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WATERFOWL BOTULISM

Botulism, also called Western Duck Sickness and Limberneck, is a food poisoning involving the nervous system which affects hundreds and sometimes thousands of waterfowl in the San Francisco Bay every fall. The problem, however, is not unique to this area; epidemics of botulism have been seen around the country where the right conditions are present. The most prevalent areas seem to be the alkaline marshes of the midwest and western U.S. It is also not unique to ducks and has been found in all types of waterfowl from gulls to stilts.

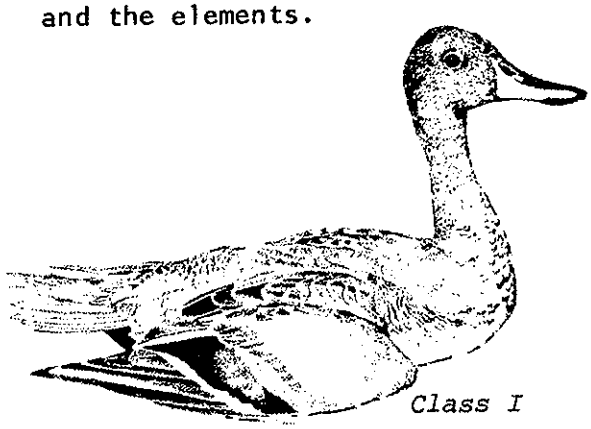
Botulism, caused by the bacterium Clostridium botulinum, has six known strains, and it is Type C that affects waterfowl, but does not seem to affect humans or dogs. The disease attacks the peripheral nerves and results in increasing paralysis of the voluntary muscles. The birds die when the respiratory or cardiac musculature becomes paralyzed, although if in the water, many will drown sooner from an inability to hold up their necks.

Just how an epidemic begins is still open to some question, but it appears that a die-off of aquatic invertebrates, especially in warm stagnant water where he food supply has been depleted, provides a food source for the botulism bacteria. Ducks may then eat these invertebrates, become sick and die; maggots eat their bodies, and other ducks eat the maggots, which have concentrated the toxin, and these ducks in turn become sick.

When an epidemic occurs, it is important for rehabilitators to work in conjunction with their local wildlife agency. It is critical that dead birds be removed from the scene to help break the cycle, but this work and other management techniques that may be employed are best left to the wildlife agency. The rehabilitators should focus their attention on saving as many sick birds as possible.

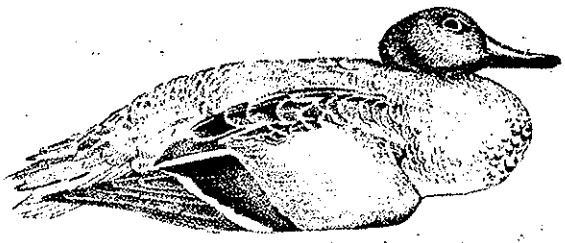
The California Department of Fish and Game divides the sick, rescued birds in three categories for treatment.

Class I - In this initial stage the bird cannot fly but will normally recover if protected from predators and the elements.



Class I

Class II - Birds in this stage are unable to fly or stand but can swim or flap on the ground. Head movements are only partially controlled. Many of these birds can be saved by giving them shelter and tubing fresh water (see treatment below).



Class II

Class III - This is the near terminal or terminal stage of botulism. Birds that have progressed this far are characterized by almost complete paralysis including the neck muscles. The recovery rate of these birds is lower than for Classes I and II.



Class III

Treatment of affected birds is about 70% successful. The treatment involves diluting the toxin and flushing it from the bird's body by tube-feeding water or a rehydrating solution. Initially birds should be tubed every hour. Tube the bird rehydrating solution for the first four hours then at the fifth tubing, tube a pureed food mixture (see paper by Hobson below). As the bird's condition improves, increase the proportion of food tubed until you are alternating tubing food and rehydrating solution each hour.

Check for maggots around the tail, wash droppings off the vent. Provide adequate ventilition in the box or pen and spray the bird's eyes with water several times daily. Ducks will usually begin self-feeding in three days and recover fully within one week. Shore birds and herons take twice as long to recover.

K.H. and A.B.

References:

The treatment section of this article was taken from Initial Care of Injured and Oiled Waterbirds by Kathy Hobson of WRC. It deals with a wide range of problems which rehabilitators will encounter when handling waterbirds. It also provides very helpful charts on proper diets and amounts for self-feeding and non-self-feeding birds, pureed food and rehydrating solution recipes, housing requirements for various species, medical treatments, etc. This is a very important paper for anyone handling waterbirds. It is available for $2.00 by writing WRC.

For those interested in more clinical details about botulism, please refer to:

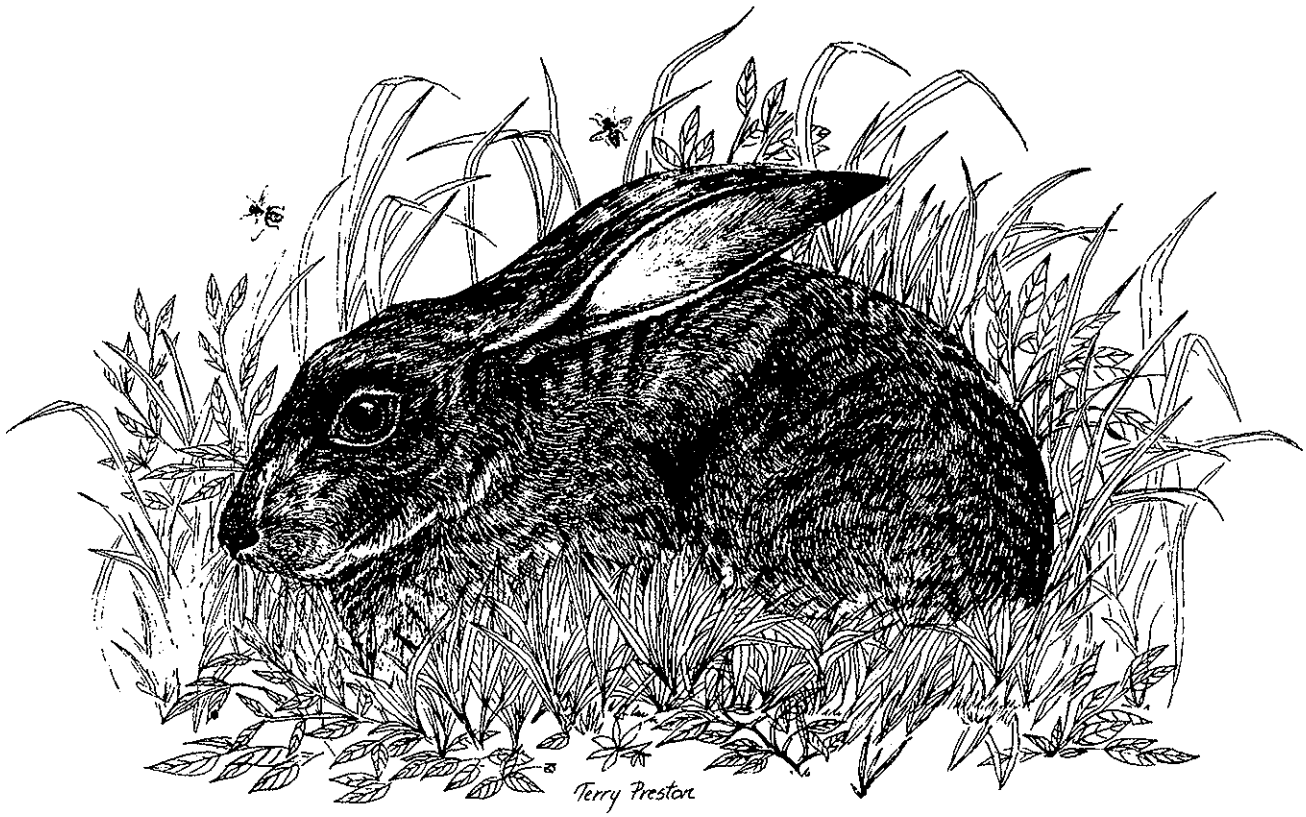
"Botulism" by Rosen in Infectious and Parasitic Diseases of Wild Birds, Iowa State University Press, Ames, Iowa.

Those wanting a good general overview of the botulism problem and a concise management plan may want to write for the following pamphlet:

Waterfowl Botulism Management
Wildlife Management Leaflet #14
CA Department of Fish and Game
1419 9th Street
Sacramento, CA 95814

Illustrations used in this article were taken from Waterfowl Botulism Management.

IMMOBILIZATION OF SIMPLE AND COMPOUND FRACTURES IN MAMMALS



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Wildlife Rehabilitation Council
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Cover illustration:
Blacktail Hare *(Lepus californicus)*

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INTRODUCTION

Purpose: The purpose of this article is to familiarize the wildlife rehabilitator with various methods for treating simple and compound fractures in mammals. While the treatments offered herein have been used successfully on domestic pets, the distinctive temperament differences in wildlife may reduce the success of these methods or present unique problems in maintenance. Some of these treatments must be applied by a veterinarian only, and some may be applied by an experienced rehabilitator under a veterinarian's direction. In certain instances this article offers recommendations and suggestions for consideration; however, the final decision for treatment and confinement rests with the veterinarian and rehabilitator after proper assessment of the particular injury and species requirements has been made.

Permit Regulations: The California Department of Fish and Game has one of the most complicated set of laws governing the possession of native wildlife in the United States. In general, anyone finding and confining an injured or diseased game bird, protected nongame bird, or game mammal must notify the Department within twenty-four (24) hours so that a special revocable permit may be issued. Rehabilitation organizations may apply for yearly permits which cover most wildlife, with the exception of some threatened and endangered species and big game animals. These species require an additional special permit for each animal possessed. The law states that only a public zoological garden, museum, college, university or other education institution, as determined by the department, may be permitted to permanently retain a non-releaseable animal in confinement.

Each state has its own laws governing this subject. Rehabilitators are urged to contact the appropriate wildlife agency for particulars on the regulations in their state.

Definition of Terms:

SID, BID, TID: once a day, two times a day, three times a day, respectively.

Caudal surface: surface closest to the tail (e.g., back of leg).

Compound or open fractures: a break in the bone with an accompanying wound at the fracture site. Often this includes shattered bone where pieces may be missing.

Cranial surface: surface closest to the head (e.g., front of leg).

Debridement: the act of cutting away or otherwise removing dead or infected tissue.

Epiphyseal growth plates: located at both ends of most long bones and is responsible for longitudinal growth of bone. Cannot detect damage without X-ray.

Green stick fracture: an incomplete fracture which passes only part way through the bone.

Reduction of the fracture: creating manual traction by a slow, steady pull on the long axis of the limb. A splint does not reduce a fracture, only maintains a previously attained reduction.

Simple or closed fractures: a break in the bone without an accompanying wound at the fracture site.

CARE AND TREATMENT

1. Rescue, Transport and Initial Care

1.1 RESCUE. A major factor hindering success in rehabilitating wildlife is the time that elapses between injury and treatment. Often an injured animal lies unattended, exposed to the elements without food or water, for several days. Injured animals should be rescued as quickly as possible and stabilized (See Secs. 1.2 and 1.3).

1.2 TRANSPORT. When rescuing an injured animal, the rescuer's safety comes first. Blankets, towels and sometimes a come-along pole (a long pole with an adjustable loop on the end which slips over the animal's head) are useful. A lightweight blanket may be placed over the animal's head, blocking its vision but allowing ventilation. If the animal is small, it may be wrapped in a towel or placed in a cage to protect the rescuer and the animal from further injury. Deer may need two to four people, depending on the size of the animal, to restrain the legs and body. The front legs can be wrapped in a blanket and each back leg held, while the head is covered with a lightweight blanket. Generally, darkness, firm pressure and wrapping calms a frightened animal. A bobcat or mountain lion may need to be anesthetized before transport. (See Sec. 1.3. INITIAL CARE for recommendations on temporary immobilization of fractures prior to transport.)

1.3 INITIAL CARE. Stabilization of the animal must be the first priority. Setting and immobilizing a fracture need not be done for up to five days, depending on the level of accompanying trauma and the length of time elapsed since injury.

Fractures fall into three classifications regarding need for repair:

(1) critical fractures requiring immediate treatment include skull, spinal, compound and certain types of luxations (dislocations);
(2) semicritical fractures requiring quick treatment to avoid resultant abnormal function or severe problems, including fractures of joint surfaces or of epiphyseal growth plates and luxations of the femoral head, shoulder, and elbow; and
(3) noncritical fractures allowing delayed reduction include scapular and pelvic fractures, green stick fractures, and closed fractures of long bone shafts.

An initial examination, usually involving two people, is made to observe and assess any life threatening signs. These signs include *labored respiration* (attempt to maintain adequate, open airway for respiration, and assist respiration, if necessary), *white or blue color to gums* (indicating shock, warm animal slowly with towel-wrapped heating pad or hot water bottle, blanket, or heat lamp and transport to veterinarian), *hemorrhage* (attempt to apply pressure dressings over the bleeding area), *cold* (wrap with blankets, and later place a heat lamp three feet from the animal or a towel-wrapped hot water bottle next to the animal), *dehydration* (Lactated Ringer's Solution, 5-40 cc/lb., depending on the level of trauma, in an IV or subcutaneously, administered until the animal is no longer critical). Keep in mind the possibility of multiple fractures or of injury to the spine, head, thorax, and abdomen. Use care and gentleness, and limit the handling of the animal. If possible,

it is recommended that fractures encountered in the field be temporarily stabilized using a modified Robert Jones bandage (See Sec. 5.1, Fig. 4). Fractures above the elbow or knee may be wrapped to the body in a flexed position with Vetrap or Elasticon (stretchy adhesive tape; becomes firm in 24 hours) prior to transport for veterinary attention.

Fractures may be observed by the appearance of swelling, deformity or inability to use the injured part. Occasionally, there is no deformity and the animal may continue limited use of the affected part. In order to assess the injury properly, all fractures should be X-rayed. Fractures with displacement should be reduced as soon after the injury as possible to avoid excessive swelling and the development of muscle traction. Closed reductions should be done gently and with the animal under general anesthesia. Wounds should be clipped of surrounding fur and flushed with diluted Betadine solution, water or saline. Debride the wound, if necessary, preserving skin wherever possible. Bacterial cultures should be made at the time of debridement, and sensitivity tests performed. Until sensitivity results are known, a broad spectrum antibiotic, such as one of the tetracyclines, may be given (See Sec. 2, Drugs and Dosages, for suggestions). The wound may be covered with a gauze bandage which has been soaked in a topical antibiotic, such as Furacin. Severely contaminated or old wounds, which may indicate delayed closure, should be treated by packing with an antibiotic dressing and repeated debridement in 3 to 10 days.

When applying a splint, it is recommended that use of adhesive tape directly on skin be reduced or avoided whenever possible. Certain species, such as jack rabbits, have tissue thin skin on their limbs which can shred when the tape is removed. Cloth or ribbon tape over gauze, or Vetrap, can be an effective alternative when movement of the splint on the limb is not an issue.

Coban and Vetrap, used interchangeably in this article, are self-adhering elastic wraps, which, when wrapped too tightly, will remain so. Therefore, any wrap with Coban or Vetrap should be checked frequently for swelling.

2. Drugs and Dosages

No drugs should be administered without prior consultation with a veterinarian. Rehabilitators and veterinarians may find it helpful to set up herd health treatment routines for preventative and therapeutic maintenance of injured wildlife. The following example of herd health policies for mammals with fractures was obtained from Wildlife Rehabilitation Service in Fairfield, California and formulated under the direction of Sandra Emanuelson, D.V.M. (Cottage Lane Veterinary Hospital, Walnut Creek, California).

(1) Animals admitted in shock, treat as follows:
   a. Incubate.
   b. Administer dexamethasone 1-4 mg/lb BID or as necessary
   c. Fluid therapy: Lactated Ringers + 1cc Multi-B Super-Vitamins. Give $NaHCO_3$ at a rate of 1 meq/lb once in fluids. (Author's note: recommended only if a state of acidosis, low pH, is confirmed.) Administer 40 cc/lb oral, subcutaneous or IV depending on species, stress, and condition. Set IV drip to deliver 10-30 ml/lb/hr. Check with veterinarian for further directions.

(2) Mammals admitted with fractures:
   a. Treat for shock if necessary.
   b. Immobilize (without setting) unstable fractures.

c. Antibiotics:
Compound Fractures (Clean wound thoroughly with diluted Betadine and apply Furacin wrap):
Keflex 10 mg/lb TID (except lagamorphs)
(Lagamorphs: Kantamycin 2.5 mg/lb BID)
Simple Fractures:
Large mammals: Pencillin G 10,000-30,000 IU/lb/day BID
SSmall mammals: Ampicillin 20 mg/lb TID (except lagamorphs)
(Lagamorphs: Kantamycin 2.5 mg/lb BID)

To reduce the possibility of occasional error in dosage calculation, rehabilitators may wish to become proficient in calculating drug dosages. With experience, the rehabilitator will eventually be able to judge whether a prescribed dosage is appropriate for a particular animal. If there is doubt, a simple calculation will enable you to double check the dosage. The rules for setting up drug dosage calculations are as follows:

Factor Label Method (also called dimensional analysis)

1. Convert the animal's weight to units of dosage (Kg or lb.)
   Conversion factors are: 454g = 1 lb.
   1000g = 1 Kg
   1 ml = 1 cc
   2.2 lbs. = 1 Kg
2. Set up calculation so that all units except cc's will cancel algebraically.
3. Always include the units in each factor.
4. Multiply BODY WEIGHT X DOSAGE X STRENGTH (of particular drug).

Example: 3 lb. raccoon
Administer Chloromycetin, dosage 30 mg/lb TID
Strenght of product: 100 mg/cc

Body Weight X Dosage X Strength

$$3\ \cancel{lb.} \times \frac{30\ \cancel{mg}}{\cancel{lb.}} \times \frac{cc}{100\ \cancel{mg}} = .90\ cc\ TID$$

2.70 cc total daily dose

Example: 3 lb. raccoon
Administer Chloromycetin, dosage 64 mg/Kg
Strength of product: 100 mg/cc

Convert body weight to dosage units (See Rule 1)

Body Weight X Dosage X Strength

$$3\ \cancel{lb.} \times \frac{1\ \cancel{Kg}}{2.2\ \cancel{lbs.}} \times \frac{64\ \cancel{mg}}{\cancel{Kg}} \times \frac{cc}{100\ \cancel{mg}} = .90\ cc\ TID$$

2.70 cc total daily dose

Any unit in the calculation can be converted properly, provided the conversion factor is written so that the correct units cancel.

Since practice is the key to proficiency in dosage calculation, three practice examples are provided here with solution set ups at the end of this article. The rehabilitator should practice with more examples.

	Weight	Dosage	Strength
1.	350 g	15 mg/Kg BID	30 mg/cc
2.	9.5 lbs.	2 mg/lb SID	50 mg/ml
3.	1127 g	25 mg/lb TID	50 mg tablets

3. Treatments for Specific Breaks

Many factors must be considered in choosing the proper immobilization treatment. Among those factors are location and type of fracture, the age and temperature of the animal and the type of confinement best adapted to the particular species. No single factor is sufficient to warrant the use of a specific treatment.

In addition, sanitation is a major concern when treating fractures (See Sec. 4.2). A treatment such as a cast or splint can be covered with a plastic bag and changed when needed. Variton, which is a safe, foul-tasting, unmedicated cream, may be applied over a treatment to discourage chewing. Another method to discourage chewing is an Elizabethan collar. Made out of X-ray film, or any sturdy but flexible plastic, the collar is cut into a circular disc with a neck hole in the center and a slit which opens to place the collar on the animal's neck. Place adhesive tape on any rough edges. The collar should be appropriately sized and flexible enough to allow sleeping.

3.1 JAW (Fig. 1).

3.1a *One Jaw.* Provided the animal can eat, confinement alone and pureed food may allow the jaw to heal. Healing may be a slow process requiring patience on the part of the rehabilitator.

3.1b *Both Jaws.*

Tape Muzzle. Jaw fractures that have either no or slight displacement will often heal adequately when an adhesive tape muzzle is applied. The muzzle prevents further displacement and reduces pain by restricting the movement of fracture segments. Application of the muzzle may require anesthesia.

The muzzle consists of two rings of tape, one around the animal's muzzle just below the eyes, and another snugly around the neck just behind the ears. Begin by wrapping the tape around the muzzle, adhesive side out. When the circle is complete, the tape is doubled back on itself completely covering the adhesive side. The neck ring is formed in the same manner. Connect the two rings with lateral straps of tape, each formed from two pieces, adhesive sides together. Secure the straps with additional tape on the neck and muzzle rings. The nose ring can be made to any circumference to allow for drinking water and eating soft food. The muzzle can be removed quickly by cutting the neck ring and slipping off the nose ring.

To prevent the muzzle from being pulled off, an Elizabethan collar (See Sec. 3) may be required initially. This fracture treatment is inappropriate for animals without a well-defined muzzle.

Wiring. A veterinarian may wire the jaws shut and suture a tube to the external skin of the neck at the esophagus. The animal is then fed through the tube. The disadvantage of this treatment is the obvious stress caused to the animal. Smaller animals might tolerate jaw wiring if they are able to lick their food while wired. However, in some cases euthanasia may be recommended.

3.2 RIBS (Fig. 1). In certain cases where fractures are minimal, confinement in calm surroundings may be adequate. Wrapping may restrict breathing and place the animal under stress. It is, therefore, not recommended. Euthanasia may be indicated in certain instances.

3.3 SPINE (Fig. 1). Spinal trauma includes fracture, compressed disc, severing of bones, and cord trauma which produces swelling and hinders the spine. The spine should be X-rayed; however, spinal trauma does not always show up on an X-ray.

In small and medium-sized mammals (for example, squirrels and opossums) which have impaired use, or a loss of use, of the hindlimbs, confinement for observation is advised. Expressing urine from the bladder of a paralyzed animal should be done as needed. If paralysis, together with an inability to

urinate, continues with no improvement for about two days, euthanasia should be considered. Prognosis is also poor when a leg pinch indicates no feeling in the limbs. If improvement is evident or if there is a limited use of the legs, observe the animal for 3 to 4 weeks for further improvement. Re-X-raying the spine each week may assist in evaluating any progress. Failure to improve after four weeks may indicate a poor prognosis. The rate of healing in spinal injuries can be sporadic with improvement occurring early, followed by no improvement for several weeks.

3.4 PELVIS (Fig. 1). Cage rest is generally recommended for minor or treatable pelvic fractures. An important consideration prior to releasing females is that of spaying or tubal ligation. Pelvic fractures may heal with some deformity and cause death when the female gives birth. The social behavior of the particular species may dictate which sterilization method to use. Coyotes, for example, are more social than bobcats. Therefore, tubal ligation would be a better alternative for a coyote since spaying would alter her scent, possibly causing rejection or harassment by other coyotes. The effect of spaying on a bobcat would probably be insignificant. Spaying might be a better alternative for squirrels since altering the scent might avoid subjecting the animal to "gang rape", which occasionally occurs.

3.5 TAIL (Fig. 1). A lightweight bandage, such as a layer of rolled cotton and Vetrap, in addition to confinement for two to four weeks will generally accomplish healing. In cases where a portion of the tail beyond the break is dead due to nerve damage, a veterinarian may deem amputation advisable. There is some question among rehabilitators whether a species, such as a fox, can exist through winter weather without the insulating capabilities of a tail. Consideration of this factor should be made prior to release.

The remainder of this section dealing with treatments for specific breaks contains a list of alternative techniques for immobilizing limb fractures. The decision to use a certain treatment rests with the veterinarian or an experienced rehabilitator. Keep in mind that treatments should be applied by experienced persons. The simpler the construction the greater the treatment will be tolerated by the animal and the greater the chance for success.

External fixation has advantages over internal fixation. For instance: (1) the original hematoma is maintained; (2) there is less risk of infection; (3) tissue trauma as a result of surgery is avoided; and (4) the procedure is less expensive. The disadvantages to external fixation include: (1) lowered precision in reduction; (2) limited exercise and use of limb muscles; (3) likelihood of disuse atrophy; and (4) increased difficulty in aftercare.

Proper immobilization of a fracture requires that the joints above and below the break be included in any treatment applied to prevent lateral movement and rotation of the bone.

3.6 HUMERUS AND FEMUR (Fig. 1). The following treatment is offered:

3.6a *Pinning*. See Sec. 5.5. (Note: Schroeder-Thomas splint, Robert Jones bandage, coaptation splint and casting are not recommended for humerus or femur fractures. The ring of the Schroeder-Thomas splint may put pressure on the fracture area, and in each of these treatments the joint above the break cannot be immobilized, which is an essential element in eliminating rotation and lateral movement of the bone.)

3.7 RADIUS/ULNA AND TIBIA/FIBULA (Fig. 1). The following treatments are offered:

3.7a *Robert Jones Bandage*. See Sec. 5.1 and Fig. 4.

3.7b *Coaptation Splint*. See Sec. 5.2 and Figs. 2 and 3.

3.7c *Casts*. See Sec. 5.4. Recommended in some cases for animals, such as raccoons, that tend to chew at bandages. Pinning (See Sec. 5.5) may be used in conjunction with a cast.

3.7d *Pinning*. See Sec. 5.5.

3.7e *Schroeder-Thomas Splint*. See Sec. 5.3 and Figs. 6 through 10.

3.7f *Mason Metasplint*. See Sec. 5.2 Useful in radius/ulna fractures only.

3.8 HOCK (tarsals) (Fig. 1).

3.8a *Robert Jones Bandage*. See Sec. 5.1 and Fig. 4. Place foot in comfortable position prior to applying treatment.

3.9 CARPALS, METACARPALS, METATARSALS, PHALANGES (Fig. 1). Foot should be flattened into a normal position and wide adhesive tape placed on the cranial and caudal surfaces of the foot. The foot is wrapped in gauze to create a cushion and adhesive tape wrapped over the gauze. Hind foot fractures in squirrels and jack rabbits may be given additional support with cotton padding wrapped around the foot and a tongue depressor placed on the outside of the padding. The tongue depressor is taped to the foot at both ends and the entire treatment wrapped with Vetrap. A metal shoe may also be used in place of a tongue depressor. (See Sec. 5.2).

4. Proper Confinement

There are several important elements in providing the proper confinement for injured wildlife.

4.1 SAFETY AND COMFORT FOR THE ANIMAL. Animals under treatment should be housed separately. Initially, the confined area should be small to reduce movement. Placement in a larger cage is advised as the animal improves. The confinement should take into consideration each species' temperament and behavior. For example, it is advisable to provide protective padded walls and floors for deer; jack rabbits require extra height to avoid back injury when jumping; squirrels, chipmunks and raccoons utilize a nesting box as a refuge. Most injured wildlife will be agitated and may cause further injury if proper care is not taken. The cage should be in good repair and free from impalements and hazards which may cause injury or entanglement to the animal or treatment. Darkness for limited periods of time as well as reduced human contact may help keep the animal calm.

4.2 SANITATION. Proper cleansing of cages, exposure to sunlight and frequent removal of feces, urine and unconsumed food is essential in controlling infection and flies. Maggots become a serious irritant when flies lay their eggs underneath a cast. Deer, with their highly-strung temperament, may ram themselves against their confinement to the point of death, if allowed to suffer the stress of flies or maggots. Cages which are easy to clean tend to be cleaned more often.

4.3 FOOD AND WATER. Provide a variety of vitamin fortified natural foods, if possible, or in combination with commercial substitutes. Water and food should be fresh daily, easy to consume (e.g. chopped, mashed or pureed) and placed within easy access. Animals may refuse to eat chopped or pureed foods if they do not recognize them. Natural food sources which are small (e.g. baby mice, berries, fruits) and do not need to be pulled apart prior to consumption may aid in stimulating the animal's apetite.

4.4 EXAMINATIONS. Some animals may need periodic examination. The confinement should allow for easy capture and restraint or removal.

5. Major Immobilization Methods

There is a relatively small number of basic methods used to immobilize fractures in mammals. These methods, when practiced and used consistently and proficiently, provide the least stress to the animal. Therefore attempt at innovation, before adequate experience in the use of these methods is obtained, may do more harm than good.

5.1 ROBERT JONES BANDAGE (Fig. 4). This treatment, while bulky in appearance, immobilizes the limb and applies even pressure which reduces swelling. While the Robert Jones is used to treat severe fractures, it is also the best single dressing for temporary immobilization of limbs. Step by step procedures follow:

(a) After X-ray and treatment of wound, if any, adhesive strips are applied lengthwise to the caudal and cranial surfaces of the limb. These strips aid in traction and assist in holding the bandage in place. The strips of tape should remain unjoined at the sides by slightly rolling the edges toward the center of the tape.

(b) Tightly wrap the limb with absorbent rolled cotton and reduce the fracture. Wrap two or more pounds of cotton around the limb to form a large bulk of padding. Leave toes exposed to evaluate any swelling. A modified Robert Jones, which eliminates the added bulk of padding, may be used for fractures requiring less support.

(c) Wrap entire dressing with elastic gauze (Vetrap, Coban) applying even tension during application to achieve a firm finished bandage (toes remain exposed). Adhesive tape may be wrapped over the elastic bandage to add additional protection from chewing by the animal.

5.2 COAPTATION SPLINT (Figs. 2 and 3). This splint is made to closely resemble the shape of the limb. Choice of splint material depends on availability, size of animal and personal preference. Materials avaiable for coaptation splints include:

(a) Tongue depressors: useful for small animals, fractures of digits, metacarpals and metatarsals.

(b) Metal shoe (Mason Metasplint): available commercially in several sizes through veterinary supply houses; can be widened or narrowed to approximate shape of padded limb; useful for fractures of radius/ulna, carpals, metacarpals, metatarsals.

(c) Yucca board: has advantage of cutting easily, shaping when wet and becoming rigid when dry. However, uniform high quality material is relatively unavailable. Useful for same fractures as metal shoe.

(d) Basswood: will not bend and is not easily cut. Used primarily as temporary splintage or for rigid immobilization of the spine by whole body splintage.

(e) Plywood or fiberboard: abundantly available through lumber supply houses. Can be marked and cut to the shape of the limb with a jig saw. One-eighth to one-quarter inch thickness is recommended useful for tibia fractures.

(f) Orthopedic plastic: may be immersed in hot water until it becomes pliable to cut. This material can also be warmed and reshaped if needed. Additional heated strips of plastic (narrower than original splint) added to the outside surface of the splint will give added support. There are two disadvantages to this material: it is relatively expensive and moisture can become trapped under the plastic. To reduce moisture problems, do not encircle the entire limb with elastic bandage or adhesive tape.

(g) Hexcelite Orthopaedic Tape (Hexcel Medical Products): this material is a plastic coated mesh which is available in varying widths. It may be soaked in water and formed to the desired shape. Two strips, one on the cranial and one on the caudal surface of the limb, may be placed over cotton padding and wrapped as described in the splinting procedures below. It is lightweight and provides ventilation to the skin.

Splinting procedures are as follows:

(1) X-ray fractured limb and choose an appropriate splinting material. If using a material which needs to be cut to the shape of the limb, such as plywood, place the normal limb on the splinting material, draw outline of the limb including digits and cut. If using wood, cut a notch at the top of the splint (See Fig. 2) which will later be used to anchor the bandage as it is wrapped.

(2) Wrap the limb with abundant padding (e.g. rolled cotton) leaving digits exposed to observe any future swelling.

(3) Place splint material (e.g. tongue depressor, metal shoe, plywood) on the outside of the limb and fix to the padding with adhesive tape. (See Fig. 3)

(4) Reduce the fracture and place a bandage of even pressure (e.g. Vetrap, Coban, roll gauze) over the length of the splint. The bandage is then covered with adhesive tape. (See Fig. 3)

5.3 SCHROEDER-THOMAS SPLINT (Figs. 6 through 10). This is a walking splint with an elliptical ring encircling the limb and rods extending to the bottom of the foot. A modified Thomas splint is altered to fit the shape of the animal's limb and type of fracture. This splint is used to reduce and fix appropriate fractures of any limb bone, although many veterinarians do not recommended its use for young animals or for femur or humerus fractures due to the possible pressure placed on these bones by the ring. A disadvantage of the Thomas splint is the likelihood of joint stiffness. Materials used include aluminum splint rod, Johnson and Johnson combine bandage, rolled cotton and adhesive tape. Bolt cutters or hack saw will cut the aluminum rod. Bailing wire can also be used in place of aluminum rod for small animals. NOTE: This splint requires a precise amount of tension for successful fusion. The instructions which follow are purposely general in nature and application of the treatment requires special training.

(a) The elliptical ring is formed, padded and taped, and angled to closely resemble the size and shape of the limb at the body (See Fig. 6). An assortment of presized, graduated rings of rubber which can be slipped on the uninjured leg will aid in finding the right size from which to form the

aluminum ring. The rods are bent at the appropriate angle for the fracture to be treated and cut to fit (See Figs. 7 and 8). Numerous modifications may be made to suit the length and shape of the limb. Adhesive tape is wrapped around the rods in a wide spiral with the adhesive side out. This prevents slippage of the bandage applied as described below.

(b) Slip the ring onto the limb up to the body.

(c) Reduce the fracture and attach combine bandage to the rod adjacent to the non-fractured bone as shown by the arrows in Figs. 7 and 8. Wrap the bandage around the bone as shown in Fig. 9, creating the tension necessary to maintain traction, and tape firmly in place.

(d) Loosely wrap combine bandage in the region of the fractured bone.

(e) Apply a smooth coating of adhesive tape to the entire splint. (See Fig. 10)

(f) Apply an aluminum rod stirrup to the foot to protect the splint. (See Fig. 10)

(g) Powder the underside of the ring daily and palpate the limb through the tape to detect swelling, especially in the area of the hock and carpus.

5.4 CASTS. Setting time for casts depends on the type of casting material chosen. For example, "extra-fast-setting" plaster becomes firm in 2 to 4 minutes (e.g. Specialist Ultra Fast Setting Plaster Bandage, Johnson and Johnson), and fast-setting plaster becomes firm in 5 to 8 minutes (e.g. Zoroc Resin Plaster Bandage, Johnson and Johnson).

The animal should be given general anesthesia to allow proper reduction and immobilization of the fracture while the treatment is applied. A stockinette is placed over the limb and the fracture reduced. The limb is well padded with two layers of cast padding and four layers over the pressure points. Plaster of Paris is rolled onto the limb, leaving the third and fourth toes exposed to check for swelling or inflammation. Lengthwise strips may be added for additional support. An X-ray and check for swelling should be made 24 hours after application and re-X-raying every 1 to 3 weeks thereafter for the period of treatment.

Plaster casts must be kept dry. An aluminum stirrup may be placed over the foot to reduce damage to the plaster caused by walking.

Removal of the cast may be done by a cast cutter (vibrating saw) and a cast spreader. The animal should be anesthetized during removal.

5.4a *Split Cast* (Fig. 5). Use of a split cast (an unpadded Plaster of Paris cast which can be removed and replaced as needed) eliminates the use of a cast cutter. It cannot be used for large mammals and works best on the fore-limb rather than the heavily muscled hindlimb.

This cast is formed by first running a continual dry plaster strip along the caudal and cranial surfaces of the limb. This measured length is then doubled four or five times to form multiple layers of plaster. Cut a notch at midpoint in the strips and roll each end toward the center notch. Submerge the rolled bundle of strips in warm water, squeeze out and apply by unrolling each part of the bundle onto the caudal and cranial surfaces of the leg, including the toes. Additional layers of plaster strips may be added for further strength. The plaster is loosely fixed in place by spirallying gauze bandage around the limb. The lengthwise edges of the plaster should be rounded and smoothed as the fracture is reduced. After the plaster has dried, the gauze is discarded and the cast removed by cutting at the notch. Place wide adhesive strips on the cranial and caudal surfaces of the foot, the cranial strip extending longer than the caudal. The longer

cranial strip will attach the caudal portion of the cast to the foot. Repositioning of the fracture may be necessary when replacing the split cast on the limb. Elastic bandage is applied with even tension over the entire treatment and adhesive tape wrapped over the bandage. (See Fig. 5) A metal stirrup may also be used.

5.5 PINNING (Internal or Surgical Fixation). A veterinarian will X-ray the limb, reduce the fracture and apply one of the following three techniques:

(1) An intermedullary pin inserted at the joint into the bone shaft. Since bacteria may form where the pin protrudes, a topical antibiotic and sterile dressing should be applied and changed as needed. Intermedullary pinning may also be used in conjunction with a cast (See Sec. 5.4), or a "half" Kirschner (see below).

(2) A Kirschner apparatus consists of 4 pins inserted in the bone from the outside, 2 pins in each portion, (a "half" Kirschner consits of 2 pins, 1 in each portion) with an external pin attached between them. Since this treatment protrudes externally, proper confinement (See Sec. 4) should be free from hazards which may entangle the treatment.

(3) A metal plate placed internally along side of the fractured bone with screws placed at the areas of shattered bone. This treatment requires reopening the incision for removal of the plate.

Each treatment should be re-X-rayed. Fusion generally occurs in six to eight weeks.

6. Healing Time and Post-treatment Rehabilitation

Healing time will, of course, vary for each animal depending on the extent of injury. In general, young animals mend in approximately 3 to 8 weeks; older animals in approximately 6 to 8 weeks. Fractures should be re-X-rayed approximately one week after applying the treatment to evaluate fusion and bone alignment, and again when the treatment is removed to determine if a hard, solid callous indicating good calcification has formed.

Every rehabilitated animal should be released back into its appropriate habitat as soon as possible. Certain injuries warrant post-treatment exercise and observation prior to release to ensure adequate strength and use of the injured area. Any injury which might potentially impair the animal's ability to secure food or defend itself against predators would require such an observation period.

7. Solutions to Practice Examples

1. $350\ \cancel{g} \times \frac{\cancel{Kg}}{1000\ \cancel{g}} \times \frac{15\ \cancel{mg}}{\cancel{Kg}} \times \frac{cc}{30\ \cancel{mg}} = .175$ cc
   . 35 cc total daily dose

2. $9.5\ \cancel{lb.} \times \frac{2\ \cancel{mg}}{\cancel{lb.}} \times \frac{\cancel{ml}}{50\ \cancel{mg}} \times \frac{cc}{\cancel{ml}} = .38$ cc

3. $1127\ \cancel{g} \times \frac{\cancel{lb}}{454\ \cancel{g}} \times \frac{25\ \cancel{mg}}{\cancel{lb}} \times \frac{tab}{50\ \cancel{mg}} = 1.24$ tab ($1\frac{1}{4}$ tab)
   3 3/4 tabs total daily dose

ACKNOWLEDGMENTS

The bulk of information contained in this article was gleaned from the years of practical experience of several rehabilitators and veterinarians. My sincere thanks and appreciation once again to Gary Bogue, Kathy Hobson and Cheryl Reynolds for their continued willingness to provide knowledge, reference materials and editorial comments in the preparation of this article. In addition, I also wish to thank Tom Williams, D.V.M., Jan White and Jay Holcomb for contributing their time and knowledge regarding this topic. Thanks also to Joel Parrott, D.V.M. for his helpful comments on the information presented here.

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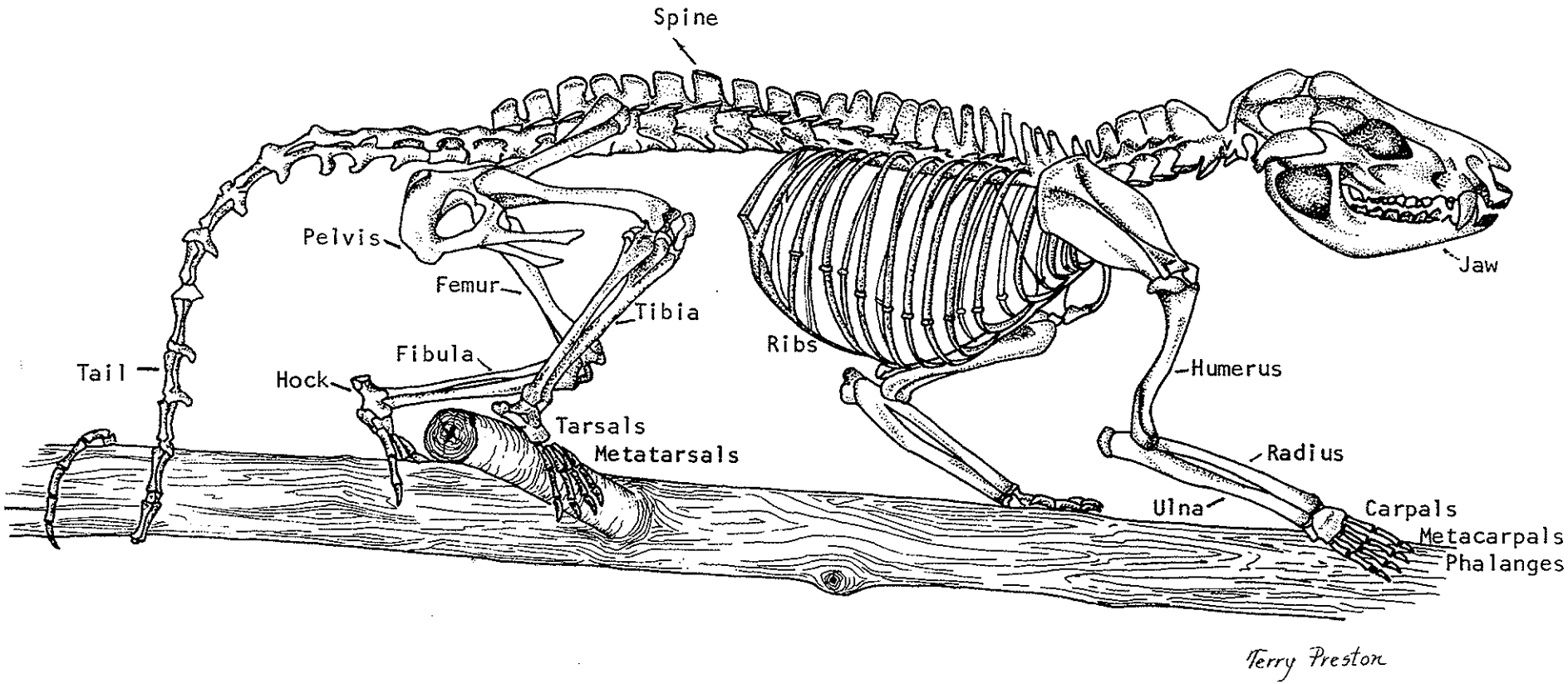


Fig. 1
Opossum Skeleton
(*Didelphis marsupialis*)

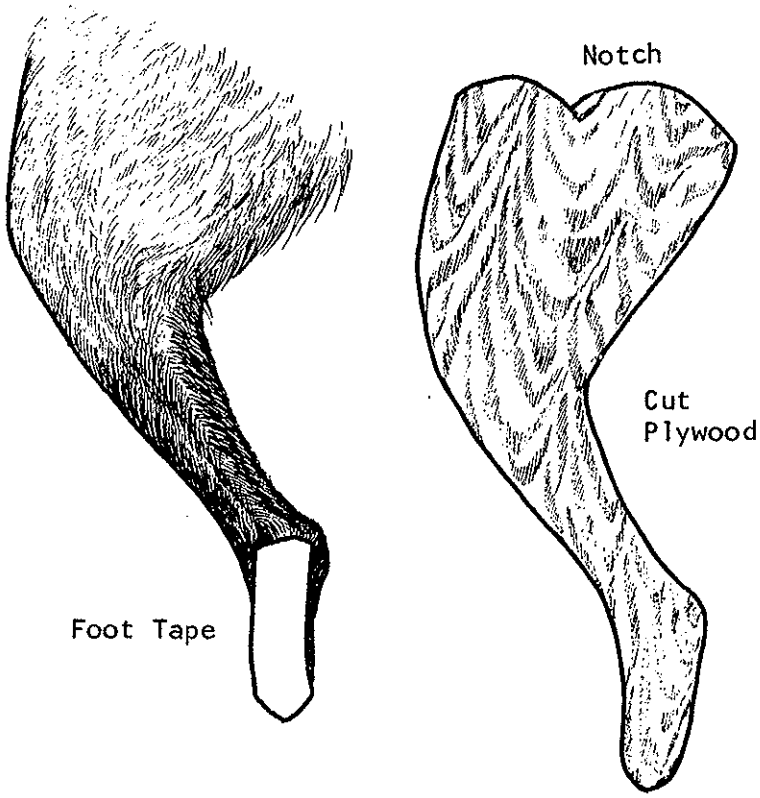


Fig. 2
Coaptation Splint
(Sec. 5.2)

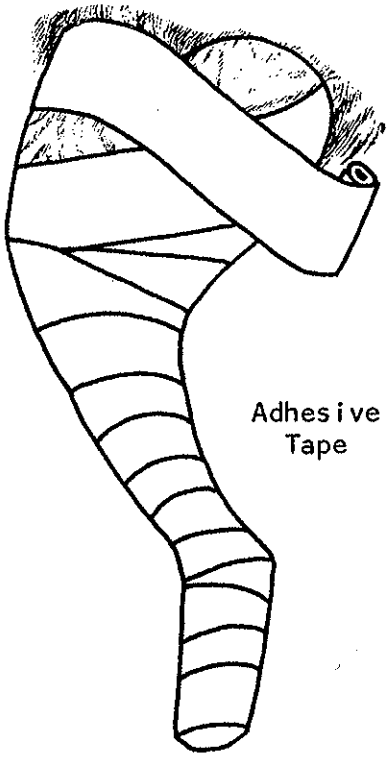


Fig. 3
Coaptation Splint
(Sec. 5.2)

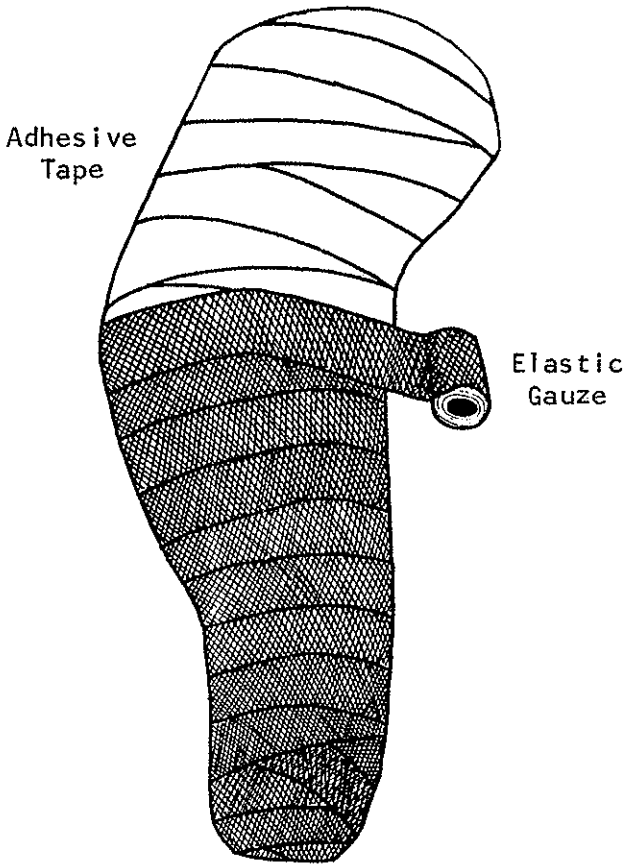


Fig. 4
Robert Jones Bandage
(Sec. 5.1)

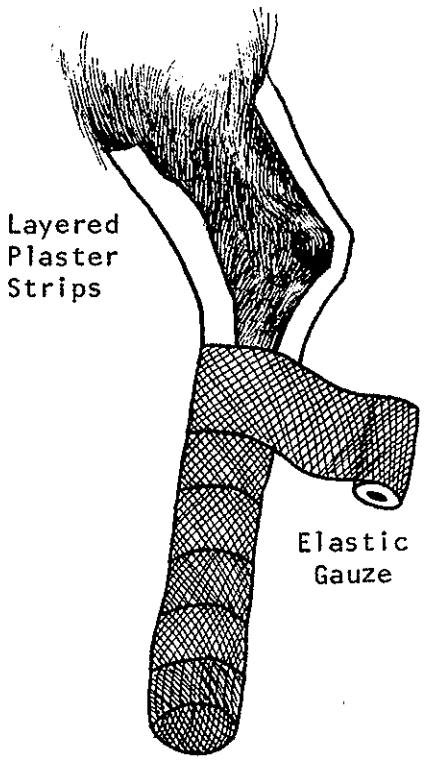


Fig 5
Split Cast
(Sec. 5.4a)

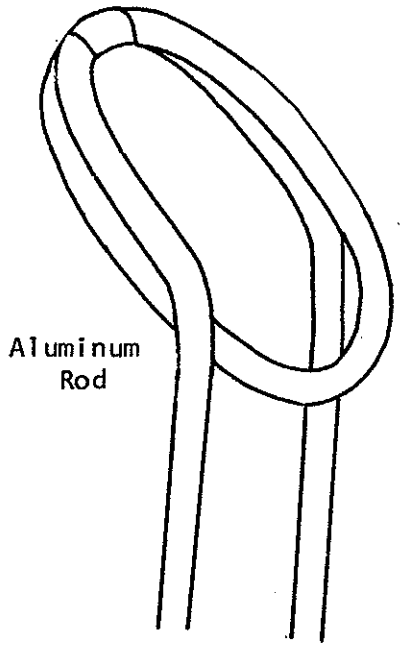


Fig. 6
Schroeder-Thomas Splint
(Sec. 5.3)

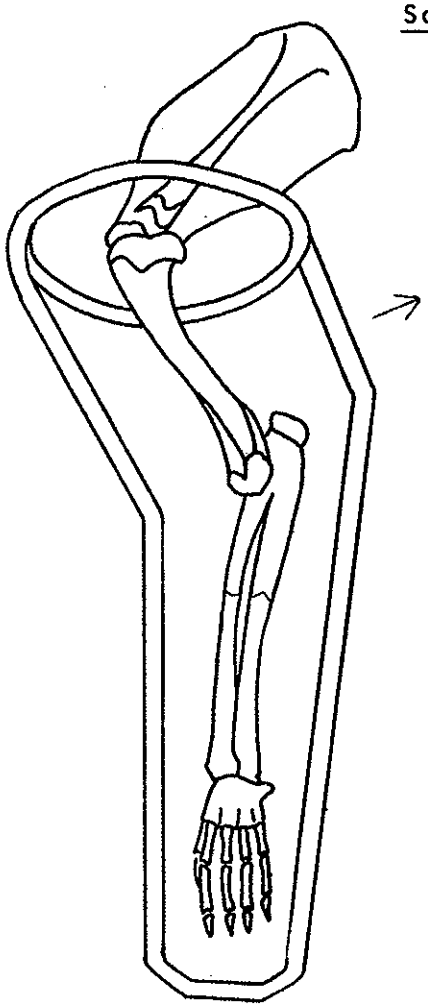


Fig. 7
Schroeder-Thomas Splint
Forelimb Splint

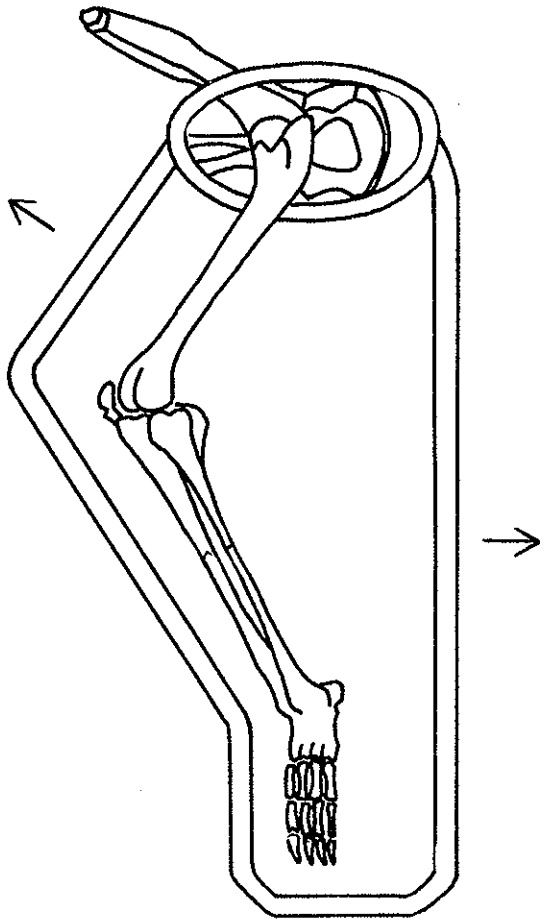
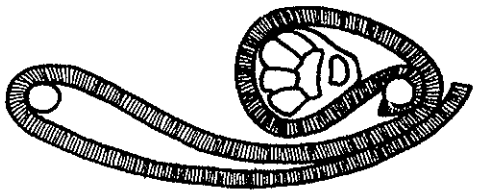
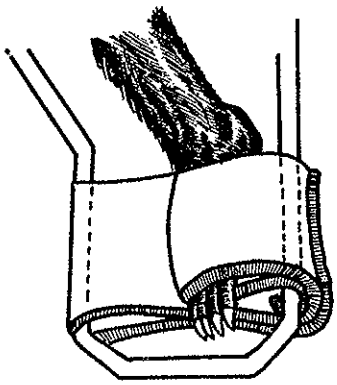


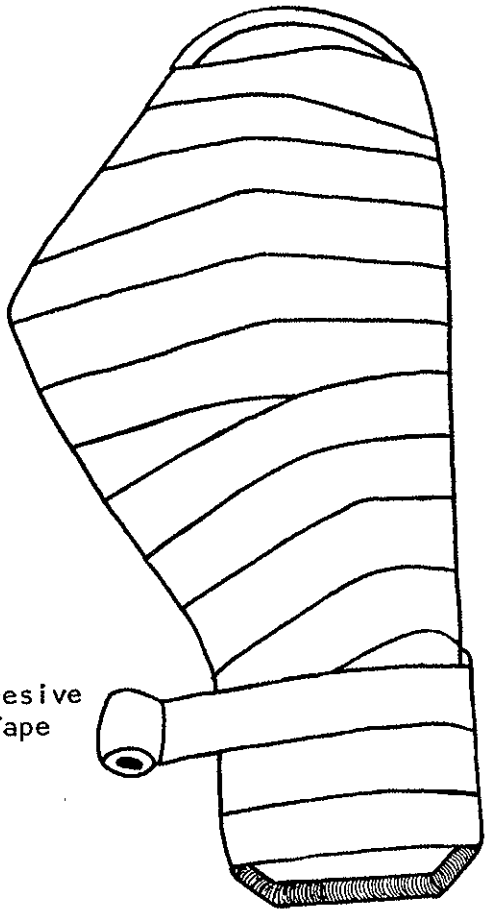
Fig. 8
Schroeder-Thomas Splint
Hindlimb Splint





Combine
Bandage

Fig. 9
Schroeder-Thomas Splint
(Sec. 5.3)



Adhesive
Tape

Fig. 10
Schroeder-Thomas Splint
(Sec. 5.3)

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This issue of the Wildlife Journal is small so that we could send you Immobilization of Simple and Compound Fractures in Mammals by Victoria Welsh. The next issue will return to its normal format. Additional copies of Victoria's article may be ordered from WRC for $2.00 postage included.

NON-RELEASABLE
SANDHILL CRANES SOUGHT

The San Francisco Zoo is interested in developing an exhibit of non-releasable Sandhill Cranes. The birds must be cosmetically exhibitable. Any group or individual wishing to place a non-releasable Sandhill Crane with the Zoo should contact:

Dr. Saul Kitchener, Director
San Francisco Zoological Society
Sloat Blvd. at the Pacific Ocean
San Francisco, CA 94132
(415) 661-2023

The Zoo will also pay for all shipping charges. Any questions regarding this should be directed to Dr. Kitchener.



Illustration by Sylvia Feder