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B.Sc. Zoology Part II

FLIGHT ADAPTATIONS IN BIRDS

INTRODUCTION

- The adjustments on the part of the animal in a particular surrounding to become efficient in locomotion, in securing sufficient food and getting good shelter are called adaptations to the particular environment.
- > The birds have taken aerial life and all the changes which have taken place in accordance with this mode of life are called volant adaptions.
- Practically almost all the body organs have been modified to cope with the new environment.
- > These modifications led Young (1958) to describe birds as "masters of the air."

A. MORPHOLOGICAL ADAPTAIONS

1. Shape:-

The stream lined, spindle shaped body offers the least resistance during passage through air.

2. Compact body:-

- The high location of light organs like lungs and air sacs and low positions of heavy muscles, sternum and digestive organs shift the centre of gravity lower.
 - This arrangement prevents the turning over the body in air.
- Further, the disposition of wings high upon the thorax helps in maintaining balance in the air.

3. Mobile neck and break:-

The two toothless jaws are produced into beak which helps in preening, feeding, nest building, offence and defense etc. To perform these efficiently the neck has elongated and flexible.



Fig. 6.1. Stream-lined body of a bird.

4. Bipedal locomotion:-

To bear the weight of body and move on ground, hind limbs shifted slightly forward on the thorax and became stouter.

5. Flight organs:-

- > Fore limbs are modified into wings which are sole organs of flight.
- The surface area of the wings are increased by the development of elongated remiges (flight feathers).
- > These feathers form a broad continuous surface for striking the air in flight and supporting the bird in air.



6. Feathers:-

- > The body is fully covered with closely fitted and backwardly directed contour feathers.
- > These make the body stream-lined and reduce the friction of air.
- The blanket formed by feathers holds a certain amount of air between the body and the feather covering.
- > The air helps buoyancy.
- Feathers also help in maintaining body temperature as they are of non-conducting nature.

7. Integument:-

- > The loose attachment of skim over the body is also a modification for flight.
- > It provides extensive movement of the skeletal musculature.

8. Short tail:-

- Rectrices (caudal feathers) are arranged in a fan like fashion as a series on short muscular tail.
- > These assist in steering, to sudden check flight and as a counter balance in perching.

9. Perching:-

- The phenomenon of holding of twig automatically at sitting by birds with the help of hind limbs is called perching.
- For this, the muscles of the hind limbs are developed in such a fashion that when a bird sits on a branch of the tree, the toes close round the twig automatically.
- It is so because the settling of the bird on the twig puts the flexor tendons on the stretch with the exertion of the pull, the toes are bent spontaneously around the perch.
- > A bird can go to sleep on a perch without any fear of falling.

B. ANATOMICAL ADAPTATIONS

1. Flight Muscles:-

- > The twig is operated by a set of well-developed muscles called flight muscles.
- ➢ These included-
 - (i) Pectoralis major causing downward stroke
 - (ii) Pectoralis minor effecting upstroke.
 - (iii) Corachobrachialis and coracohumerals bringing about rotational movement.

(iv) Tensor muscles keeping the pre-patagium tensely stretched when the wing is extended during flight.



Fig. 6.3. Flight muscles.

2. Endoskeleton:-

In order to achieve lightness without losing strength, the bone has become pneumatic containing air spaces in place of bone marrow.

> The skull bones are fused. Jaws lost teeth to make the skull lighter.

- The first four or five thoracic vertebrae are fused to form a firm fulcrum against which the wings can work.
- The fusion of about fourteen vertebrae of the vertebral column [Thoracic- 1 (last), lumber- 6, sacral- 2 and caudal-5] results in the formation of a plate like structure called synsacrum. The latter acts as girder to support the entire weight of the body.



The last four caudal vertebrae are fused to form a short pygostyle for providing seat of attachment of rectrices.



Fig. 6.5. Pygostyle with a few caudal vertebrae.

The breast bone called sternum is well developed. Its posterior elongation helps in supporting the visceral organs. It bears a median ridge called *keel* or *carina* for attachment of flight muscles. It remains firmly attached with the coracoids.



- The clavicles of the two pectoral girdles are fused ventrally to form 'V' shaped structure called furcula or merry thought bone or wish bone. It acts like a spring between the two wings.
- The fusion of the distal tarsals with the metatarsals to form tarsometatarsals as well as the fusion of proximal tarsals with the lower end of tibia to form tibiotarsus provide the legs with enormous strength for bipedality.



3. Digestive system:-

- > The efficiency of rapid digestion, for providing enormous metabolic material, is obtained by the presence of gizzard for mastication and crop for storage of food.
- > Rectum is reduced and cloaca is capable of reabsorption of water from faeces and urine.

4. Respiratory system:-

- > In addition to lungs, birds are provided with reservoirs of air i.e. air sacs.
- In other vertebrates lungs are supplied with air once only during inspiration but in birds, lungs are supplied with air twice, the second time from air sacs during expiration.
- Thus blood in birds is oxygenated twice during a single breathing. This is called double oxygenation or double ventilation.
- > Thus, the respiratory system is highly adapted to supply more oxygen to the muscles.



Fig. 6.8. Air sacs of pigeon.

5. Circulatory system:-

- More energy required for active flight needs high output of the energy which in turn required more oxygen.
- It is made possible by efficient circulatory system, highly adapted for carrying more oxygen.
- For this blood contains a large amount of haemoglobin and large heart is divided into four chambers.

6. Excretory system:-

- > It is modified to reduce the body weight.
- > Urinary bladder is absent and urine is in the form of semisolid uric acid.

7. Reproductive system:-

- > It is also specialized to reduce the unnecessary weight.
- > Only left ovary is functional.
- > The number of eggs produced is also reduced.

8. Sense organs:-

- The eyes are provided with an outer ring of sclerotic plates for resisting the pressure of air during flight.
- The special vascular body called pectin contained in the eyes helps in lubrication of the eyes and in detection of minute movements at great distance.

9. Brain:-

- > Birds have acute sense of sight and intelligence.
- > Hence, optic lobes and cerebrum are well developed.
- > The olfactory lobes are small due to poor sense of smell.
- The cerebellum is also large and convoluted to maintain the muscular co-ordination and equilibrium.

10. Worm bloodedness:-

- > This helps in perfect aeration of blood and a great output of energy.
- The constant body temperature helps the birds to take flight at high altitudes and in all seasons.
