor of the fin. The abduction is accompanied by a vertical movement of the entire fin which probably accounts for the strong tendinous insertion of the entire bipinnate unit on the first fin ray only.

M. arrector ventralis

The M. arr. vent. is comparatively a small muscle, lying below the M. abd. supf. and beside the M. abd. prof. It is broad towards the origin and as it travels towards the insertion it tapers down in a narrow and blunt end. It is a pinnate type of muscle.

The muscle arises in a broad and fleshy origin mainly from the depression of the walls of the anterior arm of the cleithrum, next to the origin of the M. abd. supf. But a few fibres also take their origin from the dorsal side of the coracoid and the cleithrum near the pectoral symphysis. These dorsally originated fibres pass through the interosseous space between the cleithrum and the coracoid to join the main muscle mass.

Towards its inner lateral side, the muscle belly is provided with a linear strip of tendon. The muscle fibres from
both the sides get attached upon this tendinous strip so as to form a bipinnate pattern. The insertion of the muscle is tendinous and it is on the outer-lateral side of the first fin ray, below the knob.

The muscle acts as a strong protractor of the first fin ray and hence, the entire fin structure is protracted.

**M. adductor**

The M. add. is conspicuously a large muscle occupying almost the entire area on the dorsal aspect of the pectoral girdle near the fin. This huge and massive muscle though not divided into a superficialis and profundus parts, is however differentiated into a deep and a superficial slips. The muscle fibres of both the slips travel in opposite directions towards the fin. The superficial slip which comprises the main muscle mass, is an elongate wedge-like structure. The deep slip lies mostly hidden beneath the superficial slip and is a comparatively smaller muscle structure, though equally massive.

The superficial slip takes a broad fleshy origin from the dorsal arm of the cleithrum whereas the deep slip arises from the coracoid, mesocoracoid and the radials.

The belly of the superficial slip runs obliquely backwards towards the post-axial rays and it becomes broad and massive as it curves towards the insertion. The deep slip travels towards the middle and the pre-axial rays. Towards the insertion the muscle forms small bundles each of which is supplied with a small ribbon-like tendon slip which gets inserted on the corresponding rays.
Plate XIX

Pectoral fin muscle of Cyprinus carpio

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)

Legends as in plate XVII.
The M.add. helps to adduct the entire fin structure powerfully. In addition to their function as adductor, the superficial slip protracts the post-axial rays whereas the deep slip slightly retracts the pre-axial rays. When the entire muscle contracts, a twisting of the fin from post-axial to pre-axial rays takes place while the fin is in adducted condition.

**M. arrector dorsalis**

This is a comparatively small muscle having a pinnate structure. The muscle belly is slightly broad in the middle but it suddenly tapers down into a narrow insertion and passes through the muscle canal formed by the mesocoracid.

The origin of the muscle is broad and fleshy. It arises from the crevice formed by the posterior oblique cleithral ridge, below the crescentic ridge. Some of its fibres also take origin from a small portion of the scapula.

Towards the insertion, the tapering belly of the muscle is provided with a narrow and strong tendinous cord by means of which the muscle inserts on the knob of the first fin ray.

The muscle adducts and retracts the first fin ray.

**CATLA CATLA & CYPRINUS CARPIO**

The musculature of the pectoral fin in Catla catla and Cyprinus carpio is almost similar in nature and disposition to that of Labeo rohita. The diagrams represent (Plate XVIII & XIX) the above fact in all details.
M. abductor superficialis

The M. abd. supf. is a large massive muscle extending between the anterior arm of the cleithrum and the fin base in the most superficial position on the ventral aspect of the pectoral girdle. The muscle is pinnate in nature and is provided with a strong and broad sheet of tendon which is partly embedded within the muscle mass.

The muscle arises in a broad and fleshy origin from the ventral lamina of the cleithrum and coracoid. The origin almost completely fills the boat shaped groove formed by the ventral lamina of the cleithrum and the coracoid.

The muscle fibres from all the directions move inwards and posteriorwards to get attached on the broad tendinous sheet. This tendinous sheet splits into small finger-like projections by means of which the muscle inserts on all the rays of the fin.

The muscle acts as a powerful abductor of the pectoral fin.

M. abductor profundus

This is a well developed muscle made up of two distinct fasciae, viz. an inner and an outer one. While the inner fascia extends between the radials and the fin over the ventral surface, the outer fascia which is the larger of the two, also extends over the dorsal surface of the girdle and passes through the coracoidal ring.
Plate XX

Muscles of the pectoral fin of *Notopterus kapirat*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)
4. Dorsal view (Abd.Prof. removed to show the details of the deep muscles)

Legends according to XVII.
The small inner fascia arises from the ventral surface of the radials in a fleshy origin. Some of the fibres however also arise from the outer surface of the coracoidal ring. The large outer fascia takes a broad fleshy origin from the dorsal surface of the anterior cleithral arm. While the arrangement of the muscle fibres in the small inner fascia is parallel, the large outer fascia of the muscle is pinnate in nature and is provided with more than one ribbon-like strips of tendon.

As the two fasciae move towards the insertion, the inner fascia becomes slightly broad whereas the outer fascia gradually tapers through the coracoidal ring. Towards the insertion both the fasciae are provided with tendon by means of which they insert on the knobs of all the rays. The insertion is strong.

The muscle acts as a very powerful abductor of the pectoral fin. The abduction of the pre-axial rays is highly pronounced.

M. arrector ventralis

It is a highly complicated pinnate type of muscle with most of its part lying hidden below the M.abd.supf. The muscle is provided with two aponeurotic tendinous strips which unite at the insertion.

The muscle arises from the coracoid and the cleithrum. The fibres arising from the coracoid and the ventral lamina of the cleithrum attach themselves on the medial tendinous strip in a pinnate fashion. The fibres arising from the dorsal arm
of the cleithrum attach themselves on the second tendinous strip. Both the pinnate units give a triangular appearance to the muscle.

As the muscle gradually narrows down towards the insertion, the two tendon strips unite before getting inserted on the lateral surface of the knob of the first fin ray.

The muscle acts as a strong protractor of the fin. As a result, the plane of the fin is rotated by about 90 degree.

**M. adductor superficialis**

It is a large parallel type of muscle extending between the cleithrum and the pectoral fin, on the dorsal side of the girdle. Towards the origin the muscle is broad, fan shaped and palmate in structure but as it twists below the mesocoracoid, it becomes compact and curvacious.

The muscle arises along the dorsal wall of the anterior arm of the cleithrum in a broad fleshy origin. The parallel muscle while travelling backwards and outwards becomes compact and narrow and is twisted in the middle by 180 degrees in such a manner that the pre-axial end of its insertion comes on the post-axial side and vice-a-versa.

Towards the insertion the muscle is provided with thin finger-like tendon strips by means of which the muscle inserts on all the rays.

The muscle adducts the fin with a slight retraction of the rays.
M. adductor profundus

The M. add. prof. is a small muscle lying in a juxtaposed position between the mesocoracoid and the coracoidal ring. The muscle has a parallel arrangement of fibres and extends over the radials during its backwards course towards the fin.

It arises from the pit formed at the joining between the mesocoracoid and the coracoid, below the coracoidal ring. The origin which is broad and fleshy also extends to the dorsal surface of the radials.

As the muscle moves towards the insertion it becomes broad and tends to divide into smaller bundles, each of which is inserted on the knobs of all the rays respectively.

The muscle acts as an adductor of the fin.

M. arrector dorsalis

This unipinnate muscle lies beside the M. add. supf. and extends between the coracoid and the first fin ray.

The muscle arises in a broad fleshy origin from the deeply placed region of the coracoid adjoining the scapula. A few superficially placed muscle fibres arise from the ventral margin of the interosseous space between the cleithrum and the coracoid.

As the muscle travels backwards and outwards towards the first fin ray, it becomes compact and narrow and is provided with a strong cord-like tendon. The muscle inserts on the knob of the first ray in a strong tendinous insertion.
By its contraction, the muscle brings about a rotating movement of the first ray in a horizontal plane. As a result the entire fin undergoes this movement which is accompanied by a slight retraction.

**OPHIOCEPHALUS PUNCTATUS** (Plate XXI)

**M. abductor superficialis**

It is a large parallel type of muscle made up of two distinctly separable slips viz. a superficial and a deep slip. Both the slips of the muscle arise in a common, broad and fleshy origin from the ventral lamina of the anterior arm of the cleithrum.

As the muscle moves towards the insertion, the fibres of the deep slip separate from the superficial slip and move in a slightly different direction. The superficial slip moves towards the post-axial side of the fin and it is supplied with a band of small tendinous sheet. The deep slip moves towards the middle and pre-axial rays of the fin and it is also supplied with a broad tendinous sheet. Both the tendinous slips split into small ribbon-like components. The fibres of the deep slip exhibit a tendency towards the formation of smaller bundles each of which corresponds to the ribbon-like component of the tendon sheet. It may be noted here that each incipient muscle bundle is partly overlapped by the succeeding one. This is especially well marked towards the fin where the overlapping of the tendinous ribbons becomes very distinct. The superficial slip
Plate XXI

Pectoral fin musculature of *Ophioccephalus punctatus*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)
4. Dorsal view (Add.Supf. removed to show the deep muscles of the fin)
5. Dorsal view (most of the fin muscles removed to expose the Add.Rad.)


Other legends according to plate XVII.
inserts on the last 6 rays whereas the deep slip inserts on the remaining rays of the fin.

The superficial slip helps in the abduction and the protraction of the post-axial rays and the deep slip on the other hand acts as a very strong abductor of the fin.

M. abductor profundus

It is a very well developed massive muscle covering a wide area on the ventral surface of the pectoral girdle. It is a parallel type of muscle.

The muscle arises in a broad and fleshy origin partly from the coracoid and partly from the scapula. The origin also covers the anterior and the posterior processes of the coracoid.

The massive muscle belly is provided with a broad, thin tendon sheet which gets divided into narrow ribbon-like bands. Each of the ribbon shaped tendon is twisted before getting inserted on the knobs of the ray. The insertion is on all the rays.

The muscle acts as a very powerful abductor of the fin.

M. arrector ventralis

It is a unipinnate type of muscle situated in a ventrolateral position to the M.abd.suf. and M.abd.prof. along its outer margin.

The muscle arises from the cleithrum below the origin of the M.abd.suf. The origin of the muscle is fleshy in nature.
As the muscle moves downwards, the muscle belly tapers gradually and is provided with a tendinous cord which is inserted on the outer-lateral surface of the first fin ray.

By its action the muscle protracts the first ray of the fin whereby the entire fin is dilated.

**M. adductor superficialis**

This is a well developed parallel type of muscle which occupies a diagonal and a superficial position on the dorsal side of the girdle.

The muscle arises from the ridge like joint between the two arms of the cleithrum. The origin which is mostly fleshy but slightly tendinous, also extends to the dorsal surface of the plate-like dorsal cleithral arm.

As the muscle travels transversely backwards and inwards, it becomes slightly broad in the middle. The muscle is supplied with a broad tendinous sheet towards the insertion. This sheet splits into a number of small tendinous ribbon-like structures which insert respectively on the inner lateral side of the 9th to 17th rays of the fin.

The muscle acts as an adductor and a retractor of the 9th to 17th rays of the fin.

**M. adductor medialis**

This is a small fan shaped muscle lying below the M. add. supf. The latter muscle completely covers the M. add. med. It is a bipinnate type of muscle.
The muscle arises from the dorsal plate of the cleithrum. The origin of the muscle is broad and fleshy in nature. As the muscle tapers downwards and a little inwards towards the fin rays it is provided with a narrow tendinous fascia in the middle of the muscle belly. The tendon gets twisted and splits up into long finger like projections. The insertion is on the 1st to 8th rays and it is continuous with that of the M.add.supf.

In addition to its function as an adductor of the first 8 pre-axial rays, it also protracts them.

M. adductor profundus

This is a well developed massive muscle, partially covered by M.add.supf, towards the insertion. It is a parallel type of muscle but as it moves towards the insertion it forms pinnate types of muscle bundles.

The origin of the muscle is broad and fleshy in nature. It arises mainly from the dorsal surface of the coracoid and partly from the anterior arm of the cleithrum. The origin is also extended to a small portion of the scapula.

As the muscle travels backwards, it splits up into small indistinct muscle bundles, which are supplied with ribbon-like tendons. Each of these tendons partially overlaps the succeeding tendon and thus form a broad tendinous sheet. The muscle inserts on the knobs of all the rays of the fin.

The action of the muscle is to adduct the entire fin.
M. adductor radialis

It is a comparatively small parallel type of muscle occupying a deep position below the M.add.prof.

The muscle arises from the radials in a broad and fleshy origin. The origin may also extend to a small portion of the scapula.

As the muscle runs transversely backwards towards the post-axial rays, it becomes slightly narrow and is supplied with a thin tendon sheet which inserts on the last 4 rays of the fin.

The M.add.rad.adducts as well as protracts the last four rays of the fin.

ANABAS SCANDENS (Plate XXII)

M. abductor superficialis

The M.abd.supf. is a large muscle situated on the ventral side of the girdle. The muscle is made up of two slips viz. a superficial and a deep slip. Both the slips arise in a common origin but towards their insertion they take different directions.

The muscle arises fleshily from the inner surface of the ventral lamina of the cleithrum. The muscle belly mostly lies hidden beneath the ventral lamina of the cleithrum.

The superficial slip, as it moves towards the post-axial rays, is supplied with a thin narrow tendon sheet which divides into finger shaped projections. These projections are inserted
on the last five rays. The deep slip on the other hand is slightly smaller in size and is also supplied with a narrow tendon sheet, the likewise terminal projections of which are inserted on the remaining rays of the fin.

The contraction of the superficial slip results in the abduction and a slight arrection of the five post-axial rays whereas the contraction of the deep slip results in the abduction of the remaining rays of the fin.

M. abductor profundus

It is a huge massive muscle, partly hidden beneath the M. abd. supf.

The muscle takes a broad origin from the entire length of the coracoid and a small portion of the scapula.

The muscle is provided with a broad tendinous sheet towards the insertion, by means of which it inserts on all the rays. The insertion is strong in nature.

It serves as a powerful abductor of the fin.

M. arrector ventralis

It is a bipinnate type of muscle lying deep below the M. abd. supf. along the outer-lateral position on the ventral aspect of the girdle.

The muscle takes a broad fleshy origin from the cleithrum and the scapula.

As it moves backwards towards the insertion, the muscle becomes narrow and is supplied with a thin tendon. The muscle
Plate XXII

Pectoral fin muscles of *Anabas scandens*

1. Ventral view (superficial)
2. Ventral view (Abd.Supf. removed to show the deeply placed muscles)
3. Dorsal view (superficial)
4. Dorsal view (with Add.Supf. removed)
5. Dorsal view (most of the fin muscles removed to exhibit Add.Rad.)

Legends according to plates XVII & XXI.
inserts on the outer-lateral side of the first ray, just below its knob.

As a result of the contraction of this muscle, the first fin ray is arrected and hence the entire fin is protracted.

**M. adductor superficialis**

As the name indicates, this muscle occupies a superficial position on the dorsal aspect of the girdle. The muscle shows a tendency towards the formation of a number of bundles which become distinct especially towards the insertion. The muscle fibres though of a parallel nature, tend to form unipinnate bundles towards the insertion.

The muscle takes a broad fleshy origin from the cleithrum near the junction between the two cleithral arms.

As the muscle moves downwards and outwards in a slightly oblique manner, it is supplied with a tendon sheet which divides into a number of ribbon-like strips, each forming a finger-like projection. The muscle is inserted on the outer-lateral surface of the ten post-axial rays by means of these finger-like projections. The insertion on each ray lies a little posterior to the knob. It is interesting to note that the distance between the points of insertion on the rays goes on gradually increasing towards the middle of the fin.

The muscle helps in the adduction and retraction of the corresponding rays.
M. adductor medialis

This fan shaped muscle lies ventral to the M.add.supf. It lies completely hidden beneath the M.add.supf. excepting a small anterior portion. The muscle fibres are parallel in nature.

The muscle arises from the cleithrum in a broad fleshy origin which appears to be confluent with that of the M.add.supf. As the muscle moves downwards and inwards, the muscle belly tapers into an obliquely placed tendon.

The tendon gets twisted before forming a number of finger-like projections. The muscle is inserted on the first five rays by means of these tendinous projections. It may be noted that the distance between the knob of the ray and the point of insertion increases gradually towards the middle of the fin. Thus the insertions of the M.add.supf. and M.add.med. when viewed together, appear to be continuous with each other forming a curvacious continuous tendinous attachment on the fin.

In addition to its function of adducting the related rays, the muscle also serves as a very powerful protractor of the fin. The co-ordinated actions of the two muscles (M.add.supf. & M.add.med.) result into an alternate retraction and protraction of the fin, the two movements working in unison with each other.

M. adductor profundus

It is a highly developed massive muscle occupying a prominent disposition between the anterior arm of the cleithrum and the fin. The muscle appears to be of parallel nature.
superficially but actually it forms a number of bundles, each of which when studied carefully reveals a pinnate structure. It is observed that the first bundle towards the pre-axial side exhibits a distinct tendency to separate from the rest of the muscle mass.

The muscle arises from the dorsal surface of the anterior arm of the cleithrum, coracoid and a part of the scapula. The origin is fleshy in mature.

Towards the insertion the muscle belly is supplied with a tendon sheet which inserts on the knobs of all the fin rays.

By its action, the muscle serves as a powerful adductor of the entire fin structure.

**M. adductor radialis**

The M.add.rad. in Anabas resembles that of Ophiiocephalus in its nature, disposition and function.

**OSPHROMENUS GOURAMI (Plate XXXIII)**

**M. abductor superficialis**

This is a well developed massive muscle comprising of two slips, a superficial and a deep one. Both the slips are made of parallel type of fibres having a common origin but separate insertions.

The muscle arises from the deep concavity formed by the ventral and the dorsal laminae of the anterior arm of the cleithrum.
As the muscle moves backwards, the muscle belly gets differentiated into two separate slips. The superficial slip tapers towards the post-axial rays and is supplied with a narrow tendon sheet. This tendon sheet soon after splits into long finger-like processes which insert respectively on the last 6 rays. The deep slip on the other hand moves backwards and is also supplied with a comparatively broad tendon sheet which is thrown into small projections. These tendinous projections of the deep slip insert on the remaining rays.

The superficial slip helps to arrect and abduct the last six fin rays whereas the abduction of the remaining rays of the fin is brought about by the deep slip.

M. abductor profundus

It is a very well developed pinnate type of muscle which extends between the anterior tip of the coracoid and the fin.

The muscle arises in a broad fleshy origin which covers the entire ventral surface of the coracoid and a part of the scapula. The muscle belly becomes slightly broad towards the insertion.

Towards the insertion the muscle is supplied with a broad triangular tendon which splits into long strips. By means of these tendinous strips the muscle inserts on the knobs of all the rays.

The muscle serves as a very strong abductor of the fin.
Plate XXIII

Musculature of the pectoral fin of Osphromenus gourami

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)
4. Dorsal view (with Add.Supf. removed)
5. Dorsal view (most of the muscles removed to show Add.Rad.)

Legends as in plates XVII & XXI.
**M. arrector ventralis**

This is an elongate and a narrow muscle situated deep on the pectoral girdle, practically hidden beneath the M. add. supf. The muscle is of a pinnate nature and is provided with a superficially placed ribbon-like tendon.

The muscle arises from the inner side of the dorsal lamina of the anterior arm of the cleithrum in a broad and fleshy origin. However some of the fibres take their origin from a small portion of the scapula and the coracoid.

The muscle travels obliquely outwards and backwards. Towards the insertion the muscle becomes very narrow and gets inserted tendinously on the outer-lateral side of the first fin ray, a little distance away from the knob.

By its action the muscle arrects the first ray of the fin whereby the entire fin is protracted.

**M. adductor superficialis**

The M. add. supf. of Gourami is quite similar to that of Anabas in its structure, disposition and function.

**M. adductor medialis**

This muscle extends between the dorsal and the anterior arms of the cleithrum occupying a middle position. The muscle is bifid and forms two fasciae which are however confluent with each other due to the presence of a thin layer of muscle fibres inbetween.
Both the fasciae arise fleshily from the inner walls of the crevice formed by the cleithral ridge. The inner fascia arising from the outer side of the dorsal lamina of the anterior cleithral arm is better developed and massive compared to the outer fascia which arises from the dorsal arm of the cleithrum. Both the fasciae are of a unipinnate nature.

As they move backwards towards the fin, they become narrow and converge towards a tendon sheet. This tendon sheet gets twisted towards the insertion forming saber shaped projections which get inserted on the first seven rays of the fin. The insertion on each ray lies posterior to the knob.

In addition to its function as an adductor, the muscle also serves as a protractor of the corresponding rays.

M. adductor profundus

It is a massive muscle situated on the dorsal side of the girdle covering almost the entire surface of the coracoid, a part of the scapula and the inner wall of the dorsal lamina of the cleithrum. Towards the insertion the muscle is covered by the M.add.supf.

The muscle arises fleshily from the inner wall of the dorsal cleithral ridge and the coracoid. The origin also extends to a small portion of the scapula.

The muscle belly is broad and towards the insertion it tends to form a number of bundles. Each of these bundles is supplied with a thin ribbon-like tendon strip. Each strip
overlaps the succeeding strip partially and gets inserted on the inner side of the corresponding knob of the fin ray. The insertion is on all the rays.

The M.add.prof. is a powerful adductor of the fin.

**M. adductor radialis**

In the gourami the M.add.rad. is similar to that of the Ophiocephalus punctatus and Anabas scandens. Barring the variation in size, the nature and the disposition of the muscle remain the same.

**GOBIUS STRIATUS (Plate XXIV)**

**M. abductor superficialis**

The M.abd.supf. is a well developed massive muscle having a broad belly. The muscle is parallel in nature and is situated superficially on the ventral side of the girdle.

The muscle arises from the ventral lamina of the cleithrum. The origin is fleshy and covers a small part of the cleithral ridge towards the ventral side.

The muscle travels in a slightly oblique manner towards the fin. The muscle becomes broader as it moves away from the origin and shows a tendency towards the formation of small bundles which are however not distinguishable superficially. These bundles are very distinct when the muscle is seen from the inner surface. Each of the bundles is supplied with a thin tendon strip by means of which the muscle inserts separately
on the knobs of all the fin rays.

The muscle acts as an abductor of the entire fin.

M. abductor profundus

The M. abd. prof. is also an equally well developed muscle on the ventral side of the pectoral girdle. The muscle is comprised of a superficial and a deep slip.

The superficial slip arises from the anterior region of the cleithral ridge and the coracoid in a fleshy origin. Its muscle fibres run parallel to each other. The deep slip takes its origin from the radials and the lower margin of the coracoid. It is observed that some fibres of the deep slip share the origin with the superficial slip. The origin of both the slips is fleshy.

The superficial slip moves straight towards the post-axial rays of the fin whereas the deep slip takes a slightly oblique course towards the pre-axial rays. Towards the insertion the superficial slip forms smaller unipinnate bundles. The deep slip also forms bundles which are not as distinct as those of the superficial slip. The superficial slip inserts on the last 11 rays whereas the deep slip inserts on the first 7 to 8 rays in a tendinous insertion.

The superficial slip acts as an abductor of its connected rays. The deep slip in addition to its function as an abductor, also retracts the related rays. It is noted that by the contraction of both the slips the fin in addition to being abducted is also slightly retracted so as to give a twist towards the pre-axial rays of the fin.
Plate XXIV

Pectoral fin muscles of *Gobius striatus*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf. removed)
3. Dorsal view (superficial)
4. Dorsal view (Add.Supf. removed to show the details of the deeply placed muscles)

Cor.Rad. - Coraco-radialis;

Other legends as in plate XVII.
M. adductor superficialis

This is a parallel type of large massive muscle occupying a superficial position on the dorsal side of the girdle.

The muscle arises from the cleithrum, scapula and the margin of the first radial in a broad origin. Towards the origin the muscle is provided with a strong aponeurotic tendon sheet which extends to the middle of the muscle surface.

As the muscle moves obliquely downwards it becomes very broad and splits into 16 laterally compressed muscle bundles each partially overlapping the other in succession. The insertion is on the lateral side of the rays and is completely fleshy in nature. The insertion of these 16 bundles has an arch-like pattern so as to ensure a uniform action of the muscle.

The action of this muscle results in the adduction of the entire fin. It may be mentioned here that during this process the first six to eight rays become slightly protracted whereas the last few rays become slightly retracted, whereby the entire fin takes a tilted posture towards the post-axial side of the fin.

M. adductor profundus

It is a deeply situated muscle having a broad belly which remains partly covered by the M.add.supf. The muscle is rather massive towards the origin but gradually becomes compressed as it moves towards the insertion.

The muscle arises fleshy from the cleithrum, scapula and the radials. Towards the pre-axial side some of the fibres
tend to separate from the main muscle mass to form a thin
spindle shaped fascia which is better differentiated towards
the middle of the muscle belly and the insertion. This small
bundle is provided with a thin long tendinous cord extending
nearly two thirds of its length towards the fin.

As the muscle moves backwards and a little inwards
towards the insertion, it becomes slightly broader. The muscle
inserts tendinously on the knobs of all the rays of the fin.

The muscle acts as a powerful adductor of the fin.

M. coraco radialis

It is a small but massive muscle extending between the
anterior arm of the cleithrum and the fourth radial.

The muscle arises from the base of the cleithral rod,
coracoid and the plate formed by the anterior and the posterior
processes of the coracoid. The origin is broad and fleshy.

The fibres run parallel in a slightly inward direction
to get inserted on the lateral ridge on the anterior margin of
the fourth radial. The insertion is strong and fleshy in nature.

The muscle acts as an adductor of the basal lobe of
the fin.

MASTACEMBELUS ARMATUS (Plate XXV)

M. abductor superficialis

It is a broad and massive muscle lying between the
cleithrum and the fin. It is a parallel type of muscle.
The muscle arises from the inner wall of the ventral lamina of the cleithrum. The origin is broad and fleshy. As the muscle runs posteriowards towards the fin, it is provided with a broad and thin tendinous sheet. This sheet forms a number of small ribbon-like processes by means of which the muscle inserts on the knobs of all the rays.

The muscle abducts the pectoral fin strongly.

*M. abductor profundus*

Lying deep on the ventral surface of the girdle, the M.abd.prof. extends almost over the entire ventral surface of the girdle. It is a parallel type of massive muscle.

The muscle arises from the entire ventral surface of the coracoid and the adjoining portion of the scapula. A few superficial fibres may also arise from the anterior arm of the cleithrum. The origin is broad and fleshy.

As the parallel muscle fibres run towards the insertion the muscle tends to form small muscle units, each of which is provided with a thin tendinous strip. The muscle is inserted on all the rays by means of these tendinous strips.

The muscle acts as an abductor of the fin.

*M. arrector ventralis*

This is a small unipinnate type of muscle extending between the cleithrum and the first fin ray. The muscle though broad towards the origin, becomes narrow towards the fin.
Plate XXV

Muscles of the pectoral fin of *Mastacembelus armatus*

1. Ventral view (superficial)
2. Ventral view (with Abd.Supf.removed)
3. Dorsal view (superficial)
4. Dorsal view (with Add.Supf.removed)
5. Dorsal view (most of the muscles removed to expose Add.Rad.)

Legends according to plates XVII & XXI.
The muscle arises from the cleithrum. The origin is
broad and fleshy in nature and lies below the origin of
M. abd. supf.

The pinnate fibres converge posteriorwards forming a
compact but tapering muscle belly which is provided with a thin
tendon. The muscle is inserted on the lateral surface of the
first fin ray. The insertion is narrow but strong and tendinous.

The muscle protracts the first ray of the fin and
hence the adjacent rays are also protracted slightly.

**M. adductor superficialis**

It is a massive muscle occupying a postero-lateral
position on the dorsal aspect of the girdle. The muscle is
parallel in nature.

The muscle arises from the dorsal arm of the cleithrum
in a broad fleshy origin. As the muscle runs obliquely downwards,
the superficial fibres and the deep fibres travel in a slightly
different directions. The deep fibres travel towards the pre-axial
rays whereas the superficial fibres, in addition to the pre-axial
rays, also run towards the post-axial rays giving the muscle a
transverse arc-like appearance.

Towards the insertion the muscle is supplied with a
broad tendon sheet which is split into small strips. The muscle
is inserted on the broad plate-like vertical processes of the
knobs of all the fin rays.

By its contraction, the muscle brings about the
adduction of the pectoral fin. The inner long muscle fibres going towards the post-axial rays bring about a very prominent action, whereas the deep fibres going towards the pre-axial rays bring about a slow and weak action. This results in a tilting of the fin towards the post-axial side along with the adduction of the fin.

M. adductor profundus

It is a parallel type of broad massive muscle covering the entire dorsal surface of the pectoral girdle.

The muscle arises mainly from the scapula, the coracoid and partly from the cleithrum. The origin is broad and fleshy.

As the muscle moves towards the fin rays the broad muscle belly is supplied with a tendon sheet which splits into ribbon-like processes. The muscle inserts on the knobs of all the rays by means of these tendinous ribbons.

The muscle acts as a strong adductor of the fin.

M. adductor radialis

The nature and disposition of the M. add. rad. in Mastacembelus is same as that observed in the Ophiocephalus punctatus and Anabas scandens.

Given below is an account of the pelvic fin musculature of the fishes studied.
WALLAGO ATTU (Plate XXVI)

M. protractor ischii

This long ribbon shaped muscle extends between the pectoral and the pelvic girdles, running along the mid-ventral line of the body. The muscle is parallel in nature showing segmentation. Each segment is joined with the other by means of a thin tendinous structure. The segments vary in their length.

The muscle arises from the cleithrum of the pectoral girdle at the pectoral symphysis. The origin is narrow and tendinous.

As the muscle runs towards the pelvic fin, it moves below the M.abd.supf. Towards the insertion the muscle becomes narrow and is provided with a thin tendon on its ventral surface to which the muscle fibres are attached in a pinnate arrangement. The muscle inserts on the posterior end of the pelvic girdle by means of a separate tendon strip running along the dorsal surface of the muscle.

The muscle acts as a protractor of the pelvic fins. Its contraction results in the abduction of the entire pelvic structure.

M. abductor superficialis

It is a very well developed parallel type of massive muscle occupying a superficial position on the ventral aspect of the pelvic girdle. The muscle is very broad towards the origin and gradually becomes narrow as it moves obliquely backwards towards the fin in a fan-like fashion.
The origin is broad and fleshy. The muscle arises from the median raphe over the ischial symphysis.

The muscle is inserted on the knobs of all the rays. Towards the insertion the muscle belly is provided with thin tendinous structures which lie embedded within the muscle mass. The muscle shows a tendency towards the formation of smaller bundles which are not conspicuous. The insertion is mainly fleshy but partly tendinous in nature.

By its action, the muscle is an abductor of the fin. It also serves as a weak retractor.

M. abductor profundus

The muscle lies deep below the M.pro.isch. and M.abd. supf. on the ventral aspect of the girdle. This massive parallel type of muscle is broad towards the origin and slightly narrow towards the insertion.

The muscle arises in a broad fleshy origin from all along the mid-line covering the outer and the middle processes of the pelvic bone including the inner process. The muscle fibres run obliquely outwards in a parallel fashion forming a massive muscle belly.

Towards the insertion the muscle is provided with a thin aponeurotic tendon and tends to form indistinct muscle bundles. The muscle inserts on the knobs of all the fin rays. The insertion is mostly fleshy but slightly tendinous.

The M.abd.prof. is a powerful abductor of the fin.
M. arrector ventralis

It is an elongate parallel type of muscle occupying an outer-lateral position on the ventral side of the pelvic girdle. It extends between the tip of the middle process and the first fin ray.

The muscle arises from the middle process of the pelvic bone. The origin also extends to a part of the outer process. The muscle moves downwards and outwards to form a uniform fleshy muscle belly.

Towards the insertion the muscle is provided with a tendon which is embedded within the muscle mass. The muscle is inserted on the inner lateral surface of the first fin ray, just below the knob. The insertion is narrow and tendinous in nature.

It is a powerful protractor of the fin.

M. adductor superficialis

This is a massive muscle having two fasciae. The muscle occupies a superficial position on the postero-dorsal aspect of the pelvic girdle. The anterior fascia which is smaller of the two, is of a pinnate nature and lies between the outer process and the first fin ray whereas the posterior fascia is parallel in nature and extends between the median raphe and the fin.

The origin of the muscle is broad and fleshy in nature. The anterior fascia takes its origin along the length of the outer process whereas the posterior fascia arises from the median
raphe. As the fibres of the anterior fascia move backwards, they form a separate bundle. The posterior fascia also splits up to form a number of muscle bundles as it travels towards the fin.

The anterior fascia is inserted on the knob of the first fin ray only. The posterior fascia is inserted on the knobs of the remaining rays of the fin in a fleshy insertion.

The muscle acts as a strong adductor of the pelvic fin and the adduction is accompanied with a slight protraction.

**M. adductor profundus**

The M. add. prof. is a large parallel type of muscle covering almost the entire dorsal surface of the pelvic girdle. At its posterior region the muscle is provided with a triangular tendon sheet.

The muscle arises from the middle process, the inner process, dorsal surface of the basipterygium and the median raphe in a fleshy origin. The parallel muscle fibres form a broad belly which becomes narrow towards the insertion.

The muscle inserts on the inner side of the knobs of all the rays of the fin. The insertion is broad and it is partly fleshy and mainly tendinous in nature.

By its contraction the muscle brings about a very powerful adduction of the entire fin.

**M. arrector dorsalis**

It is an elongate parallel type of spindle shaped
Plate XXVI

Ventral view of the pelvic fin muscles of

1. *Wallago attu*

3. *Ompok macrophthalmus* (Abd.Supf. removed from the right side to expose the deeper muscles of the fin)

Dorsal view of the pelvic fin muscles of

2. *Wallago attu*

4. *Ompok macrophthalmus* (The Add.Supf. is removed from the right side to expose the Add.Prof.)

Abd.Prof. - Abductor profundus; Abd.Supf. - Abductor superficialis; Add.Prof. - Adductor profundus; Add.Supf. - Adductor superficialis; Arr.Dor. - Arrector dorsalis; Arr.Vent. - Arrector ventralis; Prot.Isch. - Protractor ischii; Ret.Isch. - Retractor ischii.
muscle occupying an outer-lateral position on the dorsal aspect of the girdle. The muscle extends between the tip of the outer process and the first fin ray.

The muscle arises along the length of the outer process in a broad fleshy origin. The muscle fibres travel backwards and outwards in a parallel fashion to form a compact muscle belly. The belly gradually tapers towards the insertion.

The muscle inserts on the dorso-lateral side of the first fin ray just below its knob. The insertion is tendinous in nature.

By its contraction the muscle protracts the fin.

**M. retractor ischii**

It is a long parallel type of muscle situated at the posterior region of the pelvic girdle. The muscle extends inbetween the pelvic and the anal fins. During its linear run the muscle exhibits segmentation.

The muscle arises from the base of the anal fin in a narrow but fleshy origin and runs anteriorwards towards the pelvic fins on the ventro-medial aspect of the body.

The muscle inserts on the posterior process of the basipterygium. The insertion is strong and fleshy in nature.

By its action the muscle retracts the entire pelvic structure, adducting the fin in a slightly inward manner.

**OMPOK MACROPHTHALMUS (Plate XXVI)**

In Ompok macrophthalmus the muscles of the pelvic fin
are very similar to those of *Wallago attu* in all respects except that the M.arr.vent. which is distinctly differentiated in *Wallago*, is not a separate entity here. The M.arr.vent. forms an indistinguishable part of the M.abd.prof.

**Mystus BLEEKERI** (Plate XXVII)

**M. protractor ischii**

This is a thin ribbon-like muscle showing a very feeble development. The muscle is of parallel nature and is highly tendinous towards its posterior end. Along its linear run on the mid-ventral axis, the muscle exhibits segmentation which is not very conspicuous.

The muscle arises from the pectoral girdle in a narrow and fleshy origin. The muscle travels posteriorwards in close association with the body muscles.

Towards the pelvic girdle the muscle is supplied with a strong tendon which extends superficially between the outer process of the basipterygium and the posterior end of the girdle. Along the mid-line, the tendon becomes very thin and narrow and gets inserted on the posterior process of the basipterygium in a strong and narrow insertion.

The muscle pulls the pelvic girdle away from the body.

**M. abductor superficialis**

The M.abd.supf. is a small massive muscle exhibiting pinnate arrangement of fibres. The muscle is provided with a
number of strip like aponeurotic tendons which converge towards the insertion.

The muscle arises from the median raphe where it meets the fellow of the opposite side. The origin is broad and fleshy in nature.

The fibres travel downwards in a pinnate fashion to get attached on the tendinous strips present on the muscle belly. Some of these tendinous structures lie embedded within the muscle mass and help to make the muscle a compact structure. The muscle gets inserted on knobs of all the rays. The insertion is mainly tendinous. A few fibres are however inserted fleshily.

By its action, the muscle abducts the fin.

**M. abductor profundus**

It is a large muscle occupying a deep position and is partially covered by the M.abd.supf. at its posterior end. The arrangement of muscle fibres though pinnate towards the anterior end, gradually becomes parallel posteriorwards around the broad origin.

The muscle arises in a broad fleshy origin which extends to the inner process and the median raphe. Some of the fibres may also take their origin from the basipterygium. The muscle fibres arising from the inner process show a pinnate arrangement.

As the muscle moves obliquely posteriorwards towards the fin, the muscle belly becomes broad and massive and tends to divide into smaller bundles. The number of the bundles formed,
corresponds to the number of the fin rays. Each of these bundles is provided with a thin ribbon like aponeurotic tendon strip. The bundles show an overlapping arrangement. Each bundle is inserted on the knobs of all the rays respectively. The insertion is partly tendineous and partly fleshy.

The muscle serves as an abductor of the fin.

_M. arrector ventralis_

This spindle shaped muscle extends between the outer process and the first ray of the pelvic fin. The muscle is pinnate in nature and is provided with a thin tendon on its posterior half.

The muscle arises from the outer process in a fleshy origin. The origin extends along half the length of the outer process.

The fibres travel downwards and inwards in a pinnate fashion to get attached on the tendon. The tendinous insertion of the muscle is on the inner-lateral side of the first fin ray just below the knob.

By the contraction of the muscle, the first fin ray and hence the entire fin is protracted.

_M. adductor superficialis_

As the name indicates, the muscle occupies the most superficial position on the dorso-lateral aspect of the girdle. It is a large massive muscle which is partly pinnate but mainly parallel in nature.
The muscle arises from the entire length of the outer process along its dorsal surface. The fibres along the inner margin of the muscle arise from the connective tissue between the M.add.supf. and M.add.prof. The muscle fibres towards the outer-lateral side form a distinctly separate bundle which is pinnate in nature. The rest of the muscle mass has a parallel arrangement of fibres and towards the insertion tends to divide into smaller bundles which are inconspicuous.

The pinnate bundle on the outer-lateral side is inserted tendinously on the knob of the first fin ray whereas the rest of the muscle mass gets inserted on the remaining rays in a fleshy insertion.

While the contraction of the entire muscle acts as an adductor of the fin, the outer lateral bundle serves to protract the first fin ray resulting in a gradual protraction and adduction of the pelvic fin.

M. adductor profundus

The M.add.prof. is a large massive muscle with a very prominent belly which extends over the entire dorsal surface of the pelvic girdle.

The muscle arises from the outer process, inner process and the median raphe on the ischial symphysis. The origin is broad and fleshy. The fibres arising from the outer and the inner processes form a distinctly pinnate arrangement whereas those taking their origin from the median raphe travel in a parallel fashion.
Towards the insertion the muscle is supplied with a broad triangular tendon sheet by means of which the muscle inserts on the inner side of the knobs of all the rays of the fin. The muscle acts as a powerful adductor of the pelvic fin.

**M. arrector dorsalis**

This small, elongate, parallel type of muscle is situated dorso-laterally to the M.arr.vent. The muscle is slightly broad at its anterior end.

The muscle arises from the outer process in a broad and fleshy origin which extends between the tip and about two thirds length of the outer process. Towards the posterior end, the origin is slightly tendinous in nature.

As the muscle moves downwards towards the insertion, it becomes compact and narrow before getting inserted on the outer-lateral surface of the knob of the first fin ray. The insertion is fleshy in nature.

The muscle acts as a powerful protractor of the fin.

**M. retractor ischii**

It is a long strip-like muscle situated at the posterior end of the pelvic girdle. The muscle extends between the pelvic and the anal fins and exhibits segmentation along its linear run.

The muscle arises from the anal fin in a narrow and fleshy origin. The muscle moves forwards on the mid-ventral axis of the body towards the pelvic fin.
Towards the insertion the muscle is provided with a tendon and the muscle fibres are arranged in a pinnate fashion. The tendinous insertion is on the flat posterior process of the basipterygium, just below the insertion of the M.prot.isch.

By its action the muscle retracts the entire pelvic structure.

CLARIAS MAGUR (Plate XCVII)

M. protractor ischii

It is a long parallel type of massive muscle which during the course of its linear run exhibits segmentation. The muscle is situated superficially on the ventral side of the girdle and extends inbetween the pectoral and the pelvic girdles.

The muscle arises from the ventral side of the pectoral girdle in a narrow tendinous origin. The origin is located at the joint between the cleithrum and the coracoid of the pectoral girdle. As the muscle moves backwards towards the pelvic fin, it becomes slightly broad and massive in appearance.

Towards the insertion the muscle narrows down and is provided with a long triangular tendon sheet. The muscle is inserted on the postero-medial part of the basipterygium in a slightly linear insertion.

The muscle by its contraction pulls the entire pelvic structure away from the body.

M. abductor superficialis

This is a fan shaped parallel type of muscle. The
Plate XXVII

Ventral view of the pelvic fin musculature of

1. *Clarias magur*
3. *Heteropneustes fossilis*
5. *Mystus bleekeri*

(Prot.Isch. and Abd.Supf. removed from the right side to expose the deeper muscles of the fin.)

Dorsal view of the muscles of the pelvic fin of

2. *Clarias magur*
4. *Heteropneustes fossilis*
6. *Mystus bleekeri*

(Add.supf removed from the right side)

Legends according to plate XXVI.
origin of the muscle is hidden beneath the tendon of the M.prot.isch.

The muscle arises from the median raphe where it meets the fellow of the opposite side. The origin is broad and fleshy.

As the muscle moves obliquely backwards and outwards it becomes slightly narrow. Towards the insertion, it splits into a number of bundles. Each of these bundles inserts on the knobs of all the rays respectively. The insertion is tendinous in nature.

Besides serving as an abductor of the fin, this muscle also functions simultaneously as a retractor of the fin rays.

M. abductor profundus

As seen from the ventral side of the girdle it is a deeply placed muscle partially covered by the M.abd.supf. This is a very well developed massive muscle having a parallel arrangement of fibres.

The muscle arises in a broad origin which extends along the ischial symphysis upto the inner process. Some of the deep fibres take their origin from the ventral surface of the pelvic bone. The origin from the inner process is although in a slightly pinnate pattern, the muscle fibres become parallel towards the fin.

As the muscle moves towards the insertion, the muscle belly becomes broad and is provided with a thin aponeurotic tendon sheet. The muscle, alongwith the tendon sheet, divides into smaller units by means of which it inserts on all the rays.

The muscle abducts the pelvic fin.
M. arrector ventralis

This is a spindle shaped muscle situated on the ventro-lateral side of the pelvic girdle. It is a pinnate muscle supplied with a long median tendon.

The muscle arises tendinously from the tip of the outer process. The muscle fibres travel backwards in a bipinnate fashion to get attached on the median tendon.

Towards the insertion the muscle becomes narrow and gets attached on the inner-lateral side of the first fin ray. The insertion is strong and tendinous.

The muscle acts as a powerful protractor of the fin.

M. adductor superficialis

The M. add. supf. lies superficially in a slightly latero-posterior position on the dorsal side of the girdle. It is a highly fleshy muscle. The muscle is narrow towards the origin but it gradually becomes broad to form the massive muscle belly.

The muscle arises from the outer process in a comparatively narrow origin which is partly fleshy and partly tendinous. The fleshy part of the origin is near the tip of the outer process and forms a distinct pinnate fascia whereas the tendinous part of the origin lies deep below the fleshy part. While the muscle fibres in the fascia arising directly from the outer process are arranged in pinnate fashion, the rest of the muscle mass exhibits a parallel arrangement of fibres.
Towards the insertion the pinnate fascia is provided with a thin tendon which is inserted on the first fin ray. The rest of the muscle mass gets inserted on the remaining rays respectively in a fleshy insertion.

By its action the muscle adducts the fin and also retracts the fin slightly.

**M. adductor profundus**

This is the largest muscle of the pelvic fin in Clarias. It is a massive parallel type of muscle having a pinnate arrangement of some of its fibres towards the anterior end.

The muscle arises in a broad and fleshy origin which extends along the outer process, the inner process, the basipterygium and the ischial symphysis. The muscle fibres arising from the outer and the inner processes are arranged in a pinnate fashion whereas the rest of the muscle mass shows a parallel arrangement of fibres.

As the muscle travels backwards and slightly outwards, it is provided with a broad aponeurotic tendon sheet with the help of which, the muscle gets inserted on the inner side of the knobs of all the rays. Towards the insertion the muscle tends to form a number of small bundles.

The M.add.prof. is a powerful adductor of the fin.

**M. arrector dorsalis**

This spindle shaped parallel type of muscle occupies a dorso-lateral position on the pelvic girdle. The muscle is
narrow towards the origin and becomes broad and massive towards the insertion.

The muscle arises along the length of the outer process of the basipterygium in a fleshy origin. The origin extends from the tip of the process to about two thirds of its length.

The muscle inserts on the knob of the first fin ray. The insertion is strong and mostly fleshy but partly tendinous in nature.

The muscle helps to protract the pelvic fin.

M. retractor ischii

The muscle is situated at the posterior end of the pelvic girdle. It is an elongate, parallel type of fleshy muscle extending between the anal and the pelvic fins.

The muscle arises from the base of the first fin ray of the anal fin. The origin is narrow and tendinous in nature. While travelling anteriorwards towards the pelvic fin, the muscle is divided into small segments.

The muscle inserts on the posterior margin of the basipterygium. The insertion is very strong and tendinous.

By its action the muscle retracts the entire pelvic girdle.

HETEROPNEUSTES FOSSILIS (Plate XXVII)

M. protractor ischii

It is a long parallel type of muscle which exhibits
segmentation along its length. The muscle extends between the pectoral and the pelvic girdles running ventrally along the either side of the mid-line of the body.

The muscle arises in a strong tendinous origin from the ventral surface of the pectoral symphysis. As the muscle runs posteriorwards towards the pelvic girdle, it becomes distinguished into distinct segments each of which is aponeurotically connected with the succeeding one.

Towards the insertion the muscles of the two sides are provided with a common tendon which tapers gradually before getting inserted on the posterior end of the ischial symphysis.

By its action the muscle pulls the pelvic girdle away from the body. The action results in a protraction and abduction of the pelvic fin.

M. abductor superficialis

It is a broad fan shaped parallel type of muscle spread over almost the entire ventral surface of the pelvic girdle. It is partly covered by the M. prot. isch. along the mid-line.

The muscle arises from the median raphe over the ischial symphysis. The origin is broad and fleshy in nature.

As the muscle moves outwards and posteriorwards towards the insertion, it becomes slightly narrow and forms small bundles. Each of these bundles is provided with a thin tendon which gets inserted on the knobs of all the fin rays.

The muscle acts as a strong abductor of the fin. The action is also accompanied with a slight retraction of the fin.
M. abductor profundus

The M. abd. prof. is also a large parallel type of muscle lying below the M. abd. supf. The muscle extends between the inner process of the basipterygium and the pelvic fin.

The muscle arises in a strong and broad origin which extends along the inner process, the mid-line and also the ventral surface of the basipterygium.

As the muscle fibres run backwards and slightly outwards, they tend to form compact bundles towards the fin rays. Each bundle inserts on the inner side of the knobs of all the rays of the fin respectively. The insertion is partly fleshy and partly tendinous in nature.

The muscle acts as a very powerful abductor of the fin.

M. arrector ventralis

This is a long spindle shaped muscle situated ventrally along the outer lateral aspect of the girdle. The posterior part of the muscle is provided with a thin median tendon which extends up to the insertion.

The muscle arises near the tip of the outer process in a strong origin which is mostly fleshy but partly tendinous. The muscle fibres run backwards towards the fin in a parallel fashion to get inserted on the median tendon forming a pinnate pattern.

Towards the insertion the muscle tapers into a thin narrow tendon which inserts on the inner-lateral surface of the first fin ray, just below its knob.

The muscle protracts the pelvic fin strongly.
M. adductor superficialis

The M.add.supf. is a well developed parallel type of muscle occupying a superficial position on the dorsal aspect of the pelvic girdle. The muscle is situated on the outer-lateral surface along the outer process of the pelvic girdle.

The muscle arises in a broad origin which is partly fleshy and mainly tendinous. Some of the fibres take their origin directly from the outer process whereas the rest of the muscle mass arises from an obliquely placed tendon strip which also takes a strong origin from the outer process. It may be noted that the origin of the muscle lies hidden beneath the M.arr.vent.

As the muscle runs posteriorwards towards the fin, the belly of the muscle becomes broad and massive. The muscle fibres arising directly from the outer process form a compact bundle and the rest of the muscle mass also shows a tendency of forming smaller bundles. The insertion of the muscle is tendinous on the first ray and fleshy on the remaining rays of the fin.

By its action, the muscle brings about the adduction and a slight retraction of the entire fin.

M. adductor profundus

It is a large massive muscle extending over the entire dorsal surface of the pelvic girdle. On its latero-posterior side the muscle is partly covered by the M.add.supf. It is a pinnate type of muscle having a broad tendinous aponeurotic sheet toward the insertion.
The broad origin of the muscle extends from the tip of the outer process to the entire mid-line along the ischial symphysis. A few fibres also take their origin from the inner process. The fibres arising from the outer process form a distinct bipinnate pattern whereas those arising from the mid-line run in a parallel fashion towards the fin. The origin on the inner process is partly tendinous in nature.

As the muscle moves backwards and a little outwards towards the insertion, it is provided with a triangular aponeurotic tendon sheet which is inserted on the inner side of the knobs of all the rays of the fin.

The muscle acts as a powerful adductor of the fin.

**M. arrector dorsi**

It is an elongate spindle shaped, pinnate type of muscle, situated dorsally on the outer-lateral aspect of the pelvic girdle. The muscle when viewed superficially, exhibits parallel arrangement of the fibres.

The muscle arises from the outer process in a broad origin which is partly tendinous and partly fleshy. The tendinous part of the origin lies towards the tip of the outer process whereas the fleshy part of the origin extends upto the middle of the outer process.

As the muscle moves posteriorwards towards the fin, its belly becomes compact and narrow and is provided with a thin tendon which inserts on the outer-lateral surface of the first ray.

The muscle protracts the fin.
**M. protractor ischii**

This is a long parallel type of strip-like muscle extending between the anal and the pelvic fins. The muscle arises from the first pterygiophore of the anal fin in a fleshy origin. The muscle runs anteriorwards towards the pelvic girdle along the mid-ventral axis of the body. The muscle is inserted on the posterior end of the basipterygium near the ischial symphysis. The insertion is fleshy. By its action the muscle retracts the pelvic structure.

**LABEO ROHITA** (Plate XXVIII)

**M. protractor ischii**

The M. prot. isch. is a long band-like muscle extending between the pectoral and the pelvic girdles. Although the muscle has a parallel arrangement of fibres, it presents a pinnate arrangement towards the posterior end. The muscle is provided with a long ribbon-like tendon posteriorly. This tendon becomes narrow over the pelvic girdle.

The muscle arises from the pectoral symphysis in a strong narrow origin which is partly fleshy and partly tendinous. As the muscle travels posteriortowardswards towards the pelvic girdle, it exhibits segmentation.

Over the pelvic girdle the muscle fibres converge to get attached on the gradually tapering tendon. The muscle gets inserted on the ischial symphysis and the adjacent area of the posterior process of the basipterygium. The insertion is strong and tendinous in nature.
The muscle acts as a strong protractor of the entire pelvic structure. In doing so, it also abducts the fin in a slightly inward manner.

**M. retractor ventralis**

The M. ret. vent. is present in the form of a broad tendon sheet which is divided into a number of narrow bands. The muscle is devoid of any muscle fibres and extends between the ischial symphysis and the fin rays in a horizontal position and lies on the ventro-posterior aspect of the girdle.

The muscle arises from the ischial symphysis in a broad origin which extends to a part of the posterior process.

As the muscle moves horizontally towards the pre-axial rays in an outward direction, it forms 6 bands, each of which excepting the first, gets inserted on the knobs of the first five rays of the fin. The anterior most band is inserted on the pelvic bone just in front of the knob of the first fin ray.

The muscle acts as a retractor of the fin rays and it controls the degree of protraction of the related rays.

**M. abductor**

The M. abd. is conspicuously a large muscle occupying the entire area on the ventral aspect of the pelvic girdle. This large massive muscle though not distinctly divided into superficialis and profundus parts, is however separable into superficial and deep slips. The fibres of both the slips travel in a slightly different directions.
The superficial slip arises from the tendon of the M. prot. isch. and also from the median raphe along the ischial symphysis. On the other hand, the origin of the deep slip covers a broad area including the inner process, the outer process, the median raphe and the entire ventral surface of the basipterygium. The origin of both the slips is fleshy in nature.

As the muscle moves backwards and slightly outwards towards the fin, it becomes compact and narrow. The insertion of both the slips is on all the rays and it is confluent with each other towards the post-axial rays of the fin. The insertion is partly fleshy and partly tendinous in nature.

The muscle acts as a very powerful abductor of the fin.

M. arrector ventralis

This is a massive and elongate muscle extending between the tip of the outer process and the first ray of the fin, occupying an outer-lateral position on the girdle. It is a parallel type of muscle. Towards the anterior end the muscle is provided with a thin aponeurotic tendon sheet.

The muscle arises from the outer process and the surface of the outer wall of the anterior part of the basipterygium in a broad and fleshy origin.

As the muscle moves backwards towards the fin, the muscle belly tapers on a strip-like tendon which is embedded within the muscle mass. The muscle is inserted on the outer-lateral surface of the knob of the first fin ray. The insertion is strong and tendinous.
Plate XXVIII

Ventral view of the muscles of the left pelvic fin of
1. *Labeo rohita*
2. *Catla catla*
3. *Cyprinus carpio*

Dorsal view of the muscles of the pelvic fin of
4. *Labeo rohita*
5. *Catla catla*
6. *Cyprinus carpio*

(Ext.Prop. and Add.Supf. removed from the right side)

Ext.Prop. - Extensor proprius; Ret.vent. - Retractor ventralis.
Other legends as in plate XXVI.
The muscle acts as a very powerful protractor of the fin. The action is also accompanied by a gradual abduction of the fin.

**M. extensor proprius**

This is a small but highly massive muscle extending between the first and the last ray of the fin. The muscle occupies a superficial position, lying obliquely across the width of the posterior end of the girdle.

The muscle arises from the connective tissue surrounding the supernumerary ray and lining the muscle itself. The origin is broad and weak. The fibres travel inwards to get attached on a thin tendon which is embedded within the muscle mass.

The muscle is inserted on the plate-like knob of the last fin ray. The insertion is narrow and tendinous in nature.

By its contraction, the muscle protracts and adducts the last fin ray and hence the adjacent fin rays.

**M. adductor superficialis**

It is a large well developed massive and elongate muscle, lying between the tip of the girdle and the fin towards the outer-lateral aspect of the girdle. Though it is a pinnate type of muscle, it appears to be parallel in nature. On its lower surface the muscle is supplied with a thin aponeurotic tendinous sheet.

The muscle arises from the outer process in a fleshy origin. Some of the fibres also arise from the connective tissue lining the muscle.
As the muscle moves towards the insertion, it becomes slightly broad and gets inserted on the first five rays of the fin.

The muscle adducts and slightly retracts the related rays of the fin.

M. adductor profundus

The M. add. prof. is a highly developed pinnate type of muscle occupying a median position, inner to the M. add. supf. It is a broad muscle covering almost the entire dorsal surface of the girdle and is partially covered by the M. add. supf. and the M. ext. prop. The muscle is provided with a broad tendinous sheet towards the posterior region.

The muscle arises in a broad origin which covers the outer process, the inner process and most of the dorsal surface of the basipterygium. The muscle fibres from all along the broad origin travel slightly outwards and curve downwards towards the deeply placed aponeurotic tendon sheet, thus forming a deep groove for the M. add. supf. However the muscle fibres in the posterior region take a direct course towards the fin.

The muscle is inserted on all the rays by means of the aponeurotic tendon sheet.

The muscle powerfully adducts the fin.

M. retractor ischii

It is a long muscle extending between the anal and the pelvic fins. The muscle is parallel in nature, exhibiting segmentation along its entire length.
The muscle arises fleshily from the anal fin and runs anteriorwards towards the pelvic fin.

Towards the insertion the fibres of the last segment are arranged in a pinnate fashion and insert on the posterior process of the basipterygium. The insertion is strong and tendinous in nature.

By its action the muscle retracts the pelvic girdle with a slight inward adduction of the fin.

**CATLA CATLA AND CYPRINUS CARPIO**

The musculature of the pelvic fin in Catla catla and Cyprinus carpio is similar to that of Labeo rohita in all respects as shown in the diagrams (plate XXVIII).

**NOTOPTERUS KAPIRAT (Plate XXIX)**

*M. abductor*

This is a small feebly developed muscle lying between the tip of the anterior process of the basipterygium and the fin. The muscle is massive and bipinnate in nature and is provided with a median tendon.

The muscle arises in a broad and fleshy origin from the length of the anterior process and the margins of the basipterygium. The pinnate muscle fibres from the dorsal and the ventral surfaces of the round basipterygium move backwards and outwards to get attached on the median tendinous strip.

As the muscle moves backwards towards the fin, it
Plate XXII

Pelvic fin muscles of *Notopterus kapirat*

1. Inner lateral view

Pelvic fin muscles of *Ophiocephalus punctatus*

2. Ventral view (Prot.Isch. and Ret.vent. removed from the right side)

3. Dorsal view (Add.Supf. removed from the right side to show the details of Add.Prof.)

Abd. - Abductor; Add. - Adductor.

Other legends according to plate XXVI.
becomes narrow and inserts on all the rays of the fin in a strong tendinous insertion.

The muscle abducts the fin powerfully.

M. adductor

The M. add. is also a small pinnate muscle lying along the inner surface of the basipterygium. The muscle is provided with a small aponeurotic tendon towards the posterior end.

The muscle arises from the length of the anterior process and the inner surface of the basipterygium. The fibres travel outwards and downwards forming a pinnate pattern. Towards the posterior end, the muscle becomes flat and partly covers the nodular base of the pelvic bone.

The muscle is inserted on all the rays in a broad tendinous insertion.

The muscle by its contraction adducts the fin.

**OPHIOCEPHALUS PUNCTATUS** (Plate XXIX)

M. protractor ischi

This is a well developed muscle extending between the pectoral and the pelvic girdles. While the muscle is in the form of a strong median tendon towards the origin, it becomes highly fleshy over the pelvic girdle and forms a well developed triangular muscle belly. It is a parallel type of muscle and its belly is divided into two segments.

The muscle arises from the pectoral symphysis in the form of a strong tendinous cord. As the tendon moves backwards,
it becomes laterally flattened to provide base for the attachment of the muscle fibres. Near the tip of the pelvic girdle, the muscle bifurcates and forms the muscles of the two sides. Each muscle has a triangular body provided with a thin tendon sheet at its broad posterior end. The muscle fibres are parallel in nature but they move in a slightly divergent manner. The tendon sheet also bifurcates into a broad medial and a narrow lateral bands, each of which serves as an attachment for a few short posterior fibres.

The broad but discontinuous insertion is partly fleshy and partly tendinous. The lateral tendinous band with its muscle fibres inserts on the outer side of the pelvic bone just above the knob of the first fin ray whereas the medial band alongwith its fibres inserts on the knobs of all the rays of the fin and the ischial symphysis.

The muscle helps in the protraction of the entire pelvic girdle which is accompanied by a slight retraction and outward abduction of the fin.

M. retractor ventralis

This is a small muscle in which only the tendinous portion of the muscle remains, the muscular part having been probably lost during the course of evolution.

The muscle i.e. its tendinous remnant, extends between the ischial symphysis and the knobs of the fin rays. The tendon is divided into 6 tendinous bands which insert on the knobs of all the fin rays.
While the M. ret. vent. serves as a powerful retractor of the pelvic fin, the tendinous bands also help to control the degree of the protraction of the fin.

M. abductor superficialis

This is an elongate pinnate type of muscle situated on the ventral aspect of the girdle. The muscle is covered by the M. prot. isch. and the M. ret. vent.

The muscle arises from the basipterygium in a broad origin which is partly fleshy and partly tendinous. The origin extends from the anterior tip of the bone along the length of the ventral ridge. At the tip of the basipterygium the origin is strongly tendinous. The muscle belly which is bipinnate in nature, is provided with a thin tendon. The tendon is embedded within the muscle mass but as it moves posteriorwards towards the insertion, it takes a superficial position.

The muscle inserts in the middle of the knob of the first fin ray. The insertion is strong and tendinous.

The muscle by its contraction, abducts the first fin ray. The abduction of the first ray results in a gradual protraction and abduction of the remaining rays. The action which is minimum at the last ray, results in a fan-like opening of the fin, accompanied by abduction.

M. abductor profundus

The M. abd. prof. is a pinnate type of muscle extending all along the ventral surface of the medial lamina of the
basipterygium. This long muscle is narrow towards its origin but gradually becomes broad and fleshy towards the middle and is provided with a broad aponeurotic tendon sheet.

The muscle arises in a strong and fleshy origin. The origin extends all over the ventral surface of the median lamina. The muscle fibres travel inwards and backwards to form the belly which becomes gradually thick and wide.

The insertion of the muscle is by means of a strong tendinous sheet present at the posterior end of the muscle belly. The broad insertion extends over the knobs of all the fin rays.

The muscle helps to abduct the fin in a slightly inward direction. The abduction takes place with the simultaneous retraction of the fin rays.

**M. arrector ventralis**

This is a bipinnate muscle having an almost uniform elongate muscle belly. The muscle is provided with a long tendon which is embedded within the muscle mass. Towards the dorso-medial surface the muscle belly is supplied with a thin aponeurotic tendon sheet which extends to the linear ventral margin of the muscle.

The muscle arises from the outer-lateral margin of the ventral ridge and the ventral surface of the dorsal lamina of the basipterygium. The origin is broad and fleshy through out the length of the muscle and becomes tendinous towards the insertion where the muscle belly is provided with an aponeurotic sheet of tendon.
The pinnate fibres move inwards and downwards to get attached on the medial tendon which lies embedded within the muscle mass. The muscle gets slightly twisted before getting inserted on the outer surface of the knob of the first fin ray. The insertion is strong and tendinous in nature.

Besides acting as a powerful protractor of the fin, the muscle slightly abducts the adjoining rays of the fin.

**M. adductor superficialis**

This is a large massive muscle having a superficial position on the dorsal side of the girdle. The muscle though pinnate in nature, appears to be of a parallel type when viewed from above. The muscle is narrow anteriorly but towards the insertion becomes very broad and fleshy. Towards its outer-lateral margin, the muscle is provided with a thin long tendon.

The muscle arises from the dorsal surface of the medial lamina along the mid-line. The origin is highly fleshy.

The fibres move outwards and backwards to get attached on the linear tendon. The muscle gets inserted on all the rays in a broad insertion which is strongly tendinous on the first ray and fleshy on the remaining rays of the fin.

By its action the muscle adducts the fin. In addition to this function the muscle also acts as a weak retractor.

**M. adductor profundus**

This is a large pinnate type of muscle extending over the entire dorsal surface of the basipterygium and lies partly
hidden beneath the M.add.supf. The muscle is provided with a broad tendon over its surface.

The muscle arises from the deep furrow formed by the dorsal and the medial laminae of the basipterygium. The origin is highly fleshy in nature.

The fibres move inwards and backwards to get attached on the lower surface of the tendon sheet. However some of the fibres along the margin of the tendon sheet get attached on its upper surface. The muscle gets inserted on all the rays. The strong insertion is mainly tendinous but partly fleshy.

By its contraction, the muscle aids in abducting the fin.

M. retractor ischii

It is a long, band-like parallel type of muscle extending between the anal and the pelvic fins. The muscle exhibits segmentation along its length.

The muscle arises from the base of the first fin ray of the anal fin. The origin is fleshy in nature.

The muscle travels anteriorwards towards the pelvic fin and gets attached on the posterior margin of the basipterygium. The insertion, though fleshy and narrow in nature, is very strong.

The muscle retracts the pelvic structure with a slight inward adduction of the pelvic fin.

ANABAS SCANDENS (Plate XXX)

M. protractor ischii

It is a well developed tendinous muscle situated on
the ventral surface of the girdle. The muscle extends between the pectoral and the pelvic girdles. The arrangement of the muscle fibres is pinnate.

The muscle takes a strong origin from the pectoral symphysis in the form of a tendinous strip. As the muscle moves posteriorwards towards the pelvic fin, the tendon becomes embedded within the pinnately arranged muscle fibres. Along the length and the middle of the muscle belly the fibres become sparse leaving the strip-like tendon almost bare.

Towards the middle of the muscle belly the strip-like tendon becomes broad and gets inserted on almost the entire length of the edge of the ventral lamina. The muscle fibres towards its medial margin on the lower surface seek a deep fleshy insertion on the median raphe. Posteriorly the tendon bifurcates into two parts, one of which gets inserted on the tip of the median bony rib. The other extension of the tendon alongwith its pinnate muscle fibres gets inserted on all the rays. The insertion on the first ray is tendinous whereas that on the others is fleshy.

The muscle acts as very powerful protractor of the pelvic girdle.

**M. retractor ventralis**

This small muscle is present in the form of a tendon. The fleshy portion of the muscle is completely absent.

The tendon extends between the ischial symphysis and the knobs of the fin rays in the form of tendinous bands. The
number of the tendinous bands comprising the M. ret. vent. corresponds to the number of the fin rays.

The tendon due to its elasticity, brings about the retraction of the fin rays. Also, it controls the degree of protraction of the fin rays.

**M. abductor superficialis**

This is a highly fleshy, pinnate type of elongate muscle extending obliquely between the tip of the girdle and the first fin ray.

The muscle arises in a broad fleshy origin covering the entire inner surface of the ventral lamina, the outer-lateral surface of the ventral ridge of the medial lamina and the deep groove formed between the two. Anteriorly, a few muscle fibres arise from the ligament between the pectoral and the pelvic girdles. The muscle fibres from all the directions move inwards to form a pinnate muscle belly which becomes slightly narrow as the muscle moves towards the insertion.

Towards the posterior end, the muscle is provided with a narrow strip of tendon which is strongly inserted on the middle of the broad knob of the spine.

While abducting the spine the M. abd. supf. also protracts the fin structure.

**M. abductor profundus**

This is comparatively a small muscle occupying a deep position along the mid-line of the pelvic girdle. The muscle is pinnate in nature.
The muscle arises in a broad fleshy origin extending from the median raphe to the entire inner wall of the ventral ridge. A number of fibres also take their origin from the lateral surface of the median bony rib of the basipterygium. The muscle fibres from all the directions move inwards to form a pinnate structure which is provided with a weak, thin aponeurotic tendon in its middle. Towards the insertion the muscle appears to be broad and gets inserted on all the rays in a strong insertion. The insertion is mostly fleshy but slightly tendinous in nature.

The muscle acts as an abductor of the fin.

M. arrector ventralis

The M. arr. vent. is a highly developed, fleshy muscle occupying an outer-lateral position on the pelvic girdle. It is a pinnate type of muscle.

The origin of the muscle is broad and fleshy in nature. The fibres arise from the entire length of the outer-lateral surface of the ventral lamina and the ventral surface of the dorsal lamina. Anteriorly, some of the fibres take their origin from the dorsal fringe of the dorsal lamina.

As the muscle moves posteriorwards, it forms a broad and fleshy muscle belly which tapers towards the insertion. The muscle gets slightly twisted before inserting on the ventro-lateral surface of the knob of the spine. The insertion is strong and tendinous in nature.

The muscle acts as a powerful protractor of the spine and hence the fin is also protracted gradually.
M. adductor superficialis

This is a broad, parallel type of muscle occupying a superficial position on the dorsal side of the girdle. The muscle arises in a broad and fleshy origin from the dorsal surface of the medial lamina. The origin extends from the tip of the pelvic girdle to the base of the fin, along the mid-line.

The muscle fibres travel obliquely backwards and outwards to form a flattened muscle belly. The muscle belly becomes gradually broad towards the insertion and tends to divide into smaller muscle bundles. The insertion which is on all the rays is fleshy in nature.

By its action the muscle brings about the adduction of the fin, accompanied with a slight retraction of the fin rays.

M. adductor profundus

This is a dorso-laterally compressed muscle having a deep position on the dorsal side of the girdle. It is a pinnate type of muscle provided with a thin aponeurotic tendon sheet extending on almost the entire muscle surface.

The muscle arises from the dorsal surface of the dorsal lamina and partly from the medial lamina. The origin is mostly fleshy but partly tendinous.

The pinnate fibres move slightly inwards and backwards to get attached on the lower surface of the aponeurotic tendon sheet. This sheet inserts on the inner side of the knobs of all the rays of the fin in a strong insertion.
Pelvic fin musculature of *Anabas scandens*

1. Ventral view (Ret.Vent. and Prot.Isch. removed from the right side to expose the deeper muscles)
2. Dorsal view (Add.Supf. removed from the right side to show Add.Prof.)

Pelvic fin musculature of *Osphromenus gourami*

3. Inner lateral view
4. Outer lateral view

Legends according to plate XXVI.
By its action the muscle brings about the adduction and a slight retraction of the rays of the fin.

**M. retractor ischii**

It is an elongate parallel type of muscle extending between the anal and the pelvic fins. The muscle is situated at the posterior end of the pelvic girdle.

The muscle arises from the anal fin in a strong fleshy origin.

As the muscle moves towards the pelvic fin, it exhibit segmentation along its linear run. The muscle inserts on the posterior end of basipterygium in a strong fleshy insertion.

The muscle retracts the entire pelvic structure with a slight inward adduction of the fin.

**OSPHROMENUS GOURAMI** (Plate XXX)

**M. protractor ischii**

The M. prot. isch. is a large parallel type of highly fleshy muscle. The muscle is a laterally compressed structure and extends between the pectoral and the pelvic girdles.

The muscle arises in a broad and strong origin from the pectoral symphysis and the adjacent area of the cleithrum. The origin is partly fleshy and partly tendinous in nature.

As the muscle moves towards the pelvic girdle, it becomes gradually broad and inserts on the margin of the ventral lamina of the basipterygium. The insertion which is broad and strong is mainly tendinous and partly fleshy in nature.
The muscle pulls the entire pelvic structure. The action is accompanied by an outward abduction of the fin.

**M. retractor ventralis**

This is a very small muscle, present in the form of a tendon. The muscle extends between the ischial symphysis and the fin rays. The tendinous muscle is devoid of any muscle fibres. The muscle inserts on all the rays excepting the first.

The muscle helps to maintain the degree of protraction of the fin rays and later acts as a retractor of the related fin rays.

**M. abductor superficialis I**

This is a long pinnate type of massive muscle extending along the outer-lateral margin of the ventral lamina of the basipterygium. The muscle is provided with a prominent tendon within the muscle mass which is partly exposed towards the inner medial margin.

The muscle arises from the edge of the ventral lamina of the basipterygium in a highly fleshy origin. Some of the muscle fibres also seek their origin from the connective tissue spread over the M.prot.isch. The broad origin also extends to a part of the inner surface of the ventral lamina. Towards the posterior region, some of the fibres arise from the lower surface of the median bony rib.

The muscle fibres from all the directions move backwards
and inwards to get attached on the tendon sheet which remains almost completely embedded within the muscle mass. The muscle belly with its tendon forms a complicated pinnate structure which exhibits more than one pinnate muscle pattern. The muscle inserts on all the rays in a broad insertion which is partly fleshy and partly tendinous.

By its contraction the muscle helps to abduct the pelvic fin slightly and protracts the fin structure. The maximum protraction is towards the last ray and gradually decreases towards the first ray of the fin.

M. abductor superficialis II

This is a comparatively large muscle lying inner to the M. abd. supf. I. The muscle extends from and near the tip of the basipterygium towards the fin base where it passes beneath the M. abd. supf. I. It is a pinnate type of muscle.

The muscle arises in a broad fleshy origin from the ventral lamina of the basipterygium and the lateral surface of the ventral ridge of the medial lamina. The muscle belly is formed by the pinnate fibres which get attached on the deeply placed median tendon.

As the muscle moves towards the insertion, it becomes bilaterally compressed and inserts on the head of the spine. The insertion is broad and strong and is partly fleshy and partly tendinous in nature.

The muscle acts as a very strong protractor and an abductor of the spine.
M. abductor profundus

This is a small pinnate type of muscle lying deep on the ventral side of the pelvic girdle and runs along the groove formed by the medial lamina and its ventral ridge.

The muscle arises from the bony walls of the medial lamina and its ridge, in a broad fleshy origin which is slightly tendinous towards the anterior tip. The muscle fibres from the two sides attach themselves on a long median tendon in a pinnate fashion. As the muscle moves towards the insertion, the muscle belly becomes gradually broad.

The muscle is inserted on all the rays excepting the first. The insertion is partly fleshy and partly tendinous.

The muscle acts as an abductor of the fin.

M. arrector ventralis

It is a large well developed muscle situated on the ventro-lateral aspect of the pelvic girdle. The muscle occupies the groove formed between the dorsal and the ventral laminae. It is a highly pinnate muscle.

The muscle arises from the outer surface of the ventral and the dorsal laminae in a broad fleshy origin. Anteriorly, the origin also extends near the narrow tip of the basipterygium. The muscle fibres travel backwards and inwards to get attached on the long median tendon strip.

The muscle tapers gradually towards the insertion. The insertion is partly fleshy and partly tendinous and is on the
ventro-lateral surface of the spine.

The muscle acts as a powerful protractor of the spine and hence the remaining fin rays.

**M. adductor superficialis I**

It is a small muscle lying in a most superficial position on the dorsal aspect of the pelvic girdle. It is a pinnate muscle provided with a strong tendinous sheet.

The muscle arises from the margin of the medial lamina in a weak narrow fleshy origin. Some of the fibres however arise from the surrounding connective tissue.

As the muscle moves backwards towards the fin, the pinnate fibres form a massive muscle belly. The muscle inserts tendinously on the third, fourth and the fifth rays of the fin.

The muscle adducts the fin.

**M. adductor superficialis II**

The M.add.supf.II is a bilaterally compressed muscle which is narrow towards its anterior end and broad towards the posterior end. The muscle is provided with a broad aponeurotic tendon sheet on its entire lower surface. It is a highly pinnate muscle.

The muscle arises along the edge of the medial lamina in a strong, broad and fleshy origin. Towards the anterior tip of the muscle, the origin is slightly tendinous. As the muscle moves backwards towards the fin, the muscle fibres from the
narrow anterior region get attached on the aponeurotic tendon sheet. The superficial fibres from the posterior region of the origin travel in a parallel fashion so as to overlap the muscle fibres from the anterior region. The muscle in this manner gets differentiated into distinctly compressed bundles, partially overlapping in succession.

The muscle is inserted on the knobs of all the rays in a broad insertion which is partly fleshy and partly tendinous.

The muscle acts as an adductor of the pelvic fin.

**M. adductor profundus**

This is a very large muscle occupying a deep position below the superficialis muscles. The muscle covers almost the entire surface of the medial lamina, the wall of the dorsal lamina and the groove formed between the two. The muscle is highly pinnate in nature having a prominently fleshy muscle belly which becomes flattened towards the insertion and is provided with a triangular tendon sheet.

The origin of the muscle is broad and extends from the tip of the pelvic girdle to the medial and the dorsal laminae, filling the groove formed between the two. The muscle fibres from all the directions travel inwards and backwards towards the triangular tendon on which they get attached.

The broad insertion is on all the rays excepting the first. The insertion is mainly tendinous but partly fleshy.

The muscle acts as an adductor of the fin. It also slightly retracts the fin rays.
**Gobioides striatus** (Plate XXXI)

**M. protractor ischii**

The M. protractor ischii is a well developed massive muscle extending between the cleithrum of the pectoral girdle and the pelvic bone. It is a parallel type of muscle provided with a thin tendon on its posterior region. The muscle is slightly bilaterally compressed so as to form a thick wedge-like structure.

The muscle arises from the broad tip of the cleithrum, just near the condyle. The origin is narrow and strongly fleshy in nature. As the muscle travels backwards towards the pelvic fin, it forms a very bulky muscle belly.

The muscle gets strongly inserted on the transverse rib, the tip of the median rib and on the basipterygium just in front of the first fin ray. The broad insertion is partly fleshy and partly tendinous.

The muscle by its contraction abducts the pelvic structure in an inward direction. The muscle in this manner helps in bringing about the movement of the pelvic girdle on the condyle of the pectoral girdle.

**M. retractor ventralis**

This is a parallel type of small muscle situated at the posterior region of the pelvic girdle on its ventral aspect. The muscle is divided into a number of small bundles which correspond to the number of the rays of the pelvic fin.
Plate XXXI

Pelvic fin muscles of *Gobius striatus*

1. Ventral view (Prot.Isch., Ret.Vent. and Arr.Vent. removed from the right side to show Abd.supf. & Arr.Dor.)
2. Ventral view (most of the fin muscles removed to expose Abd.Prof.)
3. Dorsal view (with Ext.Prop. and Add.Supf. removed from the right side)

Legends as in plate XXVI.
The muscle arises from the median bony rib of the basiperygium. The origin is narrow and fleshy and extends along the length of the lateral margin of the bony rib. As the fibres move outwards and backward in a parallel fashion, the muscle becomes broader and gets distinctly divided into smaller bundles which successively overlap one another.

The muscle is inserted on the knobs of all the rays in a weak fleshy insertion.

The muscle acts as a powerful retractor of the pelvic fin and the action is accompanied with abduction. With the result, the pelvic fins of the two sides form a deep cup-like structure which helps in the attachment of the fish to the substratum while skipping.

**M. abductor superficialis**

The M.abd.supf. is a large muscle extending almost the entire width of the basipterygium covering the ventral surface of the bowl like cavity. It is a parallel type of muscle divided into six muscle bundles which correspond to each ray of the fin.

The muscle arises from the anterior cartilage and the medial region of the bowl of the pelvic girdle. The origin is broad and fleshy.

As the muscle curves over the fringe of the bowl towards the fin rays, it becomes slightly narrow and the muscle bundles become very distinct. Each of the bundle gets inserted
on the knobs of all the rays respectively. The insertion is fleshy in nature.

The muscle by its contraction brings about the abduction of the fin.

**M. abductor profundus**

This is a small muscle occupying a deep position on the lateral wall of the pelvic bowl on its ventral surface. It is a parallel type of muscle provided with a thin tendinous aponeurosis.

The muscle arises from the ventral surface of the basipterygium in a fleshy origin which towards the anterior end may extend to the anterior cartilage. The origin is slightly tendinous at certain places.

As the muscle moves backwards towards the fin, it divides into small compact bundles which get inserted on the knobs of all the rays. The insertion is mostly fleshy.

It suppliments the action of M. abd. supf. by abducting the fin rays.

**M. arrector ventralis**

This bilaterally compressed muscle occupies the most lateral position on the pelvic girdle when viewed from the ventral side. The muscle extends between the anterior cartilage and the knob of the first fin ray. It is a parallel type of muscle.

The muscle arises from the anterior cartilage of the pelvic girdle just below the socket. The origin is broad and
fleshy. The muscle moves backwards to form a well developed muscle belly which is provided with a very thin aponeurotic tendon sheet.

Towards the insertion the muscle becomes abruptly narrow and gets attached on the lateral side of the first fin ray just below its bifurcation forming the two knobs. The insertion is mostly fleshy but slightly tendinous.

The muscle acts as a powerful protractor of the pelvic fin and the action also results in a slight abduction of the first fin ray.

M. extensor proprius

It is a spindle shaped elongate muscle extending between the fringe of the socket of the pelvic girdle and the knob of the last ray of the fin. It is a parallel type of muscle lying slightly in an oblique manner in the most superficial position on the dorsal aspect of the pelvic girdle.

The muscle arises from the dorso-medial margin of the pelvic socket. A few fibres may also arise from the anterior cartilage.

As the muscle moves backwards towards the fin, it becomes gradually narrow and is provided with a thin tendinous strip. The muscle is inserted on the knob of the last ray in a strong tendinous insertion.

The muscle adducts the last ray with a partial protraction of the fin. The protraction is maximum at the last ray which gradually decreases towards the first ray of the fin.
M. adductor superficialis

The M.add.supf. is a parallel type of muscle extending all over the dorsal surface of the basipterygium. The muscle is distinctly divided into small bundles.

The muscle arises along the medial ridge of the pelvic dome in a broad and fleshy origin. Anteriorly, some of the muscle fibres seek fleshy origin from the anterior cartilage.

As the muscle travels backwards and outwards towards the fin rays, the bundles become more compact and distinct. Each of the bundles gets inserted on the knob of the corresponding ray in a strong and fleshy insertion.

The muscle acts as a powerful adductor of the fin.

M. adductor profundus

The M.add.prof. is a parallel type of muscle which lies in a lateral position, filling the lateral concavity of the pelvic dome.

The muscle arises from the pelvic bone in a broad and fleshy origin. The origin may also extend to the edge of the cleithrum of the pectoral girdle. As the muscle moves backwards towards the fin, it twists a little to move round the fringe of the pelvic bone.

Towards the insertion, the muscle is provided with a thin tendon sheet which is thrown into small projections. The insertion is on the first five rays and is tendinous in nature.

The muscle adducts the fin.
M. arrector dorsalis

This is a comparatively small muscle occupying a position inner to the M.arr.vent. The muscle runs over the lateral convex region of the basipterygium. The muscle is unipinnate in nature.

The muscle arises from the anterior cartilat and the basipterygium in a broad and fleshy origin. The muscle fibres converge inwards upon a weak ribbon-like tendon which lies embedded within the muscle mass.

As the muscle moves towards the insertion, the muscle belly becomes narrow and is inserted on the base of the inner ventral knob of the first fin ray.

The muscle acts as a protractor of the fin.

M. retractor ischii

This is a very well developed muscle extending between the anal and the pelvic fins. The muscle shows distinct segmentation along its linear run. Towards the pelvic fin the last segment of the muscles of the two sides unite to form a single large fan shaped structure.

The muscle arises from the base of the first fin ray of the anal fin in a narrow and fleshy origin. As the muscle moves anteriorwards, it divides into five segments. The muscle though parallel in nature through out its length, forms a fan shaped pinnate pattern in the last segment.

The muscle gets inserted on the posterior end of the
ischial symphysis in a strong narrow insertion which is tendinous in nature.

By its contraction, the muscle retracts the entire pelvic structure as a result of which the fins are slightly adducted.