ABSTRACT
The main objective of the study is to review the practices of zootherapy among the ethnic groups of the northeastern part of India and to prepare an inventory of all the information. The data were collected from 11 published papers on the practices of zootherapy among different ethnic groups from the region. All the papers were published in the years 2002-2016. A total of 181 animals species are used by 19 ethnic groups from the region. Mammals are one of the most widely used animal groups followed by Arthropods, Aves, Pisces, Reptiles, Annelids, Amphibian and Molluscs. The number of the animal species are-77 species of Mammals (42.5%) followed by 65 species of Arthropods (35.9%), 24 species of Aves (13.25%), 22 species of Pisces (12.15%), 18 species of Reptiles (9.94%), 6 species of Annelids (3.31%), 5 species of Amphibians (2.76%) and 4 species of Molluscs (2.21%). The most commonly treated ailments are-Tuberculosis, Malaria, Diabetes, Asthma, Arthritis, Rheumatic pain, Jaundice, Anaemia, Paralysis, Pertussis, etc. This review on the zootherapy practices among the ethnic groups of the region will summarise all the information in one place which will be helpful for the scientists and researchers working in the field of ethnomedicine to study and develop new potential drugs.

Keywords: Ethnic group, Zootherapy, North Eastern India

INTRODUCTION
The use of plants and animals to treat different ailments has a long history. Worldwide, almost 70-80% of the rural population depends on traditional medicine for primary health care [1]. People have been using the plants and animals, or parts therapeutically since ancient time and even in the modern time animal and plant-based medicines continue to play an essential role in world health care sector [2]. Zootherapy is the use of animals and animal products to heal different human diseases [3]. Many wild and domestic animals and their by-products (e.g., skin, bones, blood, meat, hooves, feathers, tusks) from essential ingredients in the preparation of protective, preventive and curative medicine [4, 5]. WHO has selected 252 essential chemicals that can be used to treat different ailments, out of which 11.1% come from plants and 8.7% from animals [6]. In China, people are using more than 1500 animal species to treat different ailments in their traditional medicine [7].

In Japan, 60 different species of insects used to treat a wide range of ailments [8]. The Tamang people of Nepal, use by-products of 24 animals therapeutically [9]. In North Eastern Brazil, 180 medicinally important animals have been reported from Bahia state [10]. A report of the use of 250 animal species in traditional treatments of a variety of ailments in North Eastern Brazil is there [11]. People from Pakistan also use 31 substances derived from animals and products that constitute a 9% of all the inventory of traditional medicine in Pakistan [12].

In India, zootherapy to treat different ailments is widely used too. Mahawar and Jaroli inventoried approximately 109 animal species used in the treatment of different kind of ailments in India [13]. In Maharashtra, tribal group’s like-Bhilas, Gamits, Koknas and Pawaras have been using almost 15 species of animals as medicine in combination with different plant species [14]. In Tirunelveli district of Tamil Nadu, people use 11 insect species in traditional medicine [15]. In another study, it has been reported the use of 16 animal species including 6 mammals, 5 birds, 2 reptile, 2 arthropods and 1 annelid by nine ethnic groups in four districts from Tamil Nadu [16]. They treat almost 17 different ailments using those species of animals. The Bhil tribe of Rajasthan has also been found to use animals to treat different ailments of human beings and domestic cattle [17]. In Gujarat, Gupta et al. [18] recorded 34 animal species used by local communities of Kachchh district in the primary health care of human beings and live stocks. Mishra et al. [19] recorded the use of animal parts of 7 species of vertebrates to treat 12 different illnesses in the locals of Orissa.

In the northeastern part of India, zootherapy has been practising by different ethnic groups. This region has a total of 220 ethnic groups [Indian census, 2011] distributed in seven states viz., Assam, Meghalaya, Arunachal Pradesh, Manipur, Mizoram, Tripura, Nagaland and Sikkim contributing 3.8% of the total population of India. All the tribes have their own culture and they have their own indigenous method of healing for different ailments. In this review, 19 ethnic groups from the region viz., NK (Nath and Karbi), Ka (Karbi), B (Baiete), Mis (Mishing) from Assam, Mi (Tribes from Mizoram), Ao (Ao), Ang (Angami), Se (Sema), Sang (Sangatam), Khia (Khammungan), Non (Konjik), Ch (Chinbasang), Lo (Lotha), Zel (Zelang), Po (Pochury), Re (Rengma) from Nagaland, N (Nyiuh), G (Galo), Adi from Arunachal Pradesh are considered.

Mammals used by the ethnic groups
Mammals are one of the widely and commonly used groups of animals by the ethnic groups of North East India. A total of 77 species of mammals are being used by 9 ethnic groups from the region [19]. The mammalian species Hystrix indica (the Indian Porcupine) is the most commonly used species, and it is used by nine ethnic groups. The most commonly used parts are the flesh, Gall bladder, liver, etc. and the commonly treated diseases are cancer, asthma, diabetes, malaria, tuberculosis, rheumatism, fertility improvement, etc.

Aves used by the ethnic groups
Aves are also used by many ethnic groups from the region. A total of 24 species of birds are used by 17 ethnic groups to treat different ailments (Table 2). The most commonly treated ailments are rheumatism, normal body pain, asthma, paralysis, gall bladder stone. (the Crow Pheasant) is the mostly used species and it is used by 12 ethnic groups. Mostly used parts are the flesh, fat, etc.
| S. No. | Animal species                  | English name | Parts used (Ethnic group) | Ailment treated                              | References |
|--------|---------------------------------|--------------|---------------------------|----------------------------------------------|------------|
| 1      | *Enocysteris spelae*            | Bat          | Meat(NK)                  | Asthma                                       | [20]       |
| 2      | *Rhinceros unicornis*           | Rhino        | Urine, Skin, Horn(NK)     | Eneuresis, Diabetes                          | [21]       |
| 3      | *Hystrix indica*                | Indian Porcupine | Horn(Miz) | Anti-venom                                   | [22]       |
|        |                                 |              | Alimentary Canal(NK)      | Liver Diseases                               | [20]       |
|        |                                 |              | Spine, Small intestine, Stomach(Gh) | Tonsil                                      | [23]       |
|        |                                 |              | Stomach, spine(Ka)        | Bone fracture, Gastritis, Fever              | [24]       |
|        |                                 |              | Meat, Intestine, rectum(Miz) | Pneumonia, dysentery, stomach cramp         | [22]       |
|        |                                 |              | Galbladder, Stomach, Intestine(NG) | Facilitates easy birth labor, Fever, Stomachache, dysentery, Malaria, Colic | [25]       |
|        |                                 |              | Flesh(B)                  | Easy delivery of child                       | [21]       |
|        |                                 |              | Bile(Ao)                  | Dysentery                                    | [26]       |
|        |                                 |              | Pennis, Bile (Ka)         | Sexual impotence, Stroke, Dysentery          | [27]       |
| 4      | *Canis aureus*                  | Golden Jackel | Meat(NK)                  | Body ache                                    | [20]       |
|        |                                 |              | Bone(Adi)                 | Skin diseases                                | [22]       |
|        |                                 |              | Head(Miz)                 | Wound and Ulcers                             | [22]       |
| 5      | *Capra hircus*                  | Goat         | Milk(NK)                  | Leucorrhoea                                  | [20]       |
|        |                                 |              | Placenta(Ka)              | Leg Cracking’s, Piles                        | [24]       |
|        |                                 |              | Fresh milk (Miz)          | Snake bite                                   | [22]       |
|        |                                 |              | Gall bladder, Frontal (N) | Fever, early pregnancy pain                  | [25]       |
|        |                                 |              | Flesh(B)                  | Joint pain                                   | [21]       |
| 6      | *Bos indicus*                   | Cow          | Milk,Dung(NK)             | Jaundice, Leucorrhoea, Skin disease          | [20]       |
|        |                                 |              | Fresh urine(Ka)           | Anemia                                       | [27]       |
| 7      | *Plantanista gangetica*         | River dolphin | Oil(NK)                   | Female infertility                           | [20]       |
| 8      | *Sus scrofa domestica*          | Domestic Pig | Fat(Ao)                   | Body pain, snake bite, Rheumatism, Burn      | [26]       |
|        |                                 |              | Fat(Ka)                   | Furuncles, Tumour                           | [27]       |
| 9      | *Bos taurus*                    | Bull         | Urine(NK)                 | Blood Cancer                                 | [20]       |
|        |                                 |              | Dung(Ka)                  | Epistaxis                                    | [24]       |
|        |                                 |              | Dung(Ka)                  | Mosquito repellent                           | [27]       |
| 10     | *Vulpes bengalensis*            | Indian fox   | Flesh, Fats(Ka)           | Paralysis, Asthma                            | [24]       |
|        |                                 |              | Bone(Adi)                 | Fertility                                    | [22]       |
|        |                                 |              | Flesh(N)                  | Tuberculosis                                  | [25]       |
| 11     | *Hyobates hoolock*              | Hoolock Gibbon | Flesh, Bone(Ka)           | Pertussis                                    | [24]       |
|        | *Melurus ursinus*               | Sloth bear   | Gall bladder(Ka)          | Malaria, TB, Pertussis                       | [24]       |
|        |                                 |              | Gall bladder(B)           | Easy delivery of child                       | [21]       |
|        |                                 |              | Bone, hair, fat(Miz)      | Stomach-ache, dysentery, diarrhoea, Rheumatism | [22]       |
|        |                                 |              | Fat(Ka)                   | Body pain                                    | [27]       |
| 13     | *Latra sumatra*                 | Hairy nosed otter | Trachae (Ka)             | Fishbone                                     | [24]       |
| 14     | *Pteropus medius*               | Fruit bats   | Liver(Ka)                 | Schistosomia                                 | [24]       |
| 15     | *Sciurus niger*                 | Fox squirrel | Liver(Ka)                 | Schistozenia                                 | [24]       |
| 16     | *Elephus maximus*               | Indian elephant | Ash, Tusk(Ka)            | Scabies                                      | [24]       |
| 17     | *Homo sapiens*                  | Human        | Urine, Milk (Ka)          | Piles, Eyes ailments                         | [24]       |
| 18     | *Panthera pardus*               | Common Leopard | Fats(Ka)                  | Cracking on legs, Pertussis, Joint pain      | [24]       |
|        |                                 |              | Bone marrow(N)            | Body pain                                    | [25]       |
| 19     | *Panthera leo*                  | Lion         | Tooth(Ka)                 | Pertussis                                    | [26]       |
| 20     | *Capricornis sumatraensis*      | Serow        | Horn(Ka)                  | Bone fracture                                | [25]       |
| 21     | *Maschus sp*                    | Deer         | Urine, Blood (Ch)         | Dried tongue, Horn(Miz)                      | [22]       |
|        |                                 |              | Front foot(B)             | Chronic ulcer, Revitalization                | [22]       |
|        |                                 |              | Ear swelling and pain, Anaemia, Stomach-ache | Joint pain                                  | [23]       |
| 22     | *Pteronisys sp*                 | Flying squirrel | Urine, Flesh, Hair(Ch)   | Urethritis, Constipation, Gestation, Skin burn | [23]       |
| 23     | *Cervulus sp*                   | Barking deer | Bone marrow(Ch)           | Bone                                         | [23]       |
| 24     | *Funambulus sp*                 | Squirrel     | Flesh(Ch)                 | Cough                                        | [23]       |
| 25     | *Entomias sp*                   | Chipmunk     | Flesh(Ch)                 | Cough, Fever                                 | [23]       |
| 26     | *Felis sp*                      | Wild cat     | Flesh(Ch)                 | Body swelling, Fever, Malaria, Cough, Asthma  | [23]       |
|        |                                 |              | Flesh, Bile(Ao)           | Asthma, Liver cirrhosis                      | [23]       |
|        |                                 |              | Meat(Miz)                 | Stomach pain                                 | [23]       |
| 27     | *Sus scrofa cristatus*          | Wild boar    | Flesh(Ch)                 | Piles                                        | [22]       |
|        |                                 |              | Meat(Miz)                 | Scale                                        | [23]       |
| 28     | *Manis tricuspis*               | Tree pangolin | Skin burn(Ch)             | Cough                                        | [23]       |
| 29     | *Maca ca*                       | Monkey       | Flesh(Ch)                 |                                            |            |
| No | Animal | Common Name | Parts Used | Medical Uses |
|----|--------|-------------|------------|--------------|
| 30 | Macaca mulata | Rhesus macaque | Bone(Adi) | Fertility [22] |
| 31 | Sus scrofa | Wild Boar | Bone(Adi) | Fertility [22] |
| 32 | Sphaeraeus blanfordi | Fruit bat | Wings(Adi) | Skin diseases [22] |
| 33 | Taphozous nudiventris kachensis | Naked rumped bat | Wings(Adi) | Skin diseases [22] |
| 34 | Bos gaurus | Indian bison | Urine, Bile(Miz) | Scurvey, Asthma [22] |
| 35 | Callosciurus pygerythus | Irrawaddy squirrel | Meat and soup(Miz) | Antispasmodic, Swelling and Sprain [22] |
| 36 | Canis lupus familiaris | Dog | Blood, Flesh(B) | Epilepsy, Tonic for pregnant women [21] |
| 37 | Cervus unicolor | Sambar | Tender horn, Blood(Miz) | Asthma, fever, Burn, Haemostatic, Night blindness [22] |
| 38 | Chiroptera sp | Bat | Meat, Bone(Miz) | Weakness, Dysentery [22] |
| 39 | Hylobates hoolock | Hoolock Gibbon | Meat, fresh blood, bored tusk(Miz) | Involuntary urination in night, Toothache [22] |
| 40 | Macaca assamensis | Assamese Macaque | Meat and Brain, Fresh warm blood(Miz) | Tonic for pregnant women, Rheumatism [21] |
| 41 | Manis crassicaudata | Indian pangolin | Bile, Meat, Scale, Feathers (Miz) | Splenomegaly, Muscle stiffness, Piles [22] |
| 42 | Muntiacus muntjak | Barking deer | Horn, Fresh urine(Miz) | Revitalization of body, Otterhoae [22] |
| 43 | Nycticebus couang | Slow loris | Flesh(B) | Easy conception [21] |
| 44 | Ovis aries | Sheep | Dry bones, ribs, hairs(Miz) | Haemostatic [22] |
| 45 | Panthera tigris tigris | Tiger | Fur, Blood(B) | Cuts and wound, bed sore, Chronic Malaria [21] |
| 46 | Rattus sp | Rat | Whole body(N) | Skin diseases, Torsion, Rheumatism, Weakness during Jaundice [27] |
| 47 | Talpa sp | Mole | Flesh(N) | Scabies, Itches, Leprosy [22] |
| 48 | Canis lupus | Wolf | Skin(N) | Dysentery, Cough, Fever, Low lactation [25] |
| 49 | Manis pentadactyla | Chinese Pangolin | Nails(G) | Stomach-ache [25] |
| 50 | Herpestes javanicus | Mongoose | Whole body(N) | Minimize pain after conception [25] |
| 51 | Herpestes edwardsi | Moongose | Meat(Miz) | Tuberculosis [25] |
| 52 | Moschus chrysogaster | Deer | Penis(Ao) | Any disease prevention [25] |
| 53 | Cervus unicolor | Sambar | -G | Boils [25] |
| 54 | Selenarctos thibetanus | Black bear | Gall bladder, Testicles, Lobe(N,G) | Easy delivery during gestation, Skin Burn [23] |
| 55 | Panthera tigris | Tiger | Bone and marrow(N) | Menstruation, improvement of sexual organs [25] |
| 56 | Neofelis nebulosa | Clouded leopard | Bone marrow(N) | Jaundice [25] |
| 57 | Manis crassicaudata | Indian Pangolin | Scales, Flesh, Gall bladder(B) | Body pain [25] |
| 58 | Elephant maximus | Asian elephant | Teeth(B) | Hooilworm, Tuberculosis, Malaria [21] |
| 59 | Latrogaile perspicillata | Smooth coated otter | Flesh,Fur(B) | Toothache [21] |
| 60 | Trachypithecus pileatus | Capped langur | Tongue(B) | Leucoderma, Itching [26] |
| 61 | Sus scrofa | Wild boar | Fat(B) | Fish bone stuck in throat, Burns [21] |
| 62 | Trachypithecus cristatus | Silvered leaf monkey | Gall bladder(B) | Food poisoning [21] |
| 63 | Muntiacus muntjak | Cervus unicolor | Gall bladder, Flesh(B) | Hair care [21] |
| 64 | Elephant maximus | Asian elephant | Teeth(B) | Diabetes and high blood pressure [21] |
Reptiles used by the ethnic groups

The numbers of species of reptiles used by the ethnic groups are 18. Reptiles are used by 15 ethnic groups from the region. They mostly use the reptiles from the genus *Naja*, which consists of cobra species. The most commonly treated ailments are asthma, arthritis, and malaria, etc. Mostly used parts are the fats, flesh etc.

---

Table 2: Aves used in traditional medicine by ethnic groups of North Eastern India

| S. No. | Animal species          | English name            | Parts used         | Ailments treated                               | References |
|--------|-------------------------|-------------------------|--------------------|------------------------------------------------|------------|
| 1      | *Acridotheres cristis*  | Common Myna             | Meat(NK)           | Diarrhoea                                       | [20]       |
| 2      | *Columba livia*         | Pigeon                  | Meat(NK)           | Low blood pressure                              | [20,24]    |
| 3      | *Tyto alba*             | Brow owl                | Meat(NK)           | Dysentery                                       | [20]       |
| 4      | *Gallus domesticus*     | Chicken                 | Smoked meat; Fat(Ka, Ao) | Bone fracture                                  | [20]       |
| 5      | *Grus sp*               | Crane                   | Soft furs, Fat(Ka) | Blisters, Sore, Nasal problems                | [26,27]    |
| 6      | *Centropus sinensis*    | Crow pheasant           | Cooked Bone(Ao, An, Se, Re, Khia, Po, Lo, Sang, Zel, Kon, Ch, Miz) | Body ache, Rheumatic pain and earache, Asthma | [22,30]    |
| 7      | *Aquila sp*             | Eagle                   | Feather; Fat(Ch, Ao) | Wound; Sprain, Burn                            | [23,26]    |
| 8      | *Gallus gallus*         | Red jungle fowl         | Feather, fat and Meat(Miz, B) | Pinworm removal, Nasal obstruction, Burn | [21,22]    |
| 9      | *Picus canus hassei*    | Black napped green wood pecker | Meat(Miz) | Asthma                                          | [22]       |
| 10     | *Rhyticeros undulatus*   | Weathered hornbill      | Fatty oil(Miz)     | Easy labor during delivery                     | [22]       |
| 11     | *Aceros nipalensis*     | Necked hornbill         | Fat (B)            | Burn                                            | [21]       |
| 12     | *Aceros undulatus*      | Weathered hornbill      | Fats(N, G)         | Body pain                                       | [25]       |
| 13     | *Buceros bicorinis*     | Great hornbill          | Fats(N, G)         | Body pain                                       | [25]       |
| 14     | *Anthracoceros albirostris* | Pied                | Fat(N, G)          | Body pain                                       | [25]       |
| 15     | *Corvus macrorhynchos*  | Jungle crow             | Flesh(B)           | Health tonic for aged                           | [21]       |
| 16     | *Passer domesticus*     | House sparrow           | Brain; Flesh(B, Ao) | Impotency; Stammering                        | [21,26]    |
| 17     | *Myophonus caeruleus*   | Blue whistling thrush   | Flesh(B)           | Meat allergy                                   | [21]       |
| 18     | *Upupa epops*           | Hoopoe                  | Flesh(B)           | Gab bladder stone                              | [21]       |
| 19     | *Gallus sonnerati*      | Jungle fowl             | Flesh(Ao, Ka)      | Asthma; Breathing problem                      | [26,27]    |
| 20     | *Pavo cristatus*        | Peacock                 | Bone; Flesh(Ao, Ka) | Ear ache; Paralysis                           | [26,26]    |
| 21     | *Corvus splendens*      | Crow                    | Flesh, Bone(Ao)    | Rheumatism, Paralysis, Earache                | [26]       |
| 22     | *Struthio camelus*      | Ostrich                 | Fat (Ka)           | Joint pains                                     | [27]       |
| 23     | *Struthio camelus*      | Ground dove             | Feathers(Ka)       | Stroke                                         | [27]       |
| 24     | *Columba livia*         | Pigeon                  | Excreta, Flesh(Ka) | Typhoid, Toothache, Blood pressure             | [27]       |
Amphibians used by the ethnic groups

A total of 5 species of amphibian are used by 14 ethnic groups. The mostly used species is the *Limnonectes limnocharis* (Frog) by 9 ethnic groups. Skin, flesh etc. are the commonly used parts and the ailments like wound, diabetes, tongue blister etc. are the commonly treated ailments using amphibian species.

### Table 3: Reptiles used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species       | English name          | Parts used (Ethnic groups)                      | Ailments treated                          | References |
|--------|----------------------|-----------------------|------------------------------------------------|-------------------------------------------|------------|
| 1      | Hydrophis sp         | Snake                 | Liver (Ch)                                      | Diarrhoea, Dysentery, Malaria, Typhoid    | [23]       |
| 2      | Calotes sp           | Frog                  | Roasted meat (Miz)                              | Pneumonia, Asthma, Cough                  | [22]       |
| 3      | Calotes versicolor   | Common garden lizard  | Dried and roasted meat (Miz)                    | Asthma, Cough, Gold                       | [22]       |
| 4      | Geochelone elongata  | Star tortoise         | Fluid commonly out from neck (Miz)             | Piles                                     | [22]       |
| 5      | Tehanochelys trijuga | Turtle                | Tongue, Meat, bile, Skeleton (Miz)              | Asthma, Malaria, Arthritis, Stammering    | [22]       |
| 6      | Varanus bengalensis  | Monitor Lizard        | Flesh, fat (Ka)                                 | Skin, flesh disease                       | [20]       |
|        |                      |                       | Fat (N, G)                                      | Cough and fever                           | [28]       |
| 7      | Viper russellii      | Fleshy oil, bile (Miz)|                                             | Jaundice                                  | [21]       |
| 8      | Python molurus       | Indian python         | Flesh, fats (Miz)                               | Warts, Malaria fever                      | [22]       |
| 9      | Naja sp              | Cobra                 | Flesh, fat (B)                                  | Leprosy                                   | [24]       |
|        |                      |                       | Fat (N, G)                                      | Colic, stomach-ache, cholera, burn, cut, wound | [22]       |
| 10     | Ophiophagus hannah   | King cobra            | Gall bladder (B)                                | Massage for join pain                     | [28]       |
| 11     | Gekko gecko          | Tokay gecko           | Flesh (B)                                       | Seizure, sprain, piles, burn              | [21]       |
| 12     | Melanochelys trijuga | Indian pond terrapin  | Flesh (B)                                       | Foot and mouth disease of cattle          | [29]       |
| 13     | Chryseyns formasanus | -                     | Ash of carapace (Ka)                            | Rheumatic pain, burn, healing of fracture bones | [30]       |
| 14     | Testudo sp           | Tortoise              | Flesh (Ao)                                      | Snake bite, diabetes                      | [21]       |
| 15     | Tropidurus torquatus | Lizard                | Blood, flesh (Ka)                               | Skin disease and piles                    | [26]       |
| 16     | Crotalus durissus    | Rattle snake          | Whole body (Ka)                                 | Erysipelis, piles                         | [27]       |
| 17     | Echis coloratus      | Viper snake           | Fat (Ka)                                        | Chickenpox                                | [27]       |
| 18     | Python reticulates   | Python                | Eggs, fat (Ka)                                  | Rheumatism, arthritis, inguinal hernia, joint pain of bone | [27]       |

### Table 4: Amphibians used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species                  | English names | Parts used (Ethnic group) | Ailment treated               | References |
|--------|---------------------------------|---------------|---------------------------|------------------------------|------------|
| 1      | *Limnonectes limnocharis*       | Frog          | Skin, flesh (Ch), (Ao), (Adi), (N), (G), (Zel) | Skin burn, Gastritis, tongue blister | [23]       |
| 2      | *Paludomus conica*              | Frog          | Whole body (N), (G)       | Rheumatic joint pain          | [30]       |
| 3      | *Parreysia sikkimensis*         | Frog          | Hind legs (Ka), (Adi)     | Given to weak person, diabetic | [22]       |
| 4      | *Rana sp.*                      | Frog          | Skin, flesh (Ka), (Adi)   | patient and fertility enhancement | [22]       |
| 5      | *Bufo sp.*                      | Frog          | Hind legs (Ka), (Adi)     | Wound healing                 | [28]       |
|        |                                  |               | Bile (Miz)                | Wound healing                 | [26]       |
|        |                                  |               | Gall bladder (Ch)         | Wound healing, tongue blister  | [27]       |
|        |                                  |               |                           | Urinary retention, Acne        | [27]       |
|        |                                  |               |                           | Diabetes                      | [22]       |
|        |                                  |               |                           | Thorns in the flesh            | [23]       |
Pisces used by the ethnic groups

Pisces are one of the widely used animal groups by the ethnic groups of the region. 15 ethnic groups are using 22 different species of fishes for medicinal purpose and the species *Monopterus albus* (Eel fish) is the most commonly used species which is used to treat anaemia and asthma etc. Mostly treated ailments are the skin diseases, burn, asthma, anaemia, etc.

Table 5: Pisces used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species       | English names | Parts used (Ethnic group) | Ailment treated                                      | References |
|--------|----------------------|---------------|----------------------------|------------------------------------------------------|------------|
| 1      | *Barbus sp.*         | Fish          | Slimy (Ch)                 | Chickenpox                                           | [23]       |
| 2      | *Mystus seenghala*   | Giant river cat fish | -(Adj)                  | Given to new mother, bones used for taboo purposes  | [22]       |
| 3      | *Channa punctatus*   |               | -(Adj)                    | Given to a new mother, malaria                       | [22]       |
| 4      | *Cyclemys geneli*    | Turtle        | -(Adj)                    | Skin disease                                         | [22]       |
| 5      | *Anabas testudinum*  | Climbing perch| -(Adj)                    | Given to a weak person, malaria                      | [22]       |
| 6      | *Clarias batracus*   | Walking catfish| -(Adj)                    | Given to a weak person                               | [22]       |
| 7      | *Anguilla sp.*       | Eel           | Body mucus (N,G)          | Burns                                                | [28]       |
| 8      | *Semiplotus sp.*     | Fresh water fishes | Stomach and gut (N)     | Stomach ache and digestive problems                 | [28]       |
| 9      | *Bagarius bagarius*  | Gangetic gourch| Fins, bones (G)          | Body burns, stomach pain                             | [28]       |
| 10     | *Amblyceps sp.*      | Catfish       | Bones (G)                 | Body burns                                           | [28]       |
| 11     | *Psilorhynchus*      |              | whole body (N,G)          | Diarrhoea                                            | [28]       |
| 12     | *Semiplotus sp.*     | King fish     | Whole body (N)            | Smallpox                                             | [28]       |
| 13     | *Amphipnous cuchia*  | Eel           | Blood (Ao)                | Asthma, general weakness                             | [26]       |
| 14     | *Channa gachua*      |               | Blood (Ka)                | Asthma, jaundice, weakness                           | [27]       |
| 15     | *Xenodonton cancila* | Fresh water   | Whole body (NK)           | Premenstrual abdominal pain, anaemia                | [20]       |
| 16     | *Amblypharygodon molar* | Indian carpet | Whole body (NK)          | Premenstrual abdominal pain                          | [20]       |
| 17     | *Chaca chaca*        | Devil fish    | Whole body (NK)           | Polio                                                | [20]       |
| 18     | *Channa punctatus*   | Sengeli       | Whole body                | Body pain                                            | [29]       |
| 19     | *Mastacembalus armatus* | Giant thorpy eel | Whole body      | Carbuncle                                            | [29]       |
| 20     | *Monopterus cuchia*  | Cuchia        | Blood                     | Diabetes                                             | [29]       |
| 21     | *Labo gonius*        | Carp fish     | Edible portion            | Obesity                                               | [29]       |
| 22     | *Monopterus albus*   | Eel fish      | Blood (Ao), (An), (Se), (Khia), (Lo), (Re), (Po), (Zel), (Ch), (Kon) | Anaemia, asthma                                     | [30]       |

Molluscs used by the ethnic groups

Molluscs are also used by 13 ethnic groups from the region. The mostly used species is from the genus *Pila* (Snail) among the 4 species of molluscs and mostly used part is the flesh.

The commonly treated ailments are asthma, tuberculosis, stomach disorders, jaundice etc.

Table 6: Molluscs used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species | English names | Parts used (Ethnic group) | Ailment treated                                      | References |
|--------|----------------|---------------|----------------------------|------------------------------------------------------|------------|
| 1      | *Pila sp.*     | Snail         | Flesh, shell (Ch)          | Affected bone, skin burn, injuries, gastritis, tongue blister | [23]       |
|        |                |               | Flesh (Ao), (An), (Se), (Re), (Khia), (Lo), (Sang), (Po), (Ch), (Kon) | Asthma, tuberculosis, stomach disorder | [30]       |
| 2      | *Lymnaea sp.*  | Snail         | Flesh (Miz)                | Measles, liver ailment and jaundice, swelling and sprain | [22]       |
| 3      | *Cryptozona sp.* | Snail        | Flesh (B)                  | Jaundice                                             | [22]       |
| 4      | *Ariolimax columbiaeius* | Banana slug | Flesh (B)                  | Rheumatism and sciatic                              | [22]       |

Tables 7: Anellids used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species | English names | Parts used (Ethnic group) | Ailment treated                                      | References |
|--------|----------------|---------------|----------------------------|------------------------------------------------------|------------|
| 1      | *Pheritima sp.* | Earthworm     | Whole body (Ch)            | Eye (red)                                            | [23]       |
|        |                |               | Whole body (Miz)           | Chronic fever, malaria                               | [22]       |
|        |                |               | Whole body (Rahia), (Lo), (Sang), (Re), (Po), (Zel), (Ch), (Kon), (An) | Antitode in snake and spider bites | [30]       |
| 2      | *Tachypodiumus niger* | Black millipede | Whole body (Miz)           | Tuberculosis                                         | [22]       |
| 3      | *Hirudo medicinalis* | Leech         | Whole body (Ka)            | Piles, swelling of muscle                            | [27]       |
| 4      | *Lumbricus sp.*  | Earthworm     | Whole body (Ka)            | Clear obstruction of urinary tract, arthritis         | [24]       |
|        |                |               | Whole body (NK)            | Pertussis                                            | [20]       |
| 5      | *Metaphire bouletti* | Earthworm    | Whole body (NK)            | Burn                                                 | [20]       |
| 6      | *Perionyx sp.*   | Earthworm     | Whole body (NK)            | Piles                                                | [20]       |
Arthropods used by the ethnic groups

Arthropods are the second widely used group of animals by the ethnic groups of the region. 65 different species of arthropods are used by 17 ethnic groups. The mostly used species the Blatta orientalis (Cockroach) and the Paulannaeus wammerdami (Scorpion). They mostly use the parts-whole body and honey. Ailments like diabetes, asthma, malaria are mostly treated with arthropods species. Some species like Lyttaes wascatoria (Spanish fly), Mylabris cichori (Blister beetles), Epicauta histicornis (Red headed blister beetles), etc. they also use against cancer. The traditional edible insect of northeastern India, Vespa affinis L., showed some antioxidant potential which can be a cue to the oxidative-stress associated disorders [32].

Table 8: Arthropods used in traditional medicine by the ethnic groups of North Eastern India

| S. No. | Animal species | English names | Parts used (Ethnic groups) | Ailment treated |
|-------|----------------|---------------|---------------------------|----------------|
| 1     | Cancer pararum | Crab          | Whole body (Ch)           | Ulcer, blisters, Malaria, Cough, Earache |
| 2     | Apis indicia   | Bee           | Honey (Ch)                | Stomach pain |
| 3     | Myrmeleon immaculatus | Ant lion | Whole body (Ch) | No data |
| 4     | Podius sp      | Plant bug     | Whole body (Ch)           | Cough |
| 5     | Panaeus indicus | Prawn         | Whole body (Adi)          | Diabetes |
| 6     | Oecophylla samargdina | Weaver ant | - (Adi) | Digestive system |
| 7     | Aspangopus najus | Stink insect | Honey (Miz) | Wart |
| 8     | Apis mellifera | Bee           | - (Adi) | Malaria |
| 9     | Carausius morosus | Stick insect | Honey (Ka), (N, G) | Wounds |
| 10    | Cimex lactularis | Bed Bug       | Whole body (Miz)          | Inflammatory glands, ulcers, Boils, Malaria |
| 11    | Gryllus pensylvanicus | Field cricket | Whole body flesh (B) | Malaria |
| 12    | Heteropoda vanatoria | House spider | Whole body (Miz) | Chest problem |
| 13    | Myrmeleon formicarius | Ant lion | Whole part (Miz) | Ottrhoesa |
| 14    | Parabotraphe ps | Fresh water crab | Whole body-boiled (Miz) | Warts and verrucose |
| 15    | Periplaneta americana | Cockroach | Whole body (Miz)          | Jaundice |
| 16    | Samia cynthia ricini | Eri silk worm | Whole body dried (B) | Tuberculosis |
| 17    | Vespa orientalis | Wasp          | Whole body (Miz)          | Asthma |
| 18    | Dorylus orientalis | Red ant       | Egg, adults (Misc)        | Asthma, stomach-ache, saliva exuding in children |
| 19    | Schistocera gregaria | Desert locusts | Body and body oil (Miz) | Protect Liver |
| 20    | Antheraea assamensis | Muga silk worm | Whole body and body oil (Ka) | Lip cracking |
| 21    | Eumenes petiolatus | Potter wasp    | Eggs, larvae (Misc)       | Lip and leg cracking |
| 22    | Achaeta sp      | Cricket        | Hind legs (Ka)            | Diuretic |
| 23    | Pseudocantheroterms sp | Termites | Whole body (Ka) | Asthma |
| 24    | Musca domestica | House fly      | Whole body (Ka)           | Blisters |
| 25    | Poecillocerus strictus | Grass hopper | Whole insect (Ka) | Lung infection |
| 26    | Trigona spinipes | Stingless bee  | Honey (Ka)                | Throat inflammation |
| 27    | Latyta vestatoria | Spanish fly    | Whole body (Ka)           | Anti-cancer, Increased sexual pleasure |
| 28    | Mylabris cichori | Blister beetle | Whole body (Ka)           | Anti-cancer, warts, rables |
| 29    | Epicauta histicornis | Red-headed blister beetle | Whole body (Ka) | Anti-cancer, warts, rables |
| 30    | Pediculus sp    | Louse          | Whole body (Ka)           | Clears urinary tract obstructions |
| 31    | Sceliphon sp    | Wasps          | Whole body (N, K)         | Pneumonia |
| 32    | Gryllotalpa africana | African mole cricket | Ash (Ka) | Ear infection |
| 33    | Philosoma ricini | Eri silk worm  | Whole body and Cocoon (Ka) | Dribbling saliva |
| 34    | Lampyris noctula | Common glow worm | Whole body (N, K) | Night blindness |
| 35    | Coptoterum formosanum | Termites | Whole body (Ka) | Hepatomegaly and hepatitis |
CONCLUSION

It has been seen that the practice of zoo therapy in the north-eastern part of India is very common like many other parts of India and world. From the observations on the zoo therapy practised by the ethnic groups of North Eastern India, it can be summarized that:

(1) Among the 19 ethnic groups from the region, the use of Mammalian species has found to be the highest followed by Arthropods, Aves, Pisces, Reptiles, Annelids, Amphibians and Molluscs.

(1) The most commonly treated important diseases are: Tuberculosis, Diabetes, Schizotenia, Cancer, Gallbladder stone, Kidney problem, Arthritis, Impotency and Malaria etc.

In this modern world with tremendous advancement in the medical field, cure for some diseases like-Cancer, Diabetes etc. has yet to be found. Many people around the world still prefer to go for traditional medicine to treat different ailments, which primarily is based on their knowledge and experience. This knowledge of traditional medicine has been the basis for the development of many potential drugs that are being used in modern medical field. Thus, with screening and proper scientific study of the animal species used in traditional medicine by different ethnic groups can lead to the development of new potential drugs for many serious diseases of the present time.

CONFLICTS OF INTERESTS

Declared none

REFERENCES

1. World Health Organization. Traditional medicine strategy 2002–2005. Geneva, Switzerland; 2002. p. 1-74.
2. Chivian E. Global environmental degradation and biodiversity loss: Implications for human health. In: Grifo F, Rosenthal J, editors. Biodiversity and human health. 1st ed. Washington DC: Island Press; 1997. p. 738.
3. Alves RRN, Rosa IL. Why study the use of animal products in traditional medicine? J Ethnobiol Ethnomed 2005;1:5.
4. Adeola MO. The importance of wild animals and their parts in the culture, religious festivals, and traditional medicine, of Nigeria. Environ Conserv 1992;19:125-34.
5. Angaleetti LR, Agrimi U, Curia C, French D, Mariani-Constantini R. Healing rituals and sacred serpents. Lancet 1992;340:223-5.
6. Adeola MO. The importance of wild animals and their parts in the culture, religious festivals, and traditional medicine, of Nigeria. Environ Conserv 1992;19:125-34.
7. Costa-Neto EM, Marques JGW. Faunistic resources used as medicines by artisanal fishermen from Siribinha Beach, State of Bahia, Brazil. J Ethnobiol 2000;20:93-109.
8. Marques JGW. Fauna medicinal: recurso do ambiente ou ameaça a biodiversidade? Mutum 1997;1:4.
9. China National Corporation of Traditional and Herbal Medicine: Materia medica commonly used in China Beijing, Science Press; 1995.
10. Schimmlischke E. Insekten als Nahrung, in Brauchtum, Kult und Kultur. In: Helmcke JG, Stark D, Wermuth H. editors. Handbuch der Zoologie-eine Naturgeschichte der Stämme des Tierreichs, Band 1, Berlin: Akademie Verlag; 1968. p. 6-12.
11. Lohani U. Man-animal relationships in central Nepal. J Ethnobiol Ethnomed 2010;6:31.
12. Costa-Neto EM, Marques JGW. Fanistic resources used as medicines by artisanal fishermen from Sririnbal Beach, State of Bahia, Brazil. J Ethnobiol Ethnomed 2000;6:93-109.
13. Alves RRN. Fauna used in popular medicine in Northeast Brazil. J Ethnobiol Ethnomed 2009;5:1.
14. Ali SAM, Mahdihassan S. Bazaar medicines of Karachi: the drugs of animal origin. In: Mahdihassan S. editor. Bazaar Drugs and Folk Medicine in Pakistan. Karachi: Hamdard Publ; 1984. p. 69-73.
15. Mahawar MM, Jariol DP. Traditional Zootherapeutic studies in India: a review. J Ethnobiol Ethnomed 2008;4:17-29.
16. Fatil SH. Ethn-mediczo-zoological studies on Nadurahar district of Maharashtra. Indian J Traditional Knowledge 2003;2:297-9.
17. Singh RAJ, Padmalatha C. Ethno-entomological practices in Tirunelveli district, Tamil Nadu. Indian J Traditional Knowledge 2004;3:442-6.
18. Solavan A, Paulmurungu R, Wilsanand V, Ranjith Sing AJA. Traditional therapeutic uses of animals among tribal population of Tamil Nadu. Indian J Traditional Knowledge 2004;3:198-204.
Sharma SK. A study on ethnozoology of Southern Rajasthan. In: Trivedi PC, editor. Ethnobotany. Jaipur: Aavishkar Publisher; 2002. p. 239-53.

Gupta L, Siroli CS, Mistry N, Dixit AM. Use of animals and animal products in traditional health care systems in District Kachchh, Gujarat. Indian J Traditional Knowledge 2003;2:346-56.

Mishra N, Rout SD, Panda T. Ethno-zoological studies and medicinal value of Similipal Biosphere, Orissa, India. Afr J Pharm Pharmacol 2011;5:6-11.

Borah MP, Prasad SB. Ethno zoological remedial uses by the indigenous inhabitants in adjoining areas of Pobitora Wildlife sanctuary, Assam, India. Int J Pharm Pharm Sci 2016;8:90-6.

Betula ALS. Indigenous knowledge of zootherapeutic use among the Biate tribe of Dima Hasao District, Assam, North-eastern India. J Ethnobiol Ethnomed 2013;9:56.

Chinlamiang M, Singh RK, Shukla AC. Ethno zoological diversity of Northeast India: Empirical learning with traditional knowledge holders of Mizoram and Arunachal Pradesh. Indian J Traditional Knowledge 2013;12:18-30.

Kakati LN, Doulo V. Indigenous knowledge system of zootherapeutic use by Chakhesang tribe of Nagaland, India. J Human Ecol 2002;13:419-23.

Ronghang R, Teron R, Tamuli KA, Rajkhowa R. Traditional zootherapy practised among the Karbis of Assam, India. Ecoscan 2011;1:161-6.

Chakravorty J, Ghosh S, Meyer-Rochow VB. Practices of entomophagy and entomotherapy by members of the Nyshi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). J Ethnobiol Ethnomed 2011;7:5-18.

Kalita D, Dutta M, Islam NM. Few plants and animals based folk medicines from Dibrugarh District, Assam. Indian J Traditional Knowledge 2015;4:81-5.

Jamir NS, Lal P. Ethno zoological practice among Naga tribes. Indian J Traditional Knowledge 2005;1:100-4.

Doley AK, Kalita J. Traditional uses of insect and insect products in medicine and food by the mishing tribe of Dhemaji District, Assam, North East India. Soc Sci Researcher 2012;1:11-21.

Dutta P, Dey T, Manna P, Kalita J. Antioxidant potential of vespa affinis L., a traditional edible insect species of North East India. PLoS One 2016;11:1-19.

How to cite this article
- Khirod Sankar Das, Sudipta Choudhury, K Chanreila L Nonglait. Zootherapy among the ethnic groups of North Eastern region of India-a critical review. J Crit Rev 2017;4(2):1-9.