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Based on the author's Chapter in the BSAVA Manual of Raptors, Pigeons and Passerine Birds (BSAVA 2008; eds Chitty & Lierz)

As in other species, proper balanced nutrition is fundamental to the correct husbandry and performance of the captive raptor. They therefore require a diet balanced in terms of quality, quantity and affordability that should reflect their requirements in terms of water, carbohydrate, protein, fat as well as micronutrients - vitamins and minerals.

In simplistic form, raptors eat meat. However, simple provision of meat is not sufficient.

RAPTORS ARE WHOLE CARCASE FEEDERS!

Failure to provide whole carcases of prey of an appropriate size for the raptor will result in selective feeding and nutritional imbalance.

Ideally raptors should be fed as close to their natural diet as possible and a knowledge of their basic biology is essential when formulating a diet though most raptors will take any source of meat when their preferred source is unavailable. Detailed information is available in Ferguson-Lees and Christie (2001).

In captivity, full choice of natural prey is rarely, if ever, available so some compromise is always necessary. Formulated rations have been proposed and marketed but have gained little popularity - the vast majority of falconers preferring fresh or frozen carcase as food sources.

Nutritional requirements vary according to lifestage with extra and/or specific needs during:

- Breeding;
- Rearing;
- Growth; and
- Performance.

These will be discussed and compared to "baseline" diet later in the Chapter.

All birds of prey produce castings. These are the regurgitated "indigestible" parts of the carcase (feather, fur, bones). The volume, appearance and timing of casting varies according to diet fed and, to a lesser extent, the individual bird. Experienced falconers monitor castings very closely as variance from the normal often indicates a digestive upset. In particular, failure to produce a casting within a few hours of a feed (containing material from which the bird would normally produce a casting) should be treated as an urgent medical problem.

NUTRIENTS

ENERGY

Energy is the fundament of diet. These birds eat, primarily, to fulfil their daily calorie requirements.

Energy is derived from the following sources:

- Fat
- Carbohydrate
- Protein

Of these, fat represents the major source in terms of Gross Energy (GE) being approximately twice as "energy dense" (kJ/g) as protein or carbohydrate.

Carbohydrates are not an important component of the diet. While the raptor brain is dependent on glucose (as in other species) and glycogen stores are built up in muscle and liver to act as a "store" of readily available energy, the diet is not carbohydrate-rich. Therefore carbohydrate stores are built up by conversion of other dietary components.

The GE is only the energy that enters the digestive system – digestion is not 100% efficient nor is all the energy actually available for digestion. "Indigestible" energy is removed in the form of castings, faeces, and urine.

There is also energy usage in the prehension of food and in the actual digestive processes.

While there is variation between food sources and species (Day old cockerel 85% ME/GE (71% in kestrel); mouse 75% (Forbes & Flint (2000)) a general case can be made for basic dietary calculation 75%+/- 7 for birds fed vertebrate prey (Robbins, 1993; Kirkwood, 1981).

The basal metabolic rate (BMR) of raptors can be calculated as:

$$BMR = 78 \times (\text{weight in kilos})^{0.75}$$

This represents only the needs to "stay alive". Extra physiological stress – growth, performance, breeding, thermoregulation - mean further need for dietary energy.

Any shortfall in energy intake will be made up from body stores. In general this will come from fat stores laid down in times of dietary energy excess.

However, inactive birds will utilize protein stores (muscle) in cold weather representing a need to not only increase dietary fat, but also dietary protein in winter.

As stated, birds eat to fulfil their daily energy requirements - in raptors this means they hunt when hungry.

This is the basis of falconry training – birds are kept hungry to encourage hunting behaviour.

To achieve this, falconers monitor weight and body condition very closely during the flying season.

An experienced falconer will have an excellent knowledge of the individual bird's hunting performance in relation to its body weight and feeding regime. Any variance from this

- Failure to gain/ lose weight in expected proportion to changes in feeding
- Failure to hold expected body condition in relation to bodyweight
- Failure to hunt in an expected manner ("lazy" or easily tired) given weight and/ or body condition
- Excessive or reduced appetite in relation to bodyweight or condition

may represent disease, and should be taken seriously meriting in-depth investigation in spite of a bird that often overtly seems well

Overall, the bird is judged by: **WEIGHT vs CONDITION vs PERFORMANCE.**

At the start of each flying season the bird is usually "starved" to an expected (based on previous seasons) or estimated (based on other birds of similar size) bodyweight before training. This is a part of the manning procedure.

Kirkwood (1981) studied rates of weight loss in starved raptors. Rates of energy loss did not vary significantly between species indicating the same type of tissue being broken down in each case.

Rate of loss (g/day) was shown to be 28.27 x Bodyweight (kg)$^{0.723}$
with time to achieve 25% bodyweight loss being 9.7 x Bodyweight (kg)$^{0.276}$

The presence of bodyweight in these equations indicates that larger birds are much more capable of withstanding fasting than smaller birds.

Clinically two syndromes may be seen in relation to energy:

Excess

This is very unlikely in the trained bird during the flying season. However, this tightly regulated feeding contrasts with the feeding of aviary birds that are often fed to excess in spite of doing less exercise!

Hepatic lipidosis is relatively common in aviary birds, especially those in permanent breeding aviaries especially in zoological collections.

While prolonged calorie excess is a major factor in the development of this syndrome, other factors may also play a part. In particular, Fatty Liver-Kidney Syndrome of merlins is well-described (Forbes & Cooper (1993)) where it is proposed that the feeding of day-old-cockerel to birds that feed predominantly in the wild on insects may result in a higher proportion of fat: protein in the diet and a high proportion of avidin resulting in binding of dietary biotin and reduced hepatic gluconeogenesis.

Atherosclerosis in older birds may also be a consequence of long-term excessive dietary energy combined with reduced activity, although genetic factors may also be involved.

In both cases, signs may be minimal or absent with birds dying spontaneously when stressed.

Certainly aviary birds should be handled on several occasions through the year allowing assessment of bodyweight and condition and, therefore, modification of diet. Serum cholesterol measurements may also be of assistance in screening for potential hepatic lipidosis or atherosclerosis cases.

Deficiency
Energy deficiency is seen commonly in trained birds.

The most frequent presentation is that of a thin bird that collapses during or immediately after flight.

Diagnosis is by the typical history and blood samples will reveal a hypoglycaemia. Response to intravenous glucose should be rapid. Many falconers will carry glucose or gluconeogenic compounds (eg "Liquid Life-Aid", Norbrook) for immediate oral use should this happen in the field.

In most cases, history reveals a "starved" bird. Increased feeding and a short break from hunting will enable weight gain. The bird should then be flown at a slightly higher weight, given suitable breaks during hunting, or fed during hunting trips.

However, in some cases hypoglycaemia may be the result of an underlying disease process - eg parasitism, malabsorption, hepatic disease. A thorough history and clinical investigation should be recommended for any case of hypoglycaemia (even those that seem "simple") particularly for those that fail to gain weight with increased feeding

As described earlier, smaller birds are less able to withstand periods of starvation so it is of little surprise that this is most common in smaller species used for falconry, especially the Sparrowhawk. This is one of the reasons that those new to falconry should begin with larger birds, eg the Harris' Hawk

Hypoglcaemia may be seen in these larger species but is generally only seen when the bird is being flown by an inexperienced falconer.

In this author's experience it is often seen in second season Harris' Hawks. The falconer will have worked out an "ideal flying weight" during the first season then put the bird to moult in an aviary in the close season. They then bring the bird out, man it and reduce the weight to the previous "ideal" – ignoring any growth that will have occurred during this time! Typically, these birds will be thin (even emaciated) in spite of being at the stated weight. It should always be emphasized that body weight AND condition should be assessed and that flying weight/ condition be re-assessed each year.

ESSENTIAL FATTY ACIDS (EFA'S)

It is likely that raptors do have certain requirements for these. However, good quality carcases should contain adequate levels so supplementation is unlikely to be necessary unless specific clinical syndromes suggest otherwise.

PROTEIN

Protein is the staple of the raptor's diet. As described earlier it may be utilized for energy, but is mainly used for tissue growth and repair.

Dietary protein should consist of 15-20% (Cooper (2002)). However, the limiting factors are the quality and type of protein available in the diet.

Given a good quality whole carcase diet, sufficient essential amino-acids should be present and, indeed, deficiencies are rarely seen.

Failures to absorb and process protein due to gastrointestinal disease, parasites, or metabolic disease may result in temporary "deficiency" that are evidenced by "stress" or "fret" marks in growing feathers.

The author has also seen some birds with poor quality beak and talon growth that have, apparently responded fully or partly with methionine supplementation. It is most likely that this is due to specific metabolic inability to process this amino-acid rather than absolute dietary deficiency.

WATER

All raptors require daily access to fresh clean drinking water!

Ideally this should be provided in open dishes such that the bird can bathe as well.

It has often been opined that raptors should obtain all dietary water from the prey items. In captivity, most are fed thawed frozen food - a process that loses some of the "natural" water from the carcase. Birds will also require additional water in hot weather, after exercise or when sick; wild raptors do drink!

Failure to provide access to water will deprive the bird of choice and it may be unable to drink when it most needs to. This will exacerbate or even cause disease.

It may be necessary to remove water dishes for part of a day - eg before flight (to avoid clogged feathers) or after noon in winter (to reduce incidence of Wing-Tip Oedema and Necrosis Syndrome). Nonetheless water should be available for at least part of each day.

As with all aspects of feeding, observation of the bird's regular drinking habits is essential. That way, polydipsia may be readily detected and clinical investigation undertaken.

MICRONUTRIENTS

Calcium/ phosphorus/ Vitamin D
It is impossible to discuss one aspect of these without addressing the others.

Vitamin D is required as D3 and is ingested in both active and inactive forms from prey items. Activation of Vitamin D3 in the raptor requires access to unfiltered sunlight or at least 45 minutes a day.

Calcium and phosphorus are readily available from whole carcase, provided bones can be ingested - ie prey is small enough that selective "picking" does not occur.

The ratio of these minerals is vital – ideally it should be between 1:1 and 2:1.

Deficiency of calcium or Vitamin D3 (or relative excess of phosphorus) will result in:

- Reproductive failure - soft-shelled eggs, egg binding, egg-related peritonitis.
- Nutritional secondary hyperparathyroidism - "rickets" in young birds. This will most commonly been seen in second or third clutches during a breeding season. Females lay down "stores" of calcium before the first clutch in the form of increased bone density and intra-medullary hyperostosis. These stores may become depleted with successive clutches and bone deformities may develop in chicks.
- Renal disease in the hen bird may produce a similar syndrome (Forbes and Rees Davies (2000)). Otherwise disease is seen in birds reared in the total absence of unfiltered sunlight (or artificial UV-B light) and those fed on deficient diets during rearing
- Neurological signs. Usually in growing birds or breeding females. Signs include tremors, weakness or fits. Typical signalment should arouse clinical suspicion and assessment of plasma ionized calcium levels diagnostic.

Excess calcium in the diet is unlikely to cause a clinical problem as excess will not be absorbed from the diet.

However, overdosage of activated Vitamin D3 supplements should be avoided as it will result in hypercalcaemia and mineralisation of soft tissues, especially the kidneys.

Other Minerals and Electrolytes

Given a good quality whole carcase diet, deficiency or excess of these components is extremely unlikely and clinical syndromes are correspondingly rare.

Iron supplementation may, however, be required after blood loss or haemolytic episodes.

Other Fat-Soluble Vitamins

Vitamin A

Vitamin A is stored in the liver (and, to a lesser extent, fat) and so should be available in required amounts from almost all whole prey items.

Deficiency is seen occasionally especially if only eviscerated carcasses or muscle meat are given or poor quality food is provided.

Signs include:

- Weight loss and failure to grow properly
- Poor hatch rates
- Xerophthalmia
- Opacification of the third eyelids and enlargement of the lachrymal glands. This may result in infection and/or keratoconjunctivitis sicca
- Hyperkeratosis of the eyelids

- Squamous metaplasia resulting in lesions/ infections of the mucous membranes, especially the mouth and conjunctivae
- Squamous metaplasia of the ureters will result in renal disease
- Vitamin A deficiency has also been implicated in bumblefoot pathogenesis
- Cooper (2002), Heidenreich (1997).

Diagnosis is by suggestive signs, biopsy and nutritional analysis.

Therapy involves diversification of the diet and oral supplementation of Vitamin A. Injectable Vitamin A is rarely indicated in my opinion – the pathogenesis of the disease is slow and recovery will be accordingly slow.

There is also the risk of overdosage with both oral and injectable preparations though it is less common when given by mouth. Signs of excess are very similar to those of deficiency.

Vitamin E

Vitamin E is an antioxidant. It is stored in body fat so, while deficiency should be rare, any spoilage of the carcase will deplete Vitamin E stores.

Opinions vary on the likelihood of deficiency. Klasing (1998) states that Vitamin E concentrations in the tissues of chicks, mice rats and quail are low and so deficiency is likely in raptors fed these. However, Forbes and Flint (2000) state that levels in rats and chicks should be adequate. Both sources agree that levels in quail are low unless these birds are fed Vitamin-E supplemented diets.

Requirements vary between species with piscivorous birds having a higher requirement (Klasing, 1998).

It is essential for fertility red blood cell formation and stabilization of cell membranes.

Deficiency will result in

- White muscle disease – a muscular dystrophy in young birds
- Reduced libido in males
- Reduced fertility
- Reduced hatchability and chick survival and thrift
- Splayed legs
- Encephalomalacia
- Oedema around neck wings and ventrum – possibly linked to cardiac lesions of white muscle disease
- Vitamin E excess is unlikely to cause clinical signs. However, all fat-soluble vitamins compete for absorption from the gut. Therefore excess Vitamin E may result in deficiency of Vitamins A, E or K.

Vitamin K

Deficiency is highly unlikely. However, clinical signs of haemorrhage and failure of coagulation will occur in coumarol toxicity.

Water-soluble Vitamins

Vitamin C

Adequate levels are synthesized in liver and so dietary deficiency is not a clinical entity in these species.

B-Vitamins

There are many of these yet dietary deficiency is rare – good quality whole carcase feeding should provide these.

However, the following may be seen:

Thiamine (B1)
Deficiency may occur especially in fish-eaters fed thawed frozen fish, where activation of thiaminase will destroy the available vitamin.

To avoid this, frozen fish should be thawed in boiling water or (preferably) fresh fish only should be used. In both cases, a B1 supplement should be given.

The author has also seen this deficiency in a young Red Kite, several juvenile Yellow-billed Kites and a juvenile Saker hybrid. In these cases it is more likely that deficiency was the result of a metabolic disorder or inability to absorb/ process thiamine rather than absolute deficiency. This opinion is also voiced by Forbes and Rees Davies (200) in describing thiamine-responsive fits in certain lines of Harris' Hawk.

Signs are dramatic – with incoordination progressing to seizure. Classically, affected birds will "stargaze".

Response to injectable thiamine is rapid.

Riboflavin (B2)

Forbes and Rees Davies (2000) report curled toes in very young chicks fed diets deficient in riboflavin.

AVAILABLE FOODS

Having seen what nutrients are required by the bird, we have to consider how to provide these. The ideal diet would be to allow the bird to feed on its natural prey. However, this is not possible in captivity so some compromise must be made.

Wild-caught Prey
This seems the obvious alternative to "free" hunting by the bird. However, there are a number of problems associated with this type of feeding, whether the prey is shot, caught by the bird itself, or picked up as roadkill:

1. Toxins. Wild-caught prey may contain various potential toxins including alphachlorulose, coumarol rodenticides, and, especially, lead. Certainly any quarry shot with a shotgun should be regarded as a possible source of lead as shot will be scattered through the carcase. Some falconers will only use quarry that has been "head shot" with a rifle – they will then discard the head. However, most bullets will fragment on impact so this is still a risk.

2. Infectious agents. Various infectious agents can be contracted from wild-caught quarry. Of particular importance are trichomoniasis ("frounce"), salmonellosis, *E. coli*, mycobacteriosis, campylobacteriosis, chlamydophilosis, paramyxovirus, falcon herpesvirus, as well as various enteric parasites. Many of these may be contracted from wild pigeon or doves, many of which are symptomless carriers of trichomoniasis, salmonellosis, chlamydophilosis, paramyxovirus and herpesvirus. Some advocate feeding pigeon meat after it has been frozen for several weeks then defrosted. While this will remove trichmonads it will not prevent viral infection. Therefore feeding wild pigeon is not recommended. Most birds are allowed to feed briefly on any quarry they have caught. This needs to be allowed, but the bird should be removed from the quarry at the earliest opportunity and only allowed to continue feeding after a thorough inspection of the carcase – while the quarry may have appeared fit and well in flight, it may be that the hunting raptor "selected" a weaker individual in hunting

Therefore, feeding tends to be based on commercially available foodstuffs.

Day-old Cockerel
Cheap and easily available, these are the staple of most raptor diets.

In recent years they have had a bad press as it is felt that they are capable of transmitting disease (especially salmonellosis and *E. coli*) and are too high in fat and low in calcium.

However, they have a good protein level, are less fat than commercially-available rodent, contain good levels of fat-soluble vitamins, and an excellent calcium:phosphorus ratio provided they are fed with yolk sac left in. Many falconers remove this yolk sac as it is felt that this will "reduce levels of infection". This is, of course, false. If the yolk sac appears unsuitable for feeding then the whole chick should be condemned. It will also remove the main source of calcium and fat-soluble vitamins, resulting in a carcase that is no longer nutritionally balanced! It is also worth checking that chicks have not been defrosted and re-frozen. This is apparent as red legs on the chicks – if evident then the batch of chicks should be discarded.

One potential problem with feeding whole chick is that it is messy. Some raptors will accumulate material under the talons leading to an erosive dermatitis. This will track in resulting in osteomyelitis and, often, loss or damage to the flexor tendon and its attachment. Therefore, attention must be paid to cleanliness if feeding the hawk on chicks.

A particular worry is the feeding of day-old-cockerels to Mauritius Kestrels. These have a particular sensitivity to the adenoviruses that may be found in the chick.

Quail
These have gained popularity as an alternative to day-old-cockerel. However, care must be taken as

to which sort of quail are fed.

Rat
Very good source of calcium and fat-soluble vitamins as well as being high in protein. They are often high in fat and some raptors find them unappetizing. They are also hard to prepare and reasonably expensive.

Mice
Excellent sources of protein and calcium, but expensive even if produced in a home-run "mouse farm". Can be very high in fat.

Other Rodents
Hamsters, guinea pigs, etc are often available for feeding. Hamsters probably offer little of advantage over mice. However, guinea pigs are relatively cheap and offer a good quality alternative to rats and mice. However, the fur is loose and many believe that this will result in excessive amounts of casting and possible gut impaction. They should, therefore be skinned and eviscerated (as the very large gut is unlikely to be eaten by the raptor) before feeding.

Rabbit and Hare
Excellent sources of protein and calcium for the larger birds. They are also relatively low in fat. However, they need careful preparation – the gut should be removed (as with guinea pigs) and, if fed to hawks, need the long bones and spine to be broken in pieces. Otherwise gut impaction may result.

Beef
Many falconers like to feed beef, especially to sick birds or to their favourites – this is generally anthropomorphic feeding! While the protein is excellent, the calcium: phosphorus ratio is dreadful. No amount of supplementation is going to improve this! Beef feeding may be of use when flying birds in public demonstration as feeding carcases (even chick leg) may be aesthetically unacceptable. It is vital in these cases to use only minimal amounts of beef as reward so as not to unbalance the diet
Large joins of meat (beef, lamb, or horse) may be supplied to adult non-breeding larger eagles or vultures. In these cases the joints should be pounded first so the bones are shattered enabling some improvement in the Ca:P balance.

Fish
As described earlier, fish-feeders (ospreys, fish eagles) can be fed on mammal-based diets. However, they do enjoy fish and this should form some part of the diet. Fresh whole trout is ideal, although farmed fish is much more fat than wild-caught. If frozen fish is to be used, it should be defrosted in boiling water and B-vitamin supplements used.

Prepared Meats for Humans
Feeding mince, sausages or bacon is not recommended even for short periods when desperate. Bacon, in particular, has been associated with toxicity .

FOOD PREPARATION

It is of no use obtaining good quality food if preparation methods are unhygienic.

Standard precautions should be taken with food defrosted in a clean fridge used only for the raptor food. It should never be defrosted in open areas where vermin may contaminate it. Only enough for

the next day's feed should be taken out and defrosted each time to avoid spoilage.

Similarly tools (knives, boards, etc) should be maintained in a hygienic manner.

A major problem area is the falconer's bag which should be thoroughly cleaned and disinfected after each hunting trip.

SUPPLEMENTS

In general, supplementation of vitamins and minerals should not be required in the adult non-breeding bird. These areas should be addressed in the basic diet - if the diet is fundamentally poor then the addition of various micro-nutrients is unlikely to address the main problem and definitely won't improve the state of the macro-nutrients.

Supplements, when used, should be directed specifically toward specific requirements at specific times, eg.

- Growth and rearing. Addition of a calcium/ Vitamin D3/ fat-soluble vitamin mix
- Breeding. Female birds lay down calcium stores approximately a month before breeding. Addition of a calcium/ Vitamin D3 supplement is recommended during this period
- Moulting. Use of an essential amino-acid/ fat-soluble vitamin mix during the moulting period may assist in feather growth and in speeding-up moult**.**

During all these periods, basic feeding should be increased with particular attention to protein content and quality

If supplements are to be used, then those recommended and developed for raptors should be used. These should be balanced and heavy doses of single fat-soluble vitamins should eb avoided. All supplements should be used precisely as per manufacturers' instructions

Probiotics are often used in raptors. As they do not have a fermenting gut it is unclear what role the gut flora and, therefore, the probiotics may play. However, it is proposed that probiotics paly a role in "blocking" more pathogenic bacteria, so they may eb used during times of stress (manning, transport, etc) when they will certainly do no harm and the electrolytes that are included in most mixtures will certainly help.

Rangle

This is the deliberate feeding of stones to captive hawks or falcons so they then cast up the stones. The aim is to "cleanse" the stomach removing fat deposits, thus making the bird hungrier and a better hunter. Some falconers recommend doing this up to monthly during the hunting season.

There is little evidence to show it works and, given the risk of damage to the gut and obstruction, this is a practice that may be best not done.

In the Middle East this procedure is traditionally performed using ammonium chloride ("schnather"). Many cases of toxicity have resulted and this practice is certainly not recommended.

Hand-Rearing
Attention must be paid to the normal adult diet and to any changes wild adults may make when rearing young in the wild.

As basic rules:

- Maintain a good (2:1) calcium: phosphorus ratio. Calcium and Vitamin D3 supplements should be used
- Avoid excessive protein loads. This may result in rapid soft tissue and feather growth which may overload soft bones, predisposing to deformities, eg. “angel wing”
- Birds should be restricted in small pots to prevent excessive movement and splay leg
- In the first few days of life the chick’s gut is sterile. Absolute cleanliness must be observed in the rearing room
- Probiotics may be useful
- Food should be slightly wetted with clean fresh water immediately before offering to the chick
- Young vultures require food to be part-digested. This is best achieved by soaking food in a commercial pancreatic supplement (for dogs with exocrine pancreatic insufficiency) for half an hour before feeding
- Make sure only small pieces of food are fed at a time. Assess crop filling and seek attention quickly if the crop is slow to clear

FEEDING THE REHABILITATION BIRD

The rehabilitation bird provides certain challenges:

- Most are presented malnourished – especially first year juveniles after their first spell of bad weather post-weaning. Alternatively injured birds may have starved for a period before being weak enough to be caught
- Birds are stressed and may be unwilling to feed for themselves even if physically capable
- Birds may not be familiar with the foods on offer (eg DOC)
- Imprinting is a genuine risk with immature birds. In the UK it is a legal requirement to avoid this – feeding methods must be designed to avoid imprinting birds on the feeder. They must also be designed such that food is not provided “on demand” otherwise behavioural problems may result due to creation of an arrested development phase (eg screaming or attacking humans).

Initially it is most important to correct dehydration and electrolyte balance – aside from systemic fluids, oral fluid therapy is vital. The latter can also be used as a means of providing simple carbohydrates for short-term energy use in the starving bird (eg Critical Care Formula, Vetark) .

Over the longer period, protein and fat need to be provided. The critical care diets marketed for cats and ferrets are appropriate in these cases, though Oxbow’s Carnivore Critical Care has, so far, performed very well – it is also easy to prepare and comes in small sachets – an important consideration in small rehabilitation units, where these species are only seen occasionally. It has also been excellent in piscivorous species. Emeraid Carnivore (Lafeber) is also an excellent product though the large size containers and more difficult mixing technique mean that it is more appropriate for the larger rehabilitation unit.

The quantity that can be tube fed at each time will depend on the size of the bird and whether or not it has a crop. Vomiting birds should be fed smaller volumes more frequently.

In all cases, normal carcase food should be introduced little-by-little as the bird starts to respond to the sight of it. Do not leave meat in with the patient – it may be tempted to eat after food has begun to deteriorate. Instead, show it the food, then leave for 30-60 minutes only. If it has not fed then continue tube feeding and repeat the exercise later that day or the next day.

In the early stages of "building up" half-crop feeding should be used:

- No casting is provided
- Sufficient food only to fill half the crop is given
- As soon as the crop is empty, another feed is given

Once weight is being gained, feeds can be increased in volume and decreased in frequency and casting can be given.

If the bird seems not recognize "captive" diets, it can be skinned or alternative feeds sourced – eg brown mice rather than white.

Before release, the bird should be reintroduced to "natural" diet – eg fish for piscivorous species, removal of DOC from the diet- unless a soft release "hack-back" technique is to be used.

REFERENCES

Cooper, JE (2002) Birds of Prey Health and Disease. Blackwell Science, Oxford, UK

Ferguson-Lees, J & Christie, DA (2001) Raptors of the World. Christopher Helm, London

Forbes, NA & Cooper, JE (1993) Fatty Liver-Kidney Syndrome of Merlins. In Raptor Biomedicine. Eds Redig, Cooper, Remple & Hunter. pp 45-48. Chiron Publications, Keighley, UK

Forbes, NA & Flint, CG (2000) Raptor Nutrition. Honeybrook Farm Animal Feeds, Evesham, UK

Forbes, NA and Rees Davies, R (2000) Practical Raptor Nutrition. In Proceedings of the 21st Ann Conf & Expo Assoc Avian Veterinarians, Portland OR. Aug 30th-Sept 1st: pp 165-171.

Heidenreich, M (1997) Birds of Prey medicine and management. Blackwell Science, Oxford, UK

Kirkwood, JK (1981) Maintenance energy requirements and rate of weight loss during starvation in birds of prey. In Recent Advances in the study of Raptor Diseases. Eds Cooper & Greenwood. pp153-158. Chiron Publications Ltd, Keighley, UK

Klasing, KC (1998) Comparative Avian Nutrition. CAB International, Wallingford, UK

Robbins, CT (1993) Wildlife Feeding and Nutrition 2nd Edition. Academic Press, San Diego