

# Flaying, Curing and Measuring Crocodile Skins

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CROCODILE farming and rearing operations within Zimbabwe have been described by Child (management programme; Chapter 6), Hutton and Van Jaarsveldt (farming and rearing; Chapter 31) and Foggin (diseases and their control; Chapter 36). Through a ranching and to a lesser extent captive breeding programme, Nile crocodile (*Crocodylus niloticus*) eggs are collected, incubated under artificial conditions, and the young are raised in captivity until they are at an optimum size for skin production.

The commercial viability of rearing stations is ultimately dependent on the revenue derived from skins, as most farms are located in remote areas without tourism as a subsidiary source of income. Maximizing that revenue is thus of obvious importance to individual farmers, but it is also important to Zimbabwe, and to its crocodile skin industry as a whole. This can be achieved through improved marketing; and the production of a uniformly presented, high-quality, crocodile skin product, is one method through which marketing can be improved.

Recognizing this, the Crocodile Farmers' Association of Zimbabwe prepared a protocol for each stage in the preparation of skins, and encouraged all commercial rearing stations to use it, within reason, on all crocodile skins destined for export. The guidelines cover flaying, curing, measurement, grading and packing for transportation. Most rearing stations are now complying with these guidelines, and as a consequence, marketing has become more efficient and successful.

The guidelines that apply to *C. niloticus* in Zimbabwe will not be completely transferable to all other species, in other parts of the world. However, they address problems encountered in the preparation of crocodilian skins in general, and give the best or at least most practical solutions to them, so far derived in Zimbabwe. In this way, they may assist others developing their own methodology for maximizing the value of crocodilian resources. If

there is a single conclusion that can be drawn from the Zimbabwean experience, it is that *extreme* care is needed in all stages of crocodile skin preparation — the final value of a crocodilian skin can be greatly reduced by poor or casual management during skin preparation.

## TYPES OF SKIN

As discussed by Brazaitis (Chapter 38), the skins of some species of crocodilians are not well suited to the production of high quality leather, and only small pieces of body skin (for example 'flanks') may commonly enter trade. In contrast, the skin of *C. niloticus* is regarded as a "classic" skin, in which whole skins enter trade, in one of two forms; "hornback" or "belly" skins (Fig. 1). Skins produced in Zimbabwe are almost all belly skins, which aim to maximize the uncut area of the regularly arranged scales on the ventral surface of the animal. The guidelines provided in Zimbabwe are based largely on the production of belly skins. Hornback skins are occasionally produced and aim to present the dorsal scalation of the crocodile's back, as an attractive feature of the finished leather product. Some aspects of hornback skins are discussed here.

## FLAYING

The factors which affect the efficiency of curing, and thus the quality of the final cured product, do not begin with the curing process itself, but rather with the method of removing the skin from the carcass — flaying. They are also affected by the way in which the skin is handled in the immediate post-mortem period, and correct procedures at this time are essential for maintaining high quality.

The final shape of a skin and the characteristics of the "pattern" area on it (Fig. 1), are of far greater importance in the marketplace than is generally recognized, and these are determined largely by the cuts made during flaying. The "cutting" value of the

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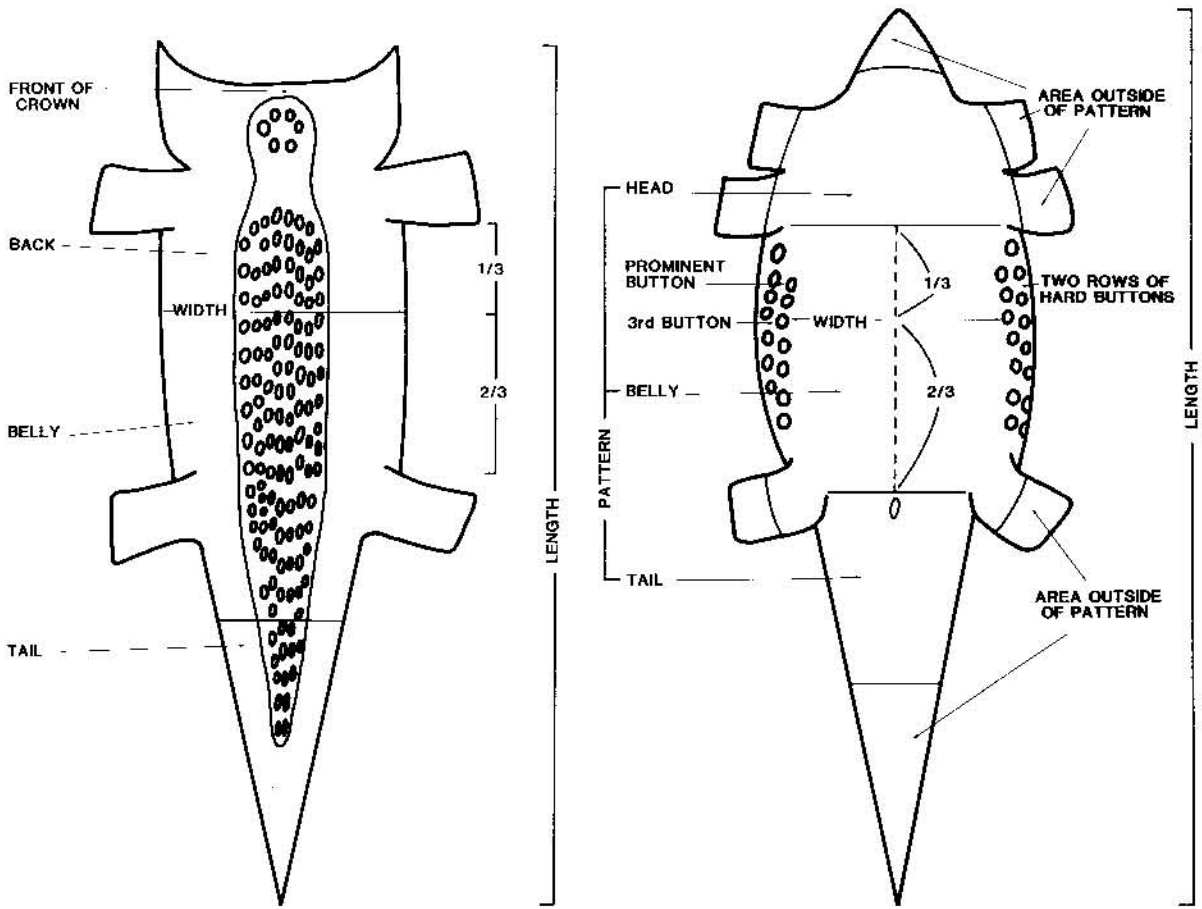


Fig. 1. Diagrams of a hornback (left) and belly skin (right) of *Crocodylus niloticus* with features used in both the measurement and grading of skins. The "pattern" of a belly skin is subdivided into head, belly and tail sections.

final, finished leather, made from a single skin, depends upon the way in which the first cuts or "opening lines" have been made on the carcass.

#### Opening Lines

Opening lines for belly skins, which are along the legs and sides of the abdomen (flanks), should be made in such a way as to maximize the square area of skin produced. Within Zimbabwe, these lines have been standardized in the following way:

1. The main opening lines are cut around the enlarged, bony neck scales (crown; nuchal cluster or crest) on the back of the animal, and down the flanks of each side, such that two distinct rows of enlarged dorsal scales (Fig. 1) remain on the belly side of the cut line, on both sides. The cuts are then extended down to the end of the tail, along the lateral base of the raised, dorsal, tail scales.
2. The opening line for the neck and head section is from the middle, anterior edge of the crown (nuchal cluster), in a straight line to the back of the skull. The cut is then extended laterally along the rear margin of the skull, following the jaw line under the head, and along the margins of the "chin" or gular area, to the end of the snout.

3. The opening lines for each foreleg extend from the back of the animal in a straight line along the top of the foreleg to the feet, and then around the limb in a circle level with the last joint in the wrist area.
4. The opening lines for each hind leg are cut again from the back of the animal in a straight line down the top of the leg, and around the limb in a circle level with the last joint in the ankle area.

#### The Flaying Procedure

The flaying procedure extends from the culling and killing of a crocodile (carried out with a 0.22" bullet in the head in Zimbabwe) to the skinning and scraping operations which precede curing. The following protocol and recommendations are made:

1. Culling should be done early in the morning or late in the afternoon, when temperatures are lowest (especially in summer). Only the number of animals that can be comfortably handled in a skinning session should be culled and killed.
2. Killing should be done where the blood can drain freely, to ensure that as little blood as possible comes into contact with the skin.

3. Make the correct opening lines on the animal.
4. Use the flaying knife sparingly and with care. Flay cuts and marks are easily inflicted and the effect of such damage on the quality, and hence market value, of the skin is very significant (see "Grading").
5. Skinning should take place immediately after killing, while the carcass is still warm, as this facilitates removal.
6. After removal from the carcass, and before curing, the skin should be allowed to cool for perhaps fifteen minutes, in a place that is clean, shaded and off the ground.



Fig. 2. Scraping excess fat and meat from the skin is essential for effective curing.

7. At all times the skin should be kept away from blood, manure, entrails or soil, which either contain bacteria or provide a medium for bacterial growth (Fig. 2). Putrefaction of skins and meat can result from excessive bacterial contamination.
8. Should a skin become badly contaminated with blood, manure or the like, remedial action should be taken as soon as practical. In its simplest form, the skin can be placed on a concrete floor, sprinkled with water and washed with a broom. However, ideally it should be washed in a tank of water containing antiseptic; for example sodium pentachlorophenate (PCP) or zinc chloride (both at 0.5 kg per 50 l of water).
9. Crocodile skin contains layers of flesh and fat, which need to be removed, without damaging the skin. Blunt knives or scrapers over scrubbing boards or concrete are the recommended methods (Fig. 3). If not removed, fat and flesh interfere with the penetration of salt and the removal of water during curing. Furthermore, if a skin heats, fat can be released from fat cells left on the skin, and this can penetrate the skin itself. This in turn impedes fat removal during the



Fig. 3. During all phases of the flaying operation, skins and animals are regularly washed to prevent contamination.

leather manufacturing process and may result in grease stains on the finished leather.

10. Crocodile meat for human consumption is not a by-product currently utilized in Zimbabwe, although it could be in the future. If so, the complete flaying operation may need to be carried out under more stringently controlled, hygienic conditions. In the U.S. (see Joanen and McNease Chapter 4; Hines and Abercrombie Chapter 5) and Thailand (see Suvanakorn and Youngprapakorn Chapter 33), the value of crocodilian meat is a significant consideration when assessing the overall value of a crocodile or alligator.

#### *Factors to Avoid During Flaying*

Although the factors listed above can be achieved in slightly different ways, by different operators, there are some things that should be specifically avoided:

1. Culling and killing should not be prolonged operations. In addition to the moral issues involved, swift selection and killing of animals ensures that the skin is not damaged by unnecessary stress, struggling and spasmodic movements on rough ground.
2. Avoid culling and killing in hot sunshine, and never leave skins exposed to the sun after removal from the carcass.
3. Avoid using opening lines of convenience in preference to those recommended.
4. Flaying knives should only be used where it is not possible to pull the skin from the carcass.
5. After flaying skins should not be placed on soil or anywhere where there is blood, manure or entrails.
6. Skins should not be folded immediately after flaying, but rather be given a short time to cool in shade.

## CURING

Crocodile skins are the basic raw materials from which expensive fashion items are created. The purpose of curing a skin is to preserve its protein-fibre structure in such a way that the tanner can restore it to something like its original state, before he commences his tanning operation.

As skins must be stored prior to shipment and may spend weeks in transit, curing must be good enough to preserve the structure of a skin for considerable periods. Curing of all types of skins is normally based on the economics of the skin being processed. The cost of curing a high value crocodile skin properly, is not a significant component of the preparation cost.

Curing methods aim to remove *most* of the water from the skin (dehydration), which is normally achieved by saturation with salt (sodium chloride). Salting also retards most bacterial growth and hence is largely responsible for preserving the skin. However, curing does not aim to completely dehydrate skins. If dried below about 15% water content, skins become brittle, may suffer from grain cracking (skin between scales cracks), and are difficult to rehydrate ("wetting back") during tanning.

Skins can decay rapidly if left exposed in air for more than a few hours between flaying and curing, and it is extremely important that this be avoided. No amount of late curing can rectify damage caused by decomposition, nor can it compensate for the monetary loss to both the owner and to the local crocodile industry.

### *Curing Methods*

Perhaps the safest curing method, and that used in Zimbabwe, is wet-salting. The method is used where there is a well ventilated curing shed, with a well drained, impervious floor upon which the skins can be salted and stacked as follows:

1. Skins are laid flat, flesh side up, on the impervious floor or on a wooden-slatted platform at least 6 cm from the floor. They are then completely covered with clean, dry salt equivalent in weight to at least 50% of the weight of the freshly flayed skin.
2. Skins are stacked, either on top of one another to build a single stack, or in an overlapping fashion to form a square stack, but always with the flesh side upward.
3. Skins are retained in such stacks for a *minimum* of 48 hours.

On completion of curing, measuring and grading, it is recommended that skins be refrigerated (not frozen) until such times as they can be shipped.

### *Red Heat*

When skins are kept in the wet-salted condition for too long, either in stacks or when rolled, "red heat" may develop, especially in hot and humid weather (see David Chapter 40). As the name implies, it manifests itself as red to orange patches on the flesh side of the skin, and is caused by a bacteria which colours as it grows (chromogenic). The bacteria responsible for red heat is able to grow in the presence of salt (halophilic). However, the absence of red heat does not necessarily mean that the skin is free of bacterial growth. Other halophilic bacteria, which do not colour, can grow in wet-salted skins. Red heat can thus best be interpreted as an indicator of bacterial growth.

In Zimbabwe, red heat is largely avoided through careful attention to hygiene during flaying, and by reducing storage times at ambient temperature to a minimum. However, it can be prevented by treating the skin with antiseptic chemicals; for example, naphthaline flakes (1%) and boric acid (1%) added to the salt (98%). The mix needs to be both carefully calculated and well homogenized to be effective.

## ASSESSING A SKIN

The standard way of describing each wet-salted crocodile skin, so that both sellers and buyers know exactly what is being offered and received in the marketplace, is to supply information on size (measurement) and quality (grading). These are approached in different ways in different countries and by different tanners (see Ashley and David Chapter 41). The standardized approach taken in Zimbabwe is outlined below.

### *Measurement*

For measurement, skins are laid flat on a table, and are smoothed but not stretched. All measurements are made in the metric system, with width expressed in centimetres and length in metres.

#### 1. *Bellies*

Belly skins are measured by both width and length.

The measurement of width is made at a point about  $\frac{1}{3}$  of the distance between the neck line (Fig. 1) and the cloaca. The actual measurement of width is made between the two inside edges of the prominent, bony scales or "horns", and thus excludes the width of the horns themselves (Fig. 1).

The measurement of length is made between the anterior and posterior tips of the skin, and is thus the total length of the skin (Fig. 1). The length of the skin

may be reduced by shrinkage when it is stored, and lengths may need to be understated by up to 4%, depending on how fresh the skin is when it is measured.

## 2. Hornbacks

Hornback skins are also measured by both width and length.

The measurement of width is made at a point  $\frac{1}{3}$  of the distance between the forelegs and hind legs, from the anterior end (Fig. 1), and is the total width of the skin at this point. The measurement of length is the total length, as for belly skins.

## Grading

Wet-salted skins are assessed according to a variety of features which ultimately affect both the quality of the finished leather and the uses to which it can be put in the eventual manufacture of products. Each skin is eventually classified as either: *first grade*; *second grade*; *third grade*; or, *reject*. The features considered during grading are:

1. Effectiveness of preservation;
2. Shape of the skin;
3. Effectiveness and quality of flaying;
4. The numbers, extent and location of any scars, cuts, scratches and holes (lumped as "cut-holes"), which are subdivided into two types depending on the size and location of defects:

*Type 1.* The diameter of the hole is less than 10 mm or the width and length of a cut does not exceed 5 mm and 20 mm respectively.

*Type 2.* The diameter of the hole is 10-20 mm or the width and length of a cut does not exceed 5 mm and 40 mm respectively.

5. The extent of osteoderms or "buttons" in the scales.

### 1. Bellies

The skin is divided into "pattern", and the area outside of the "pattern" (Fig. 1). The "pattern" itself is divided into the three main areas, which in order of importance are: belly, head and tail (Fig. 1).

### First Grade

The skin should be fresh and well preserved and its flesh should have been removed completely from the underside during flaying. It should be full sized with four legs and two rows of hard horns (scales

with osteoderms from the lateral surfaces) on both sides. It should not have any cut-holes, nor buttons. A skin with one or two *Type 1* cut-holes outside the pattern, are acceptable as *first grade*.

### Second Grade

A skin which would meet the criteria for *first grade*, except for one and occasionally two of the following:

- i.* One *Type 1* cut-hole on the belly, but the head and tail are clear of cuts, holes etc.;
- ii.* One *Type 1* cut-hole on the head and tail, but the belly is clear of cuts, holes etc.;
- iii.* Scales lifting (scale slip), but only on five or six scales in any one location within the pattern;
- iv.* The tail section is short, but more than one half remains;
- v.* One leg is missing; or,
- vi.* There are one or two buttons within the pattern.

A skin with any two of conditions *i*, *ii* or *v* above is not acceptable as *second grade*.

### Third Grade

Normally a skin which would meet the criteria for *second grade* except for one and occasionally two of the following:

- i.* One or two *Type 1* cut-holes within the pattern;
- ii.* One *Type 2* cut-hole on the belly;
- iii.* One *Type 2* cut-hole on the head and one on the tail sections of the pattern;
- iv.* Scales lifting (scale slip), but on less than one-fifth of the total skin area;
- v.* More than two legs missing;
- vi.* The tail section is short but more than a quarter remains; or,
- vii.* There are between two and ten buttons within the pattern.

With the exception of *iv*, a skin which has any two of the conditions listed above will not be accepted as *third grade*.

### Reject

Skins which are not acceptable as *third grade* and/or which are not fresh, nor well preserved (ammonia smell; spongy texture), are reject skins.

## 2. Hornbacks

The hornback skin is divided into three main areas (Fig. 1), which in order of importance are: back (horny part including the nuchal crest or crown); belly (on both sides of the back); and, tail.

### First Grade

The skin should be fresh, well preserved and have all flesh removed completely from the underside. It should be of full size, have four legs and no cut-holes. There should be at least 2 cm of skin in front of the crown (nuchal cluster) region.

### Second Grade

Skins which would be acceptable as *first grade*, except for one and occasionally two of the following:

- i.* One *Type 1* cut-hole on the back;
- ii.* One *Type 1* cut-hole on the belly and on the tail;
- iii.* The front of the skin is separated from the front of the crown by less than 2 cm;
- iv.* Scales lifting (scale slip), but only on five to six scales in any one location;
- v.* The tail is short, but at least one half remains;
- vi.* One leg is missing;
- vii.* Horns on the back are generally low in profile, or rows of horns are in disorder;
- viii.* The centre of the crown (nuchal cluster) deviates from the midline, but by not less than 1 cm left or right; or,
- ix.* The crown is oblong in shape and/or has a deformed arrangement of bony scales.

Skins that have any two of conditions *i, ii, vii* and *ix*, are not acceptable as *second grade*.

### Third Grade

Skins which would be acceptable as *second grade* except for one and occasionally two of the following:

- i.* One *Type 2* cut-hole on the back or belly;
- ii.* Scales lifting, but on less than one-fifth of the total skin area;
- iii.* The centre of the crown deviates between 1 and 2 cm either to left or right;

- iv.* The tail is short, but at least one-third remains;
- v.* More than two legs are missing.

Skins which have any two of conditions *i, ii, iv* and *v*, are not acceptable as *third grade*.

### Reject

Skins disallowed as *third grade* and/or which have extremely low horns, and/or which are not fresh nor well preserved (ammonia smell and/or spongy appearance) are reject skins.



Fig. 4. In addition to the export tag, the details of the size and quality of each skin are attached to it.

### ROLLING AND PACKING

Once measured and graded after curing, skins are rolled tightly, starting from the tip of the head section. Only the four legs are folded inwards, and special care is given to ensuring plenty of salt in this region. The three pattern areas referred to should definitely not be folded such that the flesh sides contact each other. The skins are tagged, and the individual measurements are included on a separate tag which is fixed to the skin (Fig. 4).

Skins are packed into damp hessian-lined, wooden boxes, in numerical order. The lids are sealed, secured with metal strapping, and the boxes stored under refrigeration prior to shipping.