



Research Article

## USES OF BIRDS FOR ETHNOMEDICINE AMONG THE MAASAI PEOPLE IN MONDULI DISTRICT, NORTHERN TANZANIA

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### ABSTRACT

**Background:** The use of birds for ethnomedicine is not well documented, particularly in Africa. The purpose of this study was to understand how birds are used for Traditional Medicine (TM) among the Maasai people.

**Methods:** Data on the use of birds for TM was collected on the Maasai people through informal and structured interviews. Maasai elders, traditional doctors, and Laibons were interviewed to get information on ethno medicinal uses of birds. The information collected included; the bird species used, part of the bird used, the mode of preparation and administration and, and availability of the species. The Fidelity Level (FL%) and Informant Consensus Factor (ICF) were calculated to determine the perceived availability of bird species and common ailments treated using birds.

**Results:** Birds in sixteen bird orders were said to be used for curative purpose and fifteen bird orders were used for spiritual healing. Ciconiiformes and Struthioniformes were commonly used for curative purposes, while Passeriformes and Ciconiiformes were mostly used for spiritual healing. Curative treatments were administered mainly in the form of concoctions, while in spiritual treatments the whole bird was used. Bird species were said not to be readily availability for either curative or spiritual use.

**Conclusion:** It is evident from this study that birds play an important role in healthcare among the Maasai people. Future studies should focus on analysis of the active bioactive chemicals in the parts and products of birds used for curative purposes

**KEYWORDS :** Medicinal uses of bird species Maasai people

### INTRODUCTION

Today more than half of the modern drugs are derived from biological resources. It is estimated that 80% of the world's population depend on natural animal and plant based medicines [1]. In particular cultures of the world,

birds are important for TM [2] For instance in India, birds represent the second most important animals for TM [3] and thirty-one species of birds have significant value for TM [4]. In Chhindwara, India seven species of birds are used for TM; House Sparrow (*Passer domestica*), Domestic Fowl (*Gallus gallus*), Jungle Fowl (*Gallus Sonnerati*), Pea Fowl (*Pavo cristatus*), Cattle Egret (*Bubulcus ibis*), Common Myna (*Acridotheres tristis*),

Pigeon (*Columba livia*). The ash of the feather of Pea Fowl (*Pavo cristatus*) are used to stop diarrhea, but in comparison the people of Saharia, India Pea Fowl (*Pavo cristatus*) feather are used to treat infertility [5]. In Spain, were records from the 14<sup>th</sup> century Tresor de Beutat show how four different birds species; Hen (*Gallus gallus domesticus*), Pigeon (*Columba livia*), Crow (*Corvus sp*), Goose (*Anseranser*), and Swallow (*Hirundo rustica*) were used for medical or cosmetic purposes. For treatment the bird's eggs, eggshells, feathers, bones, blood, feces, and nests were often used [6]. Thirdly, throughout Brazil fifty-four bird species were used for TM [4]. Specifically, in northeastern Brazil, birds are the most frequent animals used among folk medicine. Eleven bird species: White-bellied Nothura (*Nothura boraquira*), Black Vulture (*Coragyps atratus*), Red-legged Seriema (*Cariama cristatus*), Plain-breasted Ground-Dove (*Columbina minuta*), Ruddy Ground-Dove (*Columbina talpacoti*), Scaled Dove (*Columbina squammata*), Picui Ground-Dove (*Columbina picui*), White-tipped Dove (*Leptotila verreauxi*), Cactus Parakeet (*Aratinga cactorum*), White-naped Jay (*Cyanocorax cyanopogon*), and Chalk-browed Mockingbird (*Mimus saturninus*) were all used for curative and spiritual purposes [7]. In twenty-five African countries, 374 species of birds are used for TM. Of these 374, 306 were sold in markets in Mozambique, Malawi, South Africa, Swaziland, Zambia, Nigeria, Chad, Guinea, and Niger [4]. Specialist healers like the Maasai's laibon, Meru's mugaa, Luo's and Luhya's muganga, Arab's toubib, Twareg's marabouts, and Beni-Amer's measr are all known to rely heavily on birds to treat various ailments [8]. For example, many species of vultures (*Gyps sp.*) are used by the healers to help treat headaches and provide clairvoyant powers to people [9]. Likewise, in Tanzania and Kenya, the African Ground Hornbill (*Bucorvus leadbeateri*) is used for various spiritual and social practices [10,11]. The specific objectives of this study were to determine bird species use for treatment of ailments among the Maasai, the type of ailments treated, how the medicine is prepared and administered. This study is critical to enhancing understanding the the role of birds in TM across Africa.

## MATERIALS AND METHODS

### Study Area

The study was undertaken in the wards of Esilalei, Losirwa, and Eselela, Monduli District, Arusha Region in northern Tanzania. The area is semi-arid savannah [12]. The average annual rainfall is about 650 mm [13]. The area is rich in wildlife diversity with about 350 bird species [14]. It is home to Maasai people [15]. The Maasai people are traditionally livestock pastoralists, whose cultural lifestyle is strongly tied to livestock [12]. The Maasai have close interaction with the environment and wildlife on their land has remained relatively intact.

### Data Collection

Eighteen-detailed semi-structured interviews were undertaken with members of the Maasai people in Monduli district. The author 2 together with a translator conversant with Maasai language (Maa) conducted

interviews with specialist groups assumed to be more knowledgeable on Maasai culture. These were elders, traditional doctors (wanganga) and traditional healers/leaders (laibon). The laibon is the traditional medical and spiritual healer of the Maasai, who protects members of the community from illness and misfortune [6]. The elders in the Maasai are highly respected and possess great wealth of knowledge on the tribe [10]. The Maasai traditional doctors are highly regarded and are consulted for various medications. To ensure that the bird species in discussion was correctly identified, a field guide on birds was used to confirm the species with the respondent [16]. When a specific bird species was reported to treat an ailment, information on the; ailment treated, the bird part or product used, mode of administration, dosage and availability were recorded. The perceived availability of the bird was based on a ranking system; 1- highly available, 2-moderately available, and 3- rarely available.

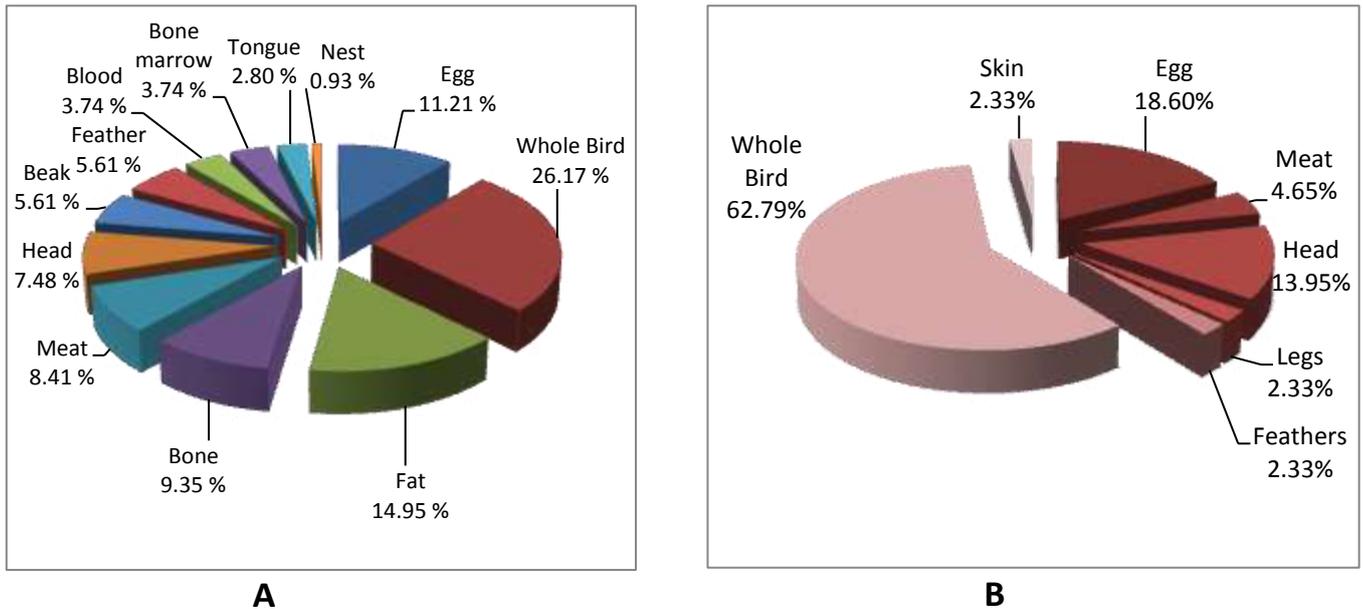
### Data Analysis

Bird taxonomic grouping was undertaken [17] and checklist of the birds used developed. A checklist of birds and bird parts was used. The availability of birds for treating various ailments was determined as the informant consensus factor (FIC) through the formula,  $FIC = \frac{nur-nt}{nur-1}$ . Where, nur is the "number of use-reports" in each disease category and nt is the number of taxa used [18]. A measurement of the percentage of times a particular bird was mentioned for ethnomedicinal use was calculated as Fidelity Level (FL). Fidelity Level (FL%) =  $(\frac{Np}{N}) \times 100$ , where, Np is the "number of informants" that cited the use of a bird order to treat a particular ailment and N is the "number of informants" who cited that bird order use within a treatment of all ailments [19]. A chi-square goodness of fit was used to compare the remedy effectiveness responses.

## RESULTS

### Important Medicinal Uses Of Bird Species For Human And Livestock Treatment

A total of 239 species were said to be used for TM. There were 158 bird species reported to be used for curative purposes and 96 for spiritual purposes. Ciconiiformes (23.3%), Struthioniformes (21.7%) and Galliformes (14.7%) were used for curative purposes, while Passeriformes (31.7%), Ciconiiformes (19.5%), and Gruiformes (7.3%) were said to be used for spiritual healing purposes. Various bird products and parts such as bone, blood, eggs, fat, head, tongue, beak, feathers, meat, and legs were reported for ethnomedicinal use (Figure 1A and 1B). However, the whole bird was mainly used for spiritual healing (63%) compared to curative purposes (26%). The most common medicinal diseases treated using birds were skin diseases (FIC; 1.00) and respiratory system diseases (FIC; 0.78). Fevers, gynecological problems, childbirth, infectious diseases, snakebites, Sexually Transmitted Diseases (STDs), urinary tract diseases, and livestock health were rarely treated using birds. The most common spiritual uses was said to deal with bad luck (FIC;0.75), to prevent miscarriages (FIC;0.5), to bring rains (FIC;0.5), and to change wealth matters (FIC;0).

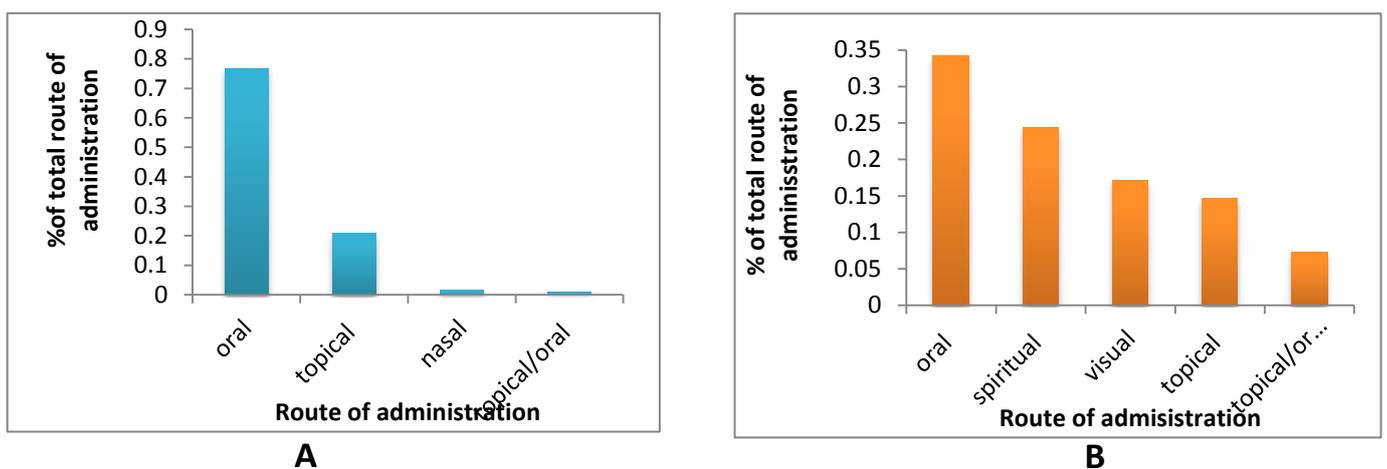


**Figure 1:** The use bird for curative (A) and spiritual healing (B).

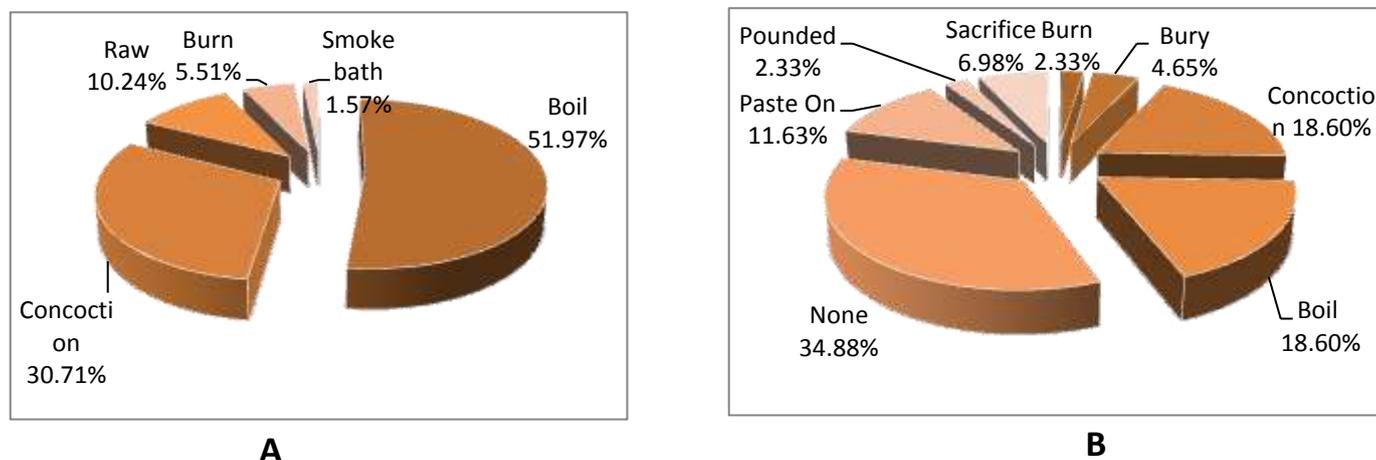
**Mode Of Preparation, Form Of Use, Dosage And Effectiveness**

Ailment treatments were mainly orally administered 76.8% (Figure 2A) and 34.1% for spiritual treatment (Figure 2B). 20.8% of the time curative treatments were administered topically, while for spiritual 14.6% of the time topically administered. Each remedy had a unique preparation, form of use, and dosage. Tuberculosis was treated with medicine that was prepared in 8 different ways and using 38 different bird species (Table 1). For spiritual healing, bad luck had 5 procedures with 26 different birds species (Table 2). Depending on the ailment the administration of treatments differed between curative and spiritual treatment.

**Figure 2:** The percent of type of administration for curative (A) and spiritual healing (B)



The majority of the curative ailments birds were prepared by boiling, 51.97% (Figure 3A). Whereas, spiritual healing did not include preparation and visual signs and auditory sounds of the birds were used for the majority of ailments, 34.88% (Figure 3B). The respondents viewed the treatments of various ailments to be moderately effective ( $P < 0.01$ ) for both spiritual and curative medicinal purposes.



**Figure 3:** Form of use for curative (A) and spiritual healing (B)

**Table 1:** Use of bird species used for medicinal ailments

Disease	Common animal	Part/product used, preparation, and administration
Anemia	White Stork	Remove the beak, burn into ashes, add several pinches to 1L of water, and drink. 1x a day for 4 days
	Carmine Bee-Eater	Burn tail feathers and head into ash, make an incision (close to the top of the ear), and directly apply ash to incision..
Arthritis	Purple Swampphen	Burn the beak into ash, make incision where arthritis is occurring and directly apply. Prepared by Laibon.
	Ostrich	Roast the bone, cut both ends off, filter the bone marrow out, fat removed. Drink 2 tsp for 2 days..
Asthma	Chicken	Mix yolk egg with goat milk. Drink 1 cup. 1X per day for 2-3 days.
	Chicken	Whole egg is eaten raw; add pinch of sodium carbonate.
	Ostrich	Lowaa (Ngesi) small fruit is dried, grinded into a powder, and mixed with boiled fat. Consume 1 spoonful for 6 days, 1x per day.
	Kori Bustard	Cook and eat whole egg.
	Ostrich	Boil fat into a liquid. Drink 1 tsp 2x a day until cured.
	Ostrich	Separate egg yolk from egg white. Drink 3 tbs of yolk + 1 cup milk (cow).
Back pain	Ostrich	Cook and eat whole egg..
	White-faced scops owls	Burn egg shell into ash and mix the ash (4 pinches) with 1L water. Then drink 1L + 4 pinches of ash for 4 days.
	Large Plovers & Small Plovers	Break the whole bird into pieces, boil it, and eat.

Blood Pressure	Wood-Hoopoes & Scimitarbills	Burn 2 tongues into ash, prepare 1L of fresh water, add 2 pinches of ashes to the water, and drink 1L of water..
	African Darter	Boil birds meat and + mix with other medicine and eat.
	Malachite sunbird, Scarlet- Tufted Malachite sunbird	Burn beak into ashes, and take 2 pinches mix with herbal medicine and mix with water, stir together, drink 1 cup. 1X per day for 4 days
	Olive Woodpecker, White-Starred Robin	Burn tail feathers into ash, add ashes to 1L of water, and drink 1L of water
	Long-Tailed Widowbird, Jackson's Widowbird	Burn tail feathers into ash, then add 2 pinches of ash into 5-6L of water, reserve 1/2 cup of the water to drink after sweating. Boil water. Wrap patient with several shukas around the boiling water, inhale steam and make sweat..
Bone cancer	Rufus Bellied Heron	Break whole bird into pieces, boil it, and eat
Bone Growth	Chicken	Whole egg is eaten raw; add pinch of sodium carbonate.
Bone/ Blood Cancer	Honeyguides & Honeybirds	Break bones and boil with meat, and eat.
Bronchitis	Chicken, ostrich	Mix 1/2 tsp of sodium carbonate into fat or egg and eat.
	Chicken	Eat whole egg.
	Kori Bustard	Boil and eat whole egg.
	Ostrich	Boil fat into a liquid. Drink 1 tsp 2x a day until cured.
	Ostrich	Separate egg yolk from egg white. Drink 3 tbs of yolk + 1 cup milk (cow).
	Ostrich	Boil and eat whole egg.
	Ostrich	Boil and eat whole egg..
Cancer	Ducks, Coursers, Pratincoles, & Thick-knees	Break the whole bird into pieces, boil it, and eat.
	Kori Bustard	Boil and eat whole egg
	Red-Bellied Paradise Flycatcher, Hybrid Red-Bellied X African Paradise Flycatcher, African Paradise Flycatcher	Burn whole head into ashes, place ashes into incision near area of cancer.
	Ostrich	Boil and eat whole egg..
	Black Headed Heron	Break the whole bird into pieces, boil it, and eat.
	Barbets	Prepare a soup using the whole bird and eat 1L.
	Barbets	Prepare a soup using the whole bird and eat 1L.
Child Growth	Ducks, Coursers, Pratincoles, & Thick-knees	Break whole bird into pieces, boil it + mix with other medicine and eat
	Secretary Bird	Boil fat into a liquid and drink.
	Hammerkop	Cook whole head, combine with milk or food to drink/ eat.
Cold & Flu Cough	Ostrich	Remove the yolk of the egg. Drink 1/4 L of egg white.
	Kori Bustard	Boil and eat whole egg
	Ostrich	Boil and eat whole egg.
	Chicken	Eat whole egg.
	Ostrich	Boil fat into a liquid. Drink 1 tsp 2x a day until cured.
Cough (children)	Ostrich	Separate egg yolk from egg white. Drink 3 tbs of yolk + and 1 cup milk (cow).
	Chicken	Remove the egg white and add salt to egg yolk. and eat
Deafness	Ostrich	Boil fat into a liquid. Place one drop into ear canal.



Delivery (pregnancy)	Goliath Heron	Break whole bird into pieces, boil it, and eat.
Diarrhea	Chicken	2 feathers burned and grinded into ash, mixed with blood. Drink feather ash + 3 teaspoons of blood, 1X.
	Cuckoos	Prepare a soup using the whole bird and eat 1L. Then after 3-4 hours eat another 1L..
Dry coughs as baby	Chicken	Mix with sodium carbonate with egg yolk. Eat for 2X per day for 2 days.
	Chicken, ostrich	1/2 tsp of sodium carbonate mixed with fat or egg. Eat. 1X
Ear Ache	Ostrich	Fat is boil and pour into ear. 2X (a.m. & p.m.)
Ear Deafness	Large Plovers & Small Plovers	Break whole bird into pieces, boil it, and eat.
Ear Infection	Greater Flamingo	Break the end of the bone, pour out the bone marrow into a small container, pour 1/4 tsp into ear with infection
	Chicken	Boil fat into a liquid. 1 droplet for 3 days - 1x (per day)
	Ostrich	Boil fat into a liquid. Place 1 drop in ear (1X), every morning for 3 days
	Ostrich	Boil fat into a liquid, use chicken feathers to soak up oil and place in ear (2 drops)
	Ostrich	Pour the bone marrow out of the bone after killed. Pour in ear with infection until filled.
Ear Infections (children)	Chicken	Boil fat and pour fat into both ears, 1/2-1 tsp for 6 days
Elephantiasis	Flying Sparrowharks, Chanting Goshawks, Pygmy Falcons, Harrier, Falcons & Kites Overhead	Burn the bones into ashes, combine with whole egg and cut a small insertion into the body and apply directly..
Epilepsy	Secretary Bird	Burn the feathers, in order to release a smoke. Inhale smoke.
	Giant Kingfisher, Pied Kingfisher	Burn the head and beak into ash and then cut a small incision with a razor near both collar bones and wrists. Then take a pinch of ashes mixed with Laibon herbal medicine and directly add the ash to the incision. 1x.
	Diederick Cuckoo	Burn the nest, in order to release a smoke inhale
	Long-Tailed Widowbird, Jackson's Widowbird	Remove the tail feathers, burn into ash, then add 2 pinches of ash into a pot of water (5-6L), reserve 1/2 cup of the water to drink after sweating. Then make water come to a boil. After wrap patient with several shukas (Maasai Blanket) around the boiling water, so they can breathe in the steam and start to sweat.
Fever	Eastern Grey Plantain-eater, White Bellied Go-Away Bird, Great Blue Turaco, Ross's Turaco, Hartlaub's Turaco, Purple Crested Turaco	Prepare meat into a soup. Eat. Prepared by Laibon.
Fever (children)	Chicken	Separate egg yolk from egg white. Eat egg yolk
Glandular swellings	Flying Sparrowharks, Chanting Goshawks, Pygmy Falcons, Harrier, Falcons & Kites Overhead	Burn the bones into ashes, combine with whole egg and cut a small insertion into the body and apply directly. Prepared by Laibon.
Gonorrhoea	Small Sandpipers	Break the whole bird into pieces, boil it, & eat. Prepared by Laibon.
Headache	Secretary Bird	Consume 1 egg plus 1-cup tea. 2x per day; morning and evening
	Red-Winged Starling, Bristle-Crowned Starling, & Slender-Billed Starling	Burn the bones into ashes, combine with whole egg and cut a small insertion into the body and apply directly. Prepared by Laibon.

Heart attack	Eagles, Buzzards, Other Raptors in Flight	Boil whole egg, add additional medicine, and eat..
	Hornbills	Prepare a soup using whole bird, Drink 1L
Infertility (female)	Rufus Bellied Heron	Break whole bird into pieces, boil it, & eat.
	Malachite sunbird, Scarlet- Tufted Malachite sunbird	Burn beak into ashes, take 2 pinches + herbal medicine and mix with water, stir together, drink 1 cup. 1X per day for 4 days.
	Double-Toothed Barbet	Prepare a soup with meat, bones + additional medicine - (only use if Red-Yellow Barbet did not work). Eat.
Internal Pain	Red and Yellow Barbet	Prepare a soup with meat, bones + additional medicine. Eat
	Chicken	Eat 1 raw egg
Kwashiorkor	Chicken	Boil 1 whole egg. Eat.
Livestock Health	Secretary Bird	Fat boiled into a liquid. Eat.
Malaria	Rufus Bellied Heron	Break whole bird into pieces, boil it, & eat
	Sandpipers, Shanks, Phalarope, Godwits, Curlews, Ruff, Turnstone, Large Pied Waders, Snipe, Painted Snipe, Gallinule, Rails, Jacanas, Finfoot, Crakes & Flufftails	Break whole bird into pieces, boil it, & eat
	Eastern Grey Plantain-eater, White Bellied Go-Away Bird, Great Blue Turaco, Ross's Turaco, Hartlaub's Turaco, Purple Crested Turaco	Prepare meat into a p and drink.
	Shrikes	Burn whole head, then patient comes close to the fire.
	Blue Swallow, Mosque Swallow, Rufous-Chested Swallow	The head is used if the disease is brought upon you through another person (cursing). Prepared by Laibon.
	Woodpeckers	Prepare a soup using whole bird and eat 1L
	Chicken	Boil 1 whole egg. Eat.
Mal-nutrient children	Parrots & Lovebirds	Boil bones and meat together and eat. (Helps to bring back to normal mental state). Prepared by Laibon.
Mental Illness	Small Sandpipers	Break whole bird into pieces, boil it, & eat.
Orchitis	Heuglin's Courser, Cream-Coloured Courser, Spotted Thick-Knee	Burn tongue into ash, make an incision into temple (right above the ear), and directly apply.
Parkinson's Disease	Buzzards, Accipiers, Chanting Goshawks Overhead, Large Raptors	Rub the eggs and blood and+ additional medicine all over body. .
Pimples	Chicken	Boil egg and eat
Pneumonia	Kori Bustard	Cook and eat whole egg..
	Ostrich	Boil fat into a liquid. Eat 1 tsp 2x a day until cured.
	Ostrich	Separate egg yolk from egg white. Drink 3 tbs of yolk + 1 cup milk (cow)..
	Ostrich	Cook and eat whole egg..
	Wood-Hoopoes & Scimitarbills	Burn 2 tongues into ash, prepare 1L of fresh water, add 2 pinches of ashes to the water, and drink 1L.
Pregnancy (good health to mother)	Ducks, Coursers, Pratincoles, & Thick-knees	Break whole bird into pieces, boil it, & eat
	Kori Bustard	Cook and eat whole egg.



Rashes	Ostrich	Cook and eat whole egg.
	Buzzards, Accipiers, Chanting Goshawks Overhead, Large Raptors Overhead	Rub the eggs and blood+ additional Laibon medicine all over body
Ringworm	Buzzards, Accipiers, Chanting Goshawks Overhead, Large Raptors Overhead	Rub the eggs and blood+ additional Laibon medicine all over body.
Sleeping sickness	Flying Sparrowharks, Chanting Goshawks, Pygmy Falcons, Harrier, Falcons & Kites Overhead	Burn the bones into ashes, combine with whole egg and cut a small insertion into the body and apply directly.
Snake Bite	Kori Bustard	Bone is burned, roasted and grinded bone in two a powder. Cut out area with snake bite. Topically add 1 tbs directly in cut and orally consume of water combined with 1 tbs of powder
Stomach ache	Goliath Heron	Break whole bird into pieces, boil it, & eat
	Cuckoos	Prepare a soup using whole bird, eat 1L and then after 3-4 hours eat another 1L.
Stroke	Malachite sunbird, Scarlet- Tufted Malachite sunbird	Burn beak into ashes, take 2 pinches + herbal medicine and mix with water, stir together, drink 1 cup. 1X per day for 4 days.
Syphilis	Small Sandpipers	Break whole bird into pieces, boil it, & eat.
Tuberculosis	Great White Pelican	Remove bone marrow by boiling the bone. Then combine with other Laibon medicine. Eat..
	Chicken	Eat whole egg.
Typhoid Fever	Kori Bustard	Cook and eat whole egg..
	Eastern Grey Plantain-eater, White Bellied Go-Away Bird, Great Blue Turaco, Ross's Turaco, Hartlaub's Turaco, Purple Crested Turaco	Prepare meat into a soup. Eat.
	Ostrich	Boil fat into a liquid. Drink 1 tsp 2x a day (a.m. & p.m.) until cured.
	Ostrich	Separate egg yolk from egg white. Drink 3 tbs of yolk + 1 cup milk (cow). Prepared by Laibon.
	Ostrich	Boil and drink whole egg. Prepared by Laibon.
	Sandpipers, Shanks, Phalarope, Godwits, Curlews, Ruff, Turnstone, Large Pied Waders, Snipe, Painted Snipe, Gallinule, Rails, Jacanas, Finfoot, Crakes & Flufftails	Break whole bird into pieces, boil it, & eat. Prepared by Laibon.
	Kori Bustard	Cook and eat whole egg.
	Ostrich	Cook and eat whole egg.
	Eastern Grey Plantain-eater, White Bellied Go-Away Bird, Great Blue Turaco, Ross's Turaco, Hartlaub's Turaco, Purple Crested Turaco	Prepare meat into a soup. Eat.
	Goliath Heron	Break whole bird into pieces, boil it, & eat.
Typhoid Fever	Shrikes	Burn whole head, then patient moves close to the fire. Prepared by Laibon.
	Blue Swallow, Mosque Swallow, Rufous-Chested Swallow	The head is used if the disease is brought upon you through another person (cursing).

Unhealthy children & elders	Tinkerbirds, Small woodpeckers & Wrynecks	Prepare a soup using whole bird. Eat 1L
	Honeyguides & Honeybirds	Break bones and boil with meat, and eat.
	Sandpipers, Shanks, Phalarope, Godwits, Curlews, Ruff, Turnstone, Large Pied Waders, Snipe, Painted Snipe, Gallinule, Rails, Jacanas, Finfoot, Crakes & Flufftails	Break whole bird into pieces, boil it, & eat.
	Chicken	Eat raw whole egg.
Urinary Infection	Cuckoos	Prepare a soup using whole bird; eat 1L, after 3-4 hours eat another 1L. Prepared by Laibon.
Water Born Disease	Great Egret, Yellow-Billed Egret	Burn beak it into ash; apply pinches of ash into 1/2-1L or water. Drink
	Mountain Yellow Warbler, Dark-Capped Yellow Warbler	Catch bird- must be alive or freshly killed. Prepare 2-3 L of fresh cow milk and place into a Cape buffalo horn. Add 2 pinches of herbal medicine to milk, place bird in milk, have children drink a small amount of milk.

**Table 2:** Use of birds for spiritual Purposes

Spiritual use	Common animal	Part/product use and preparation
Bad Luck/Cause disease	Flycatchers & Shrike-Flycatchers	If these birds land on/or sit on livestock it will lead to infection.
	Bush Strikes	A person drinks the same water of these birds, causes infection or death.
	Orioles	If bird touches human skin it leads to infection or wounds where it touched.
	Thrushes	If this bird touches skin it leads to infection or rashes where it touched.
Bad luck	Black Crowned Crane	Presence of the bird in Boma will lead to death of livestock.
	Magpie Sterling	If bird seen near livestock, then it is believed to bring danger or death.
	African Pitta	If the bird dies within boma will lead to death of livestock.
Witchcraft	Common Drongo, Velvet-mantled Drongo, Square Tailed Drongo	If bird lands in Boma and if the Laibon says specific words, then death of livestock may result.
	Common Tern	Sacrifice the bird to bring to death a person.
	Bateleur	Sacrifice the bird to bring to death a person.
	Flying Sandpipers & Plovers	Kill whole bird, break it into pieces, and combine with other ingredients. Eat. Brings death to another Laibon.
General Disease Treatment	Nightjars	Whole bird is cooked by Laibon and placed strategically to negatively affect someone.
	Owls	Break and spread the egg over whole body of a human.
	Wahlberg's Eagle	Tell the Laibon what disease patient wants cured and then he cracks the egg to help cure disease.
	Chanting Goshawks, Hieraaetus & Sparrowharks	Cook meat and eat.
	Martial Eagle, Plate 40 (1-6), Plate 44-46	Cook whole egg and eat (preferably 2 eggs)
	Swifts	Cook the meat and eggs together with in a soup, then orally consume.
	Shrikes	Burn the head in a fire and then the patient comes close to the fire..
African Skimmer	Rub the egg all over body, then boil the head & eat.	

Good luck	Greater Flamingo	Break whole bird into pieces, boil it + combine with other medicine, and eat.
	Lesser Flamingo	Break whole bird into pieces, boil it + combine with other medicine, and eat.
	African Sacred Ibis	Break whole bird into pieces, boil it + combine with other medicine, and orally consume.
	Blue-naped mousebird, Speckled mousebird	Remove tail feathers and place them into calabash, holding honey alcohol. After splash the person/livestock with the feathers holding the alcohol to bless them.
	Kori Bustard	Cook whole egg and eat.
	Ostrich	Cook whole egg and eat.
	Streptopella Doves, Pigeon & Doves	If bird is seen, then it brings good luck.
Increase in Wealth	White-browed coucal	Break whole bird into pieces, boil it, orally consume & rub it all over body. Increases luck for marriage.
	Tinkerbird	Prepare a soup using whole bird. Eat.
	Marabou Stork	Cook the head and eat.
Repel Curse	Golden Pipit, Longclaws, Pitta & Broadbill	Break whole bird apart. Rub all over body.
Infection Prevention	Woodpeckers	Rub the whole bird body all over entire body. Only for treatment of Laibon
Bring Rainfall	Bulbul, Bristlebill, Leaf-Love, Large Greenbuls & Nicator	Birds are located near water sites shows a sign of rainfall. Used to determine if water will come or not come.
	Grey crested Helmet Shrike, White-Crested Helmet Shrike, Chestnut-Fronted Helmet Strike, Retz's Helmet Shrike	The noise/call of these birds used to show that rain is coming.
	Southern Ground Hornbill	Hang dead bird in area of drought, Laibon will then beat it with a gourd (filled with water and other ingredients).
Increase Livestock	Glossy Starlings	Kill the whole bird and place/hang in the living area of livestock.
	Lesser Black-Backed Gull	Bury the legs into the ground near location of livestock.
	African Skimmer	A person will rub the egg all over body, then boil & eat the head. Increases livestock reproduction.
	Marabou Stork	Boil head and eat. Prepared by Laibon. Leads to increase in livestock.
Personal Security	Fischer's Turaco, White Crested Turaco	Break the whole bird into pieces, boil it, and eat. Then people causing patient pain or trouble will forget all about the problem.
	White-Winged Apalis	Skin the bird (thin membrane), dig a hole in the middle of the entrance to boma, place the skin in the hole fat, then draw two straight lines of other herbal medicine (2 pinches) on the skin, then bury the skin with dirt.

Falconiformes, Piciformes and Ciconiiformes for TM is common [4]. Skin care,

## DISCUSSION

The results of this study show that the Maasai extensively use bird species for TM, even though bird availability for ethnomedicine was limited. The TM for the Maasai is divided into curative treatment, the physical treating a disease or sickness, and spiritual healing, the symbolic significance of a species for the purpose of predicting good luck, bad luck, rainfall, or use in witchcraft [10]. Ciconiiformes, Struthioniformes, and Galliformes were commonly used for curative treatment. This is similar to other African countries, like Mozambique, Nigeria, the Congo, South Africa, and Zimbabwe where the sale of Passeriformes, Galliformes, Columbiformes,

respiratory system diseases, and head diseases were the most common ailments treated using birds. Comparatively, Ciconiiformes, Struthioniformes, and Galliformes are highly used for treating ailment across the world [20, 9, 21]. For spiritual remedies, birds in Passeriformes, Ciconiiformes, and Gruiformes were highly mentioned. Ciconiiformes, like vultures (*Gyps*), hammerkops (*Scopus umbretta*), and cattle egret (*Bubulcus i. ibis*), along with passeriformes, like African pied wagtails (*Motacilla aquimp vidua*), are used for spiritual remedies, taboos, or witchcraft [10]. Unlike other studies the Maasai do not commonly use Southern ground hornbills (*Bucorvus*

*leadbeateri*), Vultures (*Gyps*), or Bateleur Eagles (*Terathopius ecaudatus*) [4]. These species have been recorded as being sold among TM markets throughout southern African and are commonly used for medicinal or spiritual treatment. In particular, the Southern ground hornbill (*Bucorvus leadbeateri*) are commonly found in the spiritual treatment among the taveta people in Kenya and AmaXhosa people in South Africa [21]. Common spiritual healing included bad luck and rainfall, of which Passeriformes and Gruiformes were highly noted as being used for treatment. In contrast to other countries and tribes, Passeriformes and Gruiformes are rarely used from spiritual healing [10, 22]. In this study, many parts of the bird, including the whole bird, eggs and fat were used for both medicinal and spiritual purposes. Relating to this study eggs, fat, and feathers were found as common uses for TM among different regions of the world. For example, TM in Feira de Santana City, Brazil people often uses the fat of chickens for healing boils [23], while in Tsinghai, China chicken eggs were vastly cited for the treatment of the digestive problems, gonorrhoea, and prevention of miscarriages [24] and then in India the feathers of Indian Peafowl (*Pavo cristatus*) are highly common in treating diarrhoea and dysentery [5].

While the Maasai may not know the biochemistry behind the uses of bird parts and products, however, they rely on knowledge of ethnomedicinal functions of birds to be passed down orally from one generation to the next [25]. It is interesting that some bird products and parts used traditionally are of pharmaceutical importance today. For example, ostrich fat contains polyunsaturated fatty acids (PUFA), omega 9 (oleic), omega 6 (linoleic) and omega 3 (linolenic), and essential fatty acids (EFAs) relevant to the treatment of skin diseases, burns, and sores [26]. On the contrary to this study, ostrich fat was not used for any skin care ailments but mainly use for chest and head diseases among the Maasai. Bird eggs hold a high level of nutrients [27], therefore; the use of ostrich and chicken eggs represents how successful the treatment is for child/infant development, respiratory diseases, and pregnancy. Specifically, omega 3 fatty acids (EPA and DHA), choline, lysozyme, and ovotransferrin are all important components of the egg that help to heal or improve the conditions of child/infant development, chest diseases, and pregnancy [28].

Spiritual healing is strongly based on symbolic characteristics of a bird species. For example, the colors red, black, and white along with body size strongly influence the use of that species for spiritual healing or witchcraft. The large dominate predator size and red, black facial coloration of Southern Ground Hornbills (*Bucorvus leadbeateri*) and Bateleur eagles (*Terathopius ecaudatus*) are the characteristics why healers choose those species in particular for TM [21]. Unlike this study, within other southern African countries the use of Southern Ground Hornbill (*Bucorvus leadbeateri*) and Bateleur eagles (*Terathopius ecaudatus*) [4] are commonly used for spiritual healing among many countries [21]. Along with physically characteristics, the calls, and the visuals of particular species during a specific time of the year represent particular outcomes. Among the Maasai the call of an owl, a strigiforme, within the boma means that a member of the boma will die or suffer from misfortune. In

other studies within Kenya and Jamaica owls symbolize death and bad luck and are a common species used for witchcraft [22, 4]. Sightings of other bird species at certain times of the year may be prediction of good or bad times. If southern ground hornbill (*Bucorvus leadbeateri*) is sighted, rains are likely to fail. Such a belief is common in in other tribes in Kenya [9].

Bird availability for ethnomedicine was limited. Besides chickens, all other species are wild birds that will need to be hunted. The Maasai Laibons prepared treatment for all ailments of spiritual treatments, along with some curative treatments. For the majority of the curative treatments traditional doctors and elders of the Maasai communities determine the treatment, preparation, and dosage of the particular disease. More than fifty percent of preparations for curative treatment involved boiling of the whole bird or specific derived parts. Burning or boiling are two common forms of traditional medicine preparation [29, 5]. The preparation for most spiritual healing did not have any preparations, and a visual or auditory of a particular bird species would represent a particular outcome. Spiritually healing generally used symbolic features of bird species; therefore preparation is not needed [30]. The main form of administration was as oral consumption. Oral consumption is highly common e.g healers in Kenya eat the brain of the vulture in belief that it creates stronger connection with the dead [9]. In Hei tsui tzy, Tsinghai-china egg white of a chicken (*Gallus gallus domesticus*) is eaten to help during child delivery [24]. Another frequent administration was topical application, This is constitutively with other studies e.g in India and Brazil, bird feathers are burned or oil from fat is spread on top of the infected or irritated areas [23, 29]. Dosage of medicinal and spiritual treatment all slightly differed from one ailment to another. Some treatments needed use of 1 teaspoon of oil, while another called for 1 spoonful of oil combined with other elements to heal the same disease. For example, to treat asthma an ostrich egg is used, but one prepares the egg by boiling and eating the whole egg, while the second preparation of the egg is by separating the egg yolk from the white, combining 3 tablespoons of the egg yolk with 1 cup of cow milk. Within other studies dosages have been mentioned at a minimum and preparation along with dosage strongly dependent on the region, culture, people, and disease [32]. The effectiveness of medicinal and spiritual treatments continuously resulted as extremely effective from Maasai members, to Laibon, to traditional doctors. The effective of treatment may result in biased if a standard judgment of effectiveness is not established. [33].

## CONCLUSION AND IMPLICATIONS

Among the Maasai people birds are important for ethnomedicine. The role of birds within traditional medicine holds high importance to the Maasai. Probably due to cultural reasons, limited availability, and high cost of modern health care. A wide range of birds was used to treat various illnesses for spiritual and medicinal purposes. This information is important for advancement of modern medicine as the the parts and products may yield curative pharmaceutical drugs if investigated. We recommend increased efforts to undersand the chemical derivative of the bird parts and products used for ethnomedicine among the Maasai. Several species, including the kori bustard

(*Ardeotis kori struthiunculus*), are listed under IUCN as near threatened [34, 25]. Their continued use for medicinal use may negatively affect these species. Future studies should focus on the effects of exploitation of bird species for ethnomedicine on the species population.

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#### AUTHORS' CONTRIBUTIONS

Dr. John Kioko who as well assisted Delaney Smith in the interviews designed this study. Dr. Christian Kiffner provided useful editor input. Delaney Smith did data entry. Data analysis and paper write up were undertaken by Dr. John Kioko and Delaney Smith.

#### COMPETING INTERESTS

The author attests that there are no competing interests in this study.

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