Flight adaptations in Birds

The fitness of an organism according to its environment is called 'adaptation'. Birds lead an aerial mode of life and so in response to the new environment (= air) various modifications are met with in their body structure and functional anatomy.

1. Morphological adaptations

(1) Shape and structure of body

The perfectly streamlined, boat-shaped body facilitates birds passage through air, offering little resistance.

The equilibrium of the body is maintained by the heavy central region. This is achieved by the high position of the wings, lungs and air sacs, while the heavy flight muscles, digestive organs and sternum occupy low position.

(2) Neck and Beak

The modification of fore limbs into wings is duly compensated by a long mobile neck (flexible) and the beak. So the Bird can easily rotate its head for reaching food and can see all around. Jaws are toothless and they are suitable for picking food, making nests etc.

(3) Fore-limbs

The fore-limbs become modified into unique and powerful propelling organs, which propel the body high up in the air. These are marvellously designed for the purpose being equipped with special flight muscles and feathers of large size. The feathers form a broad continuous surface for striking the air in flight and supporting the bird in air.

(4) Hind-legs

The fore-limbs being converted into wings only the two hind limbs acts as locomotor organs (= bipedal locomotion). They have shifted forwards for balancing and supporting the entire body weight. They are also modified for perching in response to arboreal life, of birds. The muscles are so attached to the toes that they automatically flex and grip the perch when the bird sets down on a branch.

(5) Exoskeleton

Feathers are characteristic structure of birds. Feathers of various type cover the entire body surface making it smooth and streamlined. The non-conducting coat of feathers prevents surface loss of heat and helps in

maintaining a constant temperature. It encloses a layer of warm air between body and itself and acts like a jacket to the organs.

(6) Tail

The tail is very short and bears long tail feathers, rectrices, which are arranged in a fan-like manner. The tail feathers together act as a rudder for steering and balancing. Elevation and depression of the tail feathers bring about upward and downward movement while the body is steered sideways by lateral turning of the rectrices.

2. Anatomical adaptations

(1) Flight muscles

The back muscle are reduced while the flight muscles on the breast are much developed for effective movement of wings. Pectoralis major, the largest muscle is the depressor muscle and effects the down stroke of the wings. Pectoralis minor is the elevator muscle for raising the wings. Accessory muscles such as Coraco-brachialis and coraco humeral bring about rotational movement of the wings. Tensor muscles keep the wings streatched.

(2) Endoskeleton - Many adaptation for flight are apparent in the skeleton of Birds. The Endoskeleton has become light and yet maintain rigidity and strength to achieve this there is pneumatization of bones along with their reduction and fusion. Many of the bones are light being filled with air spaces and without marrow in the adult.

(a) Skull.

Skull bones are mostly fused and slender and without any sutures in between them. Jaws are without teeth making the head light.

(b) Vertebral Column

All the thoracic vertebrae except the last are fused into a single mass providing a firm fulcrum for the action of wings in striking air. The terminal caudal fuse to form a short pygostyle to which rectrices are attached.

(c) Sternum

The sternum has a keel for the insertion of pectoral muscles. The backward elongation of the sternum supports the abdominal viscera.

(3) Girdles

The Stout coracoid is attached anteriorly to the Scapula and posteriorly to the sternum. The Scapula is also attached to the ilia by a characteristic furcula (present in flying birds only) it formed by the fusion of clavicle and interclavicle serving as a fulcrum for the movement of wings

The pelvis and Synsacrum are fused to support the body weight and to counteract the shock when a bird alights on the ground.

(4) Limbs

They clearly exhibit fusion and reduction of bone which are suitably adapted for flight. The carpals and metacarpals are fused to form carpo metacarpus. The constituent bone of the fore limbs are light and strong to bear the pull of muscles during flight.

In the hind limbs the febula is much reduced. Lower end of tibia is fused with proximal row of Tarsal to form the tibiotarsus while the distal row of tarsal fuse with metatarsals forming the tarsometatarsus.

(5) Digestive System

The metabolic rate is high in Birds, and so they require much food. The food is rapidly digested with a minimum of undigested matter, which is at once voided and so the rectum is short. The sac like crop serves to store the food and the muscular gizzard grinds it.

(4) Respiratory System

Though the lungs are small, the Inter Communicating System of parabronchi provide large respiratory surface for gaseous exchange. The air sacs act bellows supplying the air contained in them for oxygenation. There is no dead space in the lungs as respiration is efficient and complete.

(5) circulatory system

Completely four chambered heart and there is double circulation. The blood contains more red blood corpuscles with high haemoglobin content for the rapid and perfect oxygenation providing more energy.

(6) Brain

Optic lobes are well developed providing acute sense of sight. The cerebellum is large and much convoluted for control and regulation of muscular co-ordination and equilibrium. The olfactory lobes are small due to poor sense of smell.

(7) Sense organs

The sense of sight being so acute, birds eye is very large in relation to the head. There is an outer ring of sclerotic plate for resisting the pressure of air during flight petten helps in lubrication of eye and in detection of minute

movements at great distance. Birds eye possess double focussing mechanism.

(8) Urinary System

In order to make the body light urinary bladder is absent in birds. As a measure for water conservation most water is absorbed in the urinary tubules and also in the cloaca. The semisolid urine is got rid of intermittent

(9) Genital System

Loss of right ovary and oviduct, reduces the body weight. A single ovary also results in decrease in the number of eggs produced and this the body weight.

The above account clearly indicates that the birds have undergone drastic adaptations in relation to flight and almost every system has been influenced by the aerial mode of life.