

## 7. SUMMARY

### **Morphological examination of the digestive tract of different raptor birds with regard to their respective feeding habits**

The digestive tract including the attached glands of Osprey, Eurasian Buzzard, Marsh-Harrier, Red Kite, Sparrow-Hawk, Kestrel, Peregrine Falcon and Honey Buzzard were demonstrated anatomically and histologically with regard to species-specific adaptations to their typical prey and manner of feeding.

The oesophagus of the examined raptor birds is covered with an inner cutaneous mucous membrane. This membrane is arranged in longitudinal folds which run parallel in the fore and hind parts of the oesophagus and irregularly in the crop. The oesophageal mucous membrane contains mostly irregularly shaped mucous glands which decrease in number in the crop. A spindle-shaped genuine crop is either hardly recognisable when not filled or very distinct, but always present. In the Lamina propriae mucosae of oesophagus and crop of all examined raptor bird species, single smooth muscle fibres insertions are detectable. A thick layer of longitudinal muscle fibres, i.e. a Lamina muscularis mucosae, is always present in the oesophagus. The proventriculus is thick-walled and spindle- or cone-shaped. Its inner glands are arranged in four to six longitudinal bulges. A thin-walled gizzard, typical for raptor birds, was demonstrated in all examined specimens. Its mucous membrane contains a Lamina muscularis mucosae in all examined species.

The Duodenum of Red Kite, Kestrel and Peregrine Falcon is arranged in a snail-shell-like coil. In the other examined species of raptorial birds, it runs in a plain loop around the gizzard. The Jejunioileum forms a double intestinal spiral in Kestrel and Peregrine Falcon. In the other examined species, the wreath-like Jejunum lies on the right and the ileum ventral and to the left of the body cavity. The short Rectum always runs straight caudal. The Caeca of all examined species regress to form a short rounded object which contains a small lumen and much lymphatic tissue. The liver is always bilobed. A gall bladder is present in all examined birds of prey. The trilobed pancreas is situated in the Mesoduodenum. A sexual dimorphism regarding intestinal length is detectable. The examined female raptor birds display a longer intestinal tract in relation to body length compared to their male counterparts. In ospreys only, this relation is reverse. With 15 glands per cm only, the Osprey develops few mucous glands in the oesophagus, and only occasional glands in the spindle-shaped crop. In comparison to other examined species, the Osprey has an extremely long intestinal tract which is arranged in

many small loops. A prominent Stratum compactum in the Lamina propria mucosae is detectable in the digestive tract of this species which can be pursued through the whole digestive tract. This particular layer in the wall of the digestive tract can be interpreted as a specific adaptation to the digestion of fish.

The Eurasian Buzzard displays apparently few glands in the oesophagus. Its intestinal tract is twice as long as its body length. The Eurasian Buzzard, which usually does perch hunting, takes advantage of a wide variety of prey, therefore its intestinal tract needs to be longer compared to species with avian prey, but not as long as in the Osprey.

The Marsh-Harrier has a distinctly developed crop. Its gut is longer and thinner-walled compared to that of the Eurasian Buzzard. The Marsh-Harrier hunts from a search flight and often takes juvenile prey or ravages nests, and therefore does not need to be very maneuverable. Its easy digestible food requires no particular adaptation of its digestive tract.

The Red Kite develops by far the longest duodenum and also in all a long digestive tract which points to a long action time of the stomach fluids and therefore enables the use of varying, low quality food (carrion).

The Sparrow-Hawk displays a short and therefore possibly not as efficient digestive tract, but this enables it to save weight and be light and maneuverable for its hunt on avian prey. Thus, it is dependant on highly digestible food.

The Kestrel has a distinct Lamina muscularis mucosae in the proventriculus which is directly adjacent to the Tunica muscularis. Its short gut is adapted to its hunt of prey, therefore economising on weight and length.

The digestive tract of the Peregrine Falcon shows similarities to that of the Kestrel. The Diverticulum vitelli of Meckel of this species has developed into a distinct lymphatic organ. The intestinal tract of the Peregrine Falcon is short in relation to its body length. Thus, it economises on weight in favour of well-developed flight muscles which enable this falcon to be a swift hunter - but one which is dependant on highly digestible food due to its short digestive tract.

The Honey Buzzard is a food specialist and therefore displays a thick epithelial layer in the mucous membrane of the oesophagus which protects it from stings of swallowed insects. Its digestive tract is adapted to highly digestible food and therefore comparatively short.