

**Economic Relations and Utilization of Turtles**  
**by Karl F. Lagler,**  
**University of Michigan**

**From: Investigations of Indiana Lakes and Streams Volume 3**  
**Indiana Department of Conservation, Indianapolis and**  
**Indiana University, Department of Zoology, Bloomington**  
**1945**

<b>Abstract.....</b>	<b>Page 139</b>
<b>Contents.....</b>	<b>Page 140</b>
<b>Introduction.....</b>	<b>Page 141</b>
<b>Turtles of Indiana.....</b>	<b>Page 141</b>
<b>Habits of Turtles.....</b>	<b>Page 145</b>
<b>Economic Relations.....</b>	<b>Page 147</b>
<b>Methods of Catching Turtles.....</b>	<b>Page 147</b>
<b>Marketing.....</b>	<b>Page 154</b>
<b>Dressing.....</b>	<b>Page 156</b>
<b>Preparation for Eating.....</b>	<b>Page 159</b>
<b>Conservation of Turtles.....</b>	<b>Page 160</b>
<b>Biological investigations.....</b>	<b>Page 160</b>
<b>Protective legislation.....</b>	<b>Page 161</b>
<b>Artificial propagation.....</b>	<b>Page 161</b>
<b>Public education.....</b>	<b>Page 163</b>
<b>Utilization.....</b>	<b>Page 163</b>
<b>Bibliography.....</b>	<b>Page 164</b>

**INVESTIGATIONS  
of  
INDIANA LAKES  
AND STREAMS**

**VOLUME III**

1. Shelby D. Gerking: Distribution of the fishes of Indiana.
2. Karl F. Lagler: Economic relations and utilization of turtles.

Published by the  
INDIANA DEPARTMENT OF CONSERVATION  
Division of Fish and Game  
and the  
DEPARTMENT OF ZOOLOGY, INDIANA UNIVERSITY  
Indianapolis, 1945

## 2. Economic Relations and Utilization of Turtles

*by*

KARL F. LAGLER

*University of Michigan*

### ABSTRACT

In time of war, as in peace, wise utilization of all natural resources is the aim of conservation practice. At the present time it is deemed expedient to encourage the use of land and freshwater turtles as a source of meat supply to an extent commensurate with the realization of a maximum sustained yield. It is the purpose of this bulletin to show a way in which this may be done and also to point out some of the other relationships of turtles to man. Since some of these relationships are beneficial, it is important that exploitation be not overdone. In a rehabilitation program following war, turtle hunting and turtle farming are seen both as recreational outlets and as possible structural units in the economic system to come.

Investigations of Indiana Lakes and Streams 3(2) : 139-165, 1945  
Indiana Department of Conservation, Indianapolis.  
Indiana University, Department of Zoology, Bloomington.

## CONTENTS

	Page
Introduction .....	141
Turtles of Indiana .....	141
Habits of Turtles .....	145
Economic Relations .....	147
Methods of Catching Turtles .....	147
Marketing .....	154
Dressing .....	156
Preparation for Eating .....	159
Conservation of Turtles .....	160
Biological investigations .....	160
Protective legislation .....	161
Artificial propagation .....	161
Public education .....	163
Utilization .....	163
Bibliography .....	164

## 2. Economic Relations and Utilization of Turtles<sup>1</sup>

by

KARL F. LAGLER

*University of Michigan*

### INTRODUCTION

This paper is largely restricted to a consideration of the land and pond turtles of Indiana and the other north-central states and thus excludes those turtles that are usually marine or brackish water inhabitants. Furthermore, since the terrestrial kinds are nowhere abundant, particular emphasis is placed on the aquatic kinds that constitute the bulk of the resource.

From the early history of our nation there has been an interest in turtles. Apparently all are edible and the high quality of some of them as food for man has long been recognized. The Indians used their shells for rattles and ornaments and early settlers carefully saved the oil for its therapeutic value in cases of bruises and sprains. Writings from olden days to the present show that concern has ever been felt over the relationships of turtles to food and game animals including birds, mammals, and fishes. Turtles have long served in schools and laboratories for study and experimentation. They are commonly sold and used as pets and novelties. For irresponsible individuals they have made many a target for rifle or pistol. Many fallacies regarding their economic role have come into being. It is the purpose of this bulletin to correct common misconceptions, to point out the best methods of taking turtles for food or for controlling their numbers, and to show means for the extension of the marketing of these animals and their utilization as food.

### TURTLES OF INDIANA

For convenience, the reptiles here considered are collectively called turtles, although some of them have elsewhere been named "tortoises" or "terrapins." Four principal families are represented in Indiana: the snapping turtles (Family Chelydridae), the musk and mud turtles (Family Kinosternidae), the pond and land turtles (Family Testudinidae), and the soft-shelled turtles (Family Trionychidae). Turtles of these families are common throughout the central and eastern part of the country and there is hardly a lake, pond, stream, or slough in which one or more kinds do not occur (FIGURE 1).

---

<sup>1</sup> Contribution from the Department of Zoology, University of Michigan. This report is part of the work of the Indiana Lake and Stream Survey, sponsored jointly by Indiana University and the Department of Conservation, Division of Fish and Game. Financial assistance has been given this study by the Associated Fishing Tackle Manufacturers.

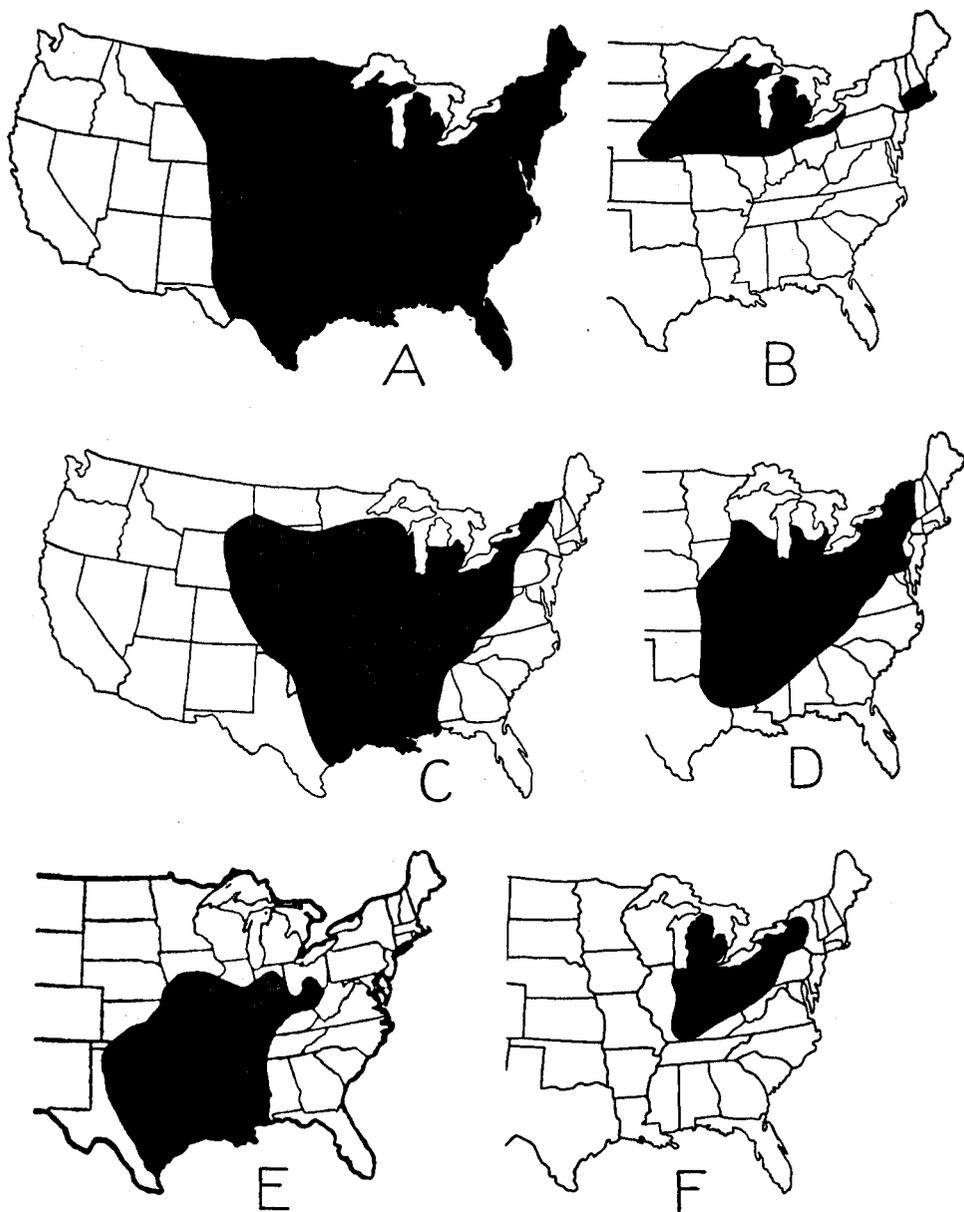


Figure 1. Areas (in black) where some of the common edible turtles occur in the United States (After Conant, 1938). A. The common snapping turtle, *Chelydra serpentina*. B. Blanding's turtle, *Emys blandingii*. C. The spiny soft-shelled turtle, *Amyda s. spinifera*. D. The geographic turtle, *Graptemys geographica*. E. The Cumberland terrapin or redhead turtle, *Pseudemys scripta elegans*. F. The mid-western painted turtle, *Chrysemys picta marginata*.

These turtles are known by very many different common or vernacular names; any one kind has a different appellation in different parts of its range. For clarity in this text, the technical names of turtles and the common ones, too, largely follow those given by STEJNEGER and BARBOUR, 1943. A means for identifying the turtles of the state and learning their range is given in the following key. With a specimen in hand one may readily determine its kind by observing it carefully and "running" it through the key. In each couplet of characters, the first one given should

suffice for identification; the others which are presented may be used to substantiate the conclusions drawn from the first. Identifications may be verified in such publications as Cagle, 1941, and others listed in the bibliography.

Key for the Identification of the Turtles of Indiana<sup>2</sup>

- 1 { Back (carapace) covered with skin; edge of carapace flexible (Soft-shelled turtles) ..... 2  
 { Back (carapace) covered with horny shields; edge of carapace not flexible ... 3
- 2 { Hind feet mottled with black underneath; front margin of carapace set with a row of tubercles.  
*Amyda s. spinifera* (LeSueur). Spiny soft-shelled turtle.  
 Statewide.  
 { Hind feet not mottled with black underneath; front margin of carapace smooth, not set with tubercles.  
*Amyda mutica* (LeSueur). Brown soft-shelled turtle.  
 Southern half of state.
- 3 { Belly shell (plastron) with 11 parts (shields), including the small, unpaired plate at middle of front end but not counting parts which extend from each side to join plastron to carapace ..... 4  
 { Belly shell (plastron) with 12 parts (shields) (Land and pond turtles) .... 7
- 4 { Tail short and bearing only small fleshy papillae on its upper surface; rear margin of carapace without tooth-like projections of the plates which compose its margin; size not exceeding 6 inches (Mud turtles) ..... 5  
 { Tail long and bearing a row of large horny tubercles on its upper surface; rear margin of carapace with marginal plates forming strong, tooth-like projections; size to more than 6 inches (Snapping turtles) ..... 6
- 5 { Horny parts of the first pair of shields of the plastron smaller than those of the last pair of shields of plastron; plastron without transverse hinges.  
*Sternotherus odoratus* (Latreille). Musk turtle.  
 Statewide.  
 { Horny parts of the first pair of shields of the plastron about equal in size to those of the last pair of shields of the plastron; plastron with two transverse hinges (not discernable in small specimens).  
*Kinosternon s. subrubrum* (Lacépède). Mud turtle.  
 Rare in state.
- 6 { Carapace with three distinct longitudinal ridges (keels) in all sizes of individuals; posterior half of tail with many small scales on its under surface; head covered with plates.  
*Macrochelys temminckii* (Troost). Alligator snapper.  
 Rare in southern part of state.  
 { Carapace without three ridges on specimens larger than about 8 inches; posterior half of tail with only two rows of scales on its under surface; head covered with skin.  
*Chelydra s. serpentina* (Linné). Common snapper.  
 Statewide.

<sup>2</sup> Modified from Cagle, 1941. Verified by Dr. NORMAN HARTWEG, whose help is gratefully acknowledged.

- 7 { Plastron bendable on a transverse hinge across its middle; carapace conspicuously domed ..... 8  
 Plastron without a transverse hinge; carapace only moderately convex above ..... 10
- 8 { Cutting edge of upper jaw, when viewed from side, curving upward toward front; underpart of chin and throat clear yellow in life, not otherwise marked.  
*Emys blandingii* (Holbrook). Blanding's turtle.  
 Northern part of state.  
 Cutting edge of upper jaw, when viewed from side, curving downward (and usually bearing a downward projection); chin and throat not clear yellow in life, variously marked (Box turtles) ..... 9
- 9 { Carapace with no trace of a ridge on its midline; nostrils in lateral position, easily seen when head is viewed from side.  
*Terrapene ornata* (Agassiz). Ornate box turtle.  
 Rare.  
 Carapace with some trace of a median ridge; nostrils at front of head, terminal in position, and not visible when head is viewed from side.  
*Terrapene carolina* (Linné). Common box turtle.  
 Statewide.
- 10 { Carapace with distinct round yellow dots.  
*Clemmys guttata* (Schneider). Spotted turtle.  
 Northern part of state.  
 Carapace without yellow dots ..... 11
- 11 { Tip of lower jaw rounded; lower jaw somewhat spoon-like with an extensive grinding surface behind its cutting edge (Map turtles) ..... 12  
 Tip of lower jaw pointed; lower jaw not spoon-like and with no extensive grinding surface on it ..... 13
- 12 { Largest yellow spot on side of head behind eye isolated and triangular or comma-shaped; carapace keel absent or poorly developed.  
*Graptemys geographica* (LeSueur). Map turtle.  
 Statewide.  
 Largest yellow spot on side of head behind eye extending backward as a narrow line, boomerang shaped; carapace usually with a well-developed keel.  
*Graptemys p. pseudogeographica* (Gray). False map turtle.  
 Rare in the state.
- 13 { Cutting edge at tip of upper jaw with a very sharp notch and a toothlike projection on each side of this notch; edges of plates margining carapace behind lacking indentations.  
*Chrysemys picta marginata* Agassiz. Mid-western painted turtle.  
 Statewide.  
 Cutting edge at tip of upper jaw smooth and scarcely notched, downward projection lacking; edges of plates margining carapace behind each with an indentation.  
*Pseudemys scripta elegans* (Wied). Slider turtle.  
 Southern part of state.

## HABITS OF TURTLES

All turtles reproduce by laying eggs. These eggs vary in shape according to species from ovoid in the land and pond turtles to spheroid in the snapping and soft-shelled kinds. Numbers range from few in the spotted turtle (*Clemmys guttata*) to many, often more than thirty, in the snapping turtle (*Chelydra serpentina*). The eggs are covered with a leathery, somewhat calcareous shell and are deposited in a hole in the ground excavated by the female with her hind legs. After oviposition, the loose earth is packed into the cavity over the eggs and wet down. The surface is sometimes smoothed so that it is difficult to locate a nest by sight. Warming by the sun incubates the eggs. The length of the incubation period may be several weeks or as much as three months. Although the eggs are usually laid in spring or summer and the young appear before fall, sometimes they are deposited late in the season and do not hatch until the following spring. Like a chick, a young turtle has an egg tooth with which it pips its way out of the shell.

Growth of the turtles here considered is slow; common kinds, such as the painted turtles (*Chrysemys* spp.), ordinarily grow only a fraction of an inch in a year, though somewhat more rapid growth may characterize the young. Consequently there are veritable Methuselahs of the animal world among the larger turtles, such as the alligator snapper (*Macrochelys temminckii*) of the Mississippi Valley.

The food habits of turtles vary according to the structure, mode of life, size, and season (LAGLER, 1940, 1943b). Land forms, such as the box turtles, are characteristically vegetarian but also eat small land animals including insects, worms, and slugs. Aquatic turtles are ordinarily omnivorous and at the least some of them eat much more vegetable matter than commonly supposed (FIGURE 2, A-C). Most turtles are also scavengers to a greater or lesser degree but spurn putrefied material. The diet, furthermore, changes as seasonal variations in available materials shift. There is evidence that a more carnivorous feeding habit is followed in the early season, before vegetation is lush, and that later a more herbivorous diet is followed. To the south, proportionately more coarse and forage fishes and fewer game and pan fishes are eaten since the coarser varieties are more common. Feeding is of course suspended during hibernation.

Turtles hibernate in various attitudes during colder months. Some kinds, such as the musk turtle and the snapper, often form sizeable aggregations in the soft bottoms of waterways and spend a period of inactivity varying in length with the latitude, the time of inactivity being longer to the north. Others, such as the box turtle, normally hibernate on land under piles of leaves or detritus.

The enemies of turtles are those animals which either eat them or which wantonly or accidentally destroy them. Man does all of these things and is one of the most important enemies of turtles. He has taken certain species for food for a long time. The seriousness of uncontrolled activity of this sort may be seen in the practical extermination of the diamond-

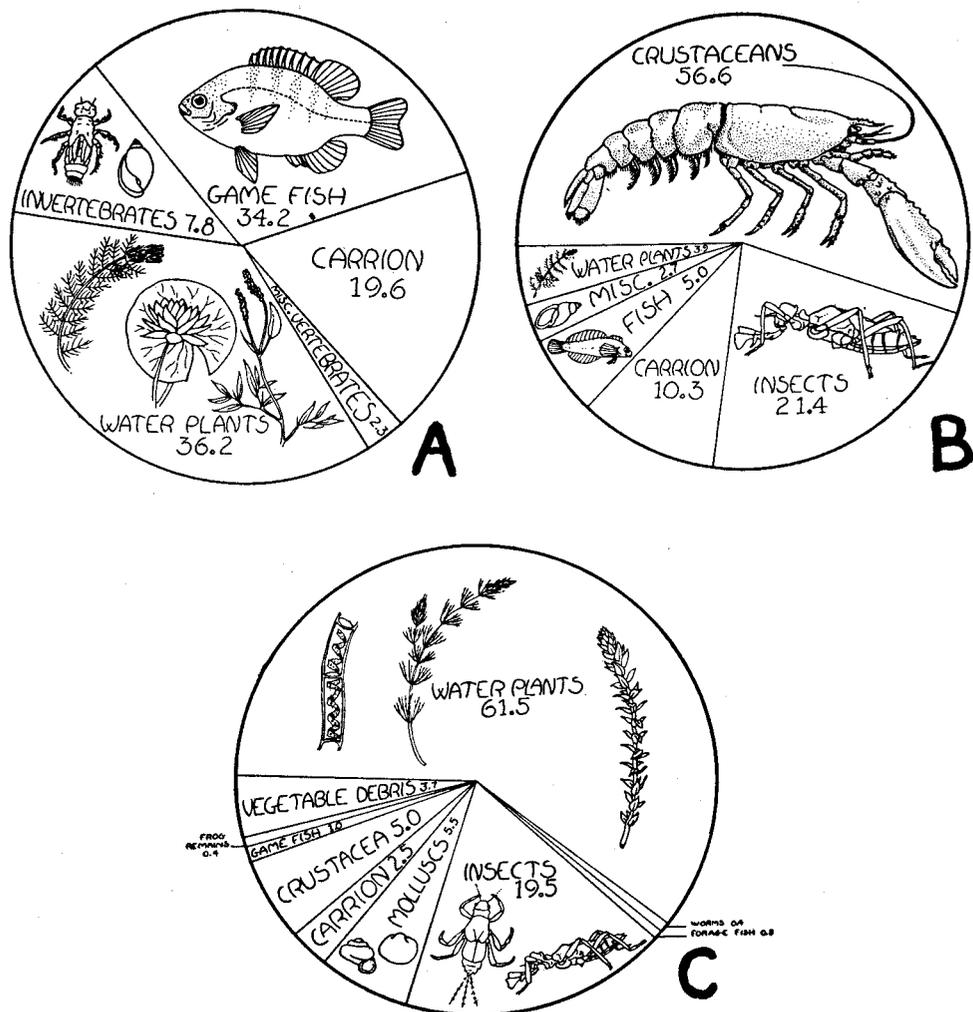


Figure 2. Food of some common edible turtles based on analyses of their stomach contents (Lagler, 1943b). A. The common snapping turtle, *Chelydra serpentina*. B. Blanding's turtle, *Emys blandingii*. C. The mid-western painted turtle, *Chrysemys picta marginata*.

back terrapins (*Malaclemys* spp.) from the salt-water marshes of the eastern United States, owing to the demands made on it in years past by man for food. The deplorable destruction of turtles by shooting has already been mentioned. Automobile traffic accounts for a high annual mortality of turtles, particularly during the nesting season when dead specimens are common on highways. Many young are taken each year to be sold in pet shops or by novelty dealers. Large numbers are sometimes drowned in the trap nets of commercial fishermen.

The animals reported to dig up and eat the eggs of turtles are numerous and include dogs, cats, skunks, weasels, foxes, muskrats, and raccoons. Enemies of young and adults are predacious fishes, mud-puppies (*Necturus* spp.), water snakes (*Natrix* spp.), larger fish-eating birds, birds of prey,

otter, and other animals. Larger turtles, such as snappers, also eat smaller ones.

### ECONOMIC RELATIONS

All turtles are edible but up to the present only a few species have been utilized to any extent as food. Varieties currently marketed are the common snapper, the alligator snapper, sliders, and soft-shelled turtles. The principal explanation of the fact that these kinds are thus used is that they are the most common turtles of medium to large size in the areas where they occur. There are, however, many other medium-sized kinds that might well be caught and eaten, including Blanding's turtle, the geographic or roughback turtles, the painted turtles, and others.

Besides being of value as food for man, turtles also figure in the food of lower animals. In the list of the natural enemies of turtles which has been given there are important fur-bearers and other economically desirable animals.

Under natural conditions it seems unlikely that turtles are important predators of any other animals. They alone do not appear to limit the populations of any of their prey organisms except possibly in fish hatchery waters, in waterfowl sanctuaries (LAGLER, 1943b), and in certain truck gardens (SURFACE, 1908). Under such special circumstances turtle populations may be reduced or their numbers controlled by means subsequently given in this paper.

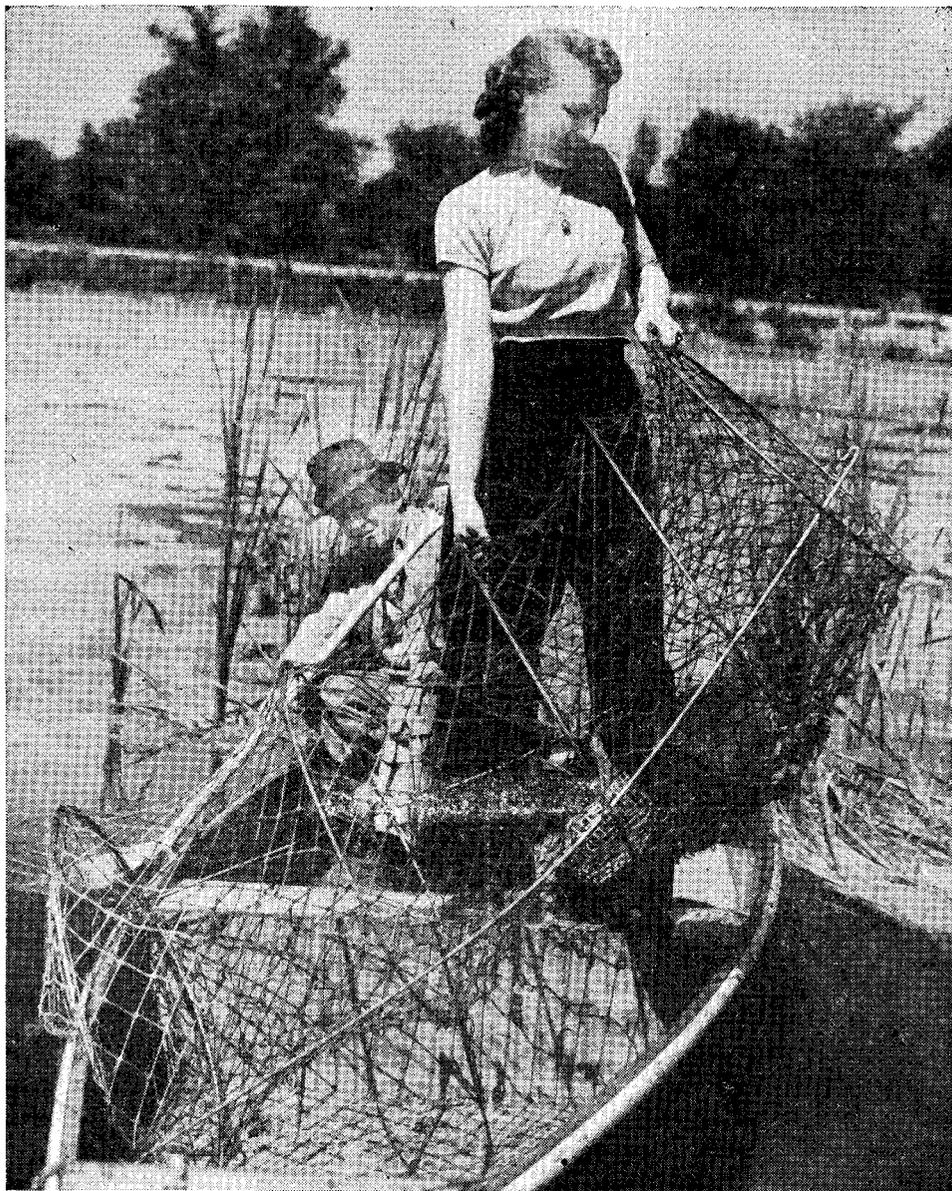
Turtles are beneficial in acting as natural controls against overpopulation of valuable fish species and others (LAGLER, 1941). At least some of them are scavengers and eat carrion fish and animal remains from lakes, ponds, and streams. Furthermore, they are known to consume insect pests of lower animals and man, including mosquitos (LAGLER, 1934b).

### METHODS OF CATCHING TURTLES

In order to obtain turtles for private use as food or for market, or to reduce populations where study has shown them to be deleterious to more desired animals or plants, any of several different means may be employed (LAGLER, 1943a). All of these ways are easy and have been successfully carried on both by men and women interested in the out-of-doors and in turtles to eat.

The method that one decides to use in catching turtles depends to a certain extent on the habits of the kind that he desires to take. Since most turtles are aquatic, trapping, seining, and other means for collecting them from the water are perhaps the most important and will be described in some detail. Land forms such as the box and wood turtles are easily obtained by hand from their wooded and open lowland habitats.

The all-round best means for catching aquatic turtles is the conventional turtle trap. This trap (FIGURES 3-7) may be purchased from dealers or made up to the following specifications, modified as needed to satisfy the legal requirements where use is intended:



**Figure 3.** Details of turtle trap. Note bait container in middle of trap and stretcher along side disconnected at one end to show detail. Copyright, The Detroit News.

- Net:* Made of No. 24 linen seine twine. Minimum legal mesh varies with the state, being 4 inches square in Indiana. Such a net will catch few fish and is the all-round best net for turtles.
- Length:* Four to six feet from front hoop to back hoop.
- Hoops:* Three to five per trap, each 30 inches in diameter; made of wood or of six-gauge steel wire with welded joints.

- Throat:* Funnel shaped, 18 inches deep from front hoop to opening inside; opening one inch high by 20 inches wide; corners tied by twine to middle hoop.
- Rear end:* Closed by pursing string.
- Preservative:* Tan bark, copper oleate, tar, or asphalt applied to hoops and twine alike.
- Stretchers:* Wood or nine-gauge steel wire, two for each trap.



**Figure 4.** Turtle trap properly set near a promising bed of spatterdock, with hoops just breaking surface of water.

Upon setting such a turtle trap, the stretchers are put in place to keep the trap from collapsing. A perforated tin can with a cover or a container made of hardware cloth, capable of holding at least a half pound of bait is hung in the middle of the trap. The best and almost universally effective bait is reasonably fresh fish; other somewhat satisfactory lures are fresh chicken entrails, other fresh, juicy meat or entrails, or melon rind. A prospective trapper should note the emphasis placed on fresh bait since it has been found that turtles spurn putrified materials.

If the turtles are wanted alive, as they would be if one were catching them for market, the trap should be set so that the hoops just break the surface of the water (FIGURE 4). A trap thus set makes it possible for turtles to get air to breathe and thus prevents death by drowning. In hot weather it is essential that the turtles be kept alive, as they decompose very quickly after drowning. Traps are tended and the catch removed morning and evening (FIGURES 5-6). Set in lakes or bayous, they give best results when situated near beds of water plants and in soft-bottomed areas. In rivers, the mouth should be pointed downstream and the trap anchored to keep it from being moved away by the current. For commercial trapping a minimum of four dozen such traps should be in operation simultaneously; this number can easily be handled by one man and

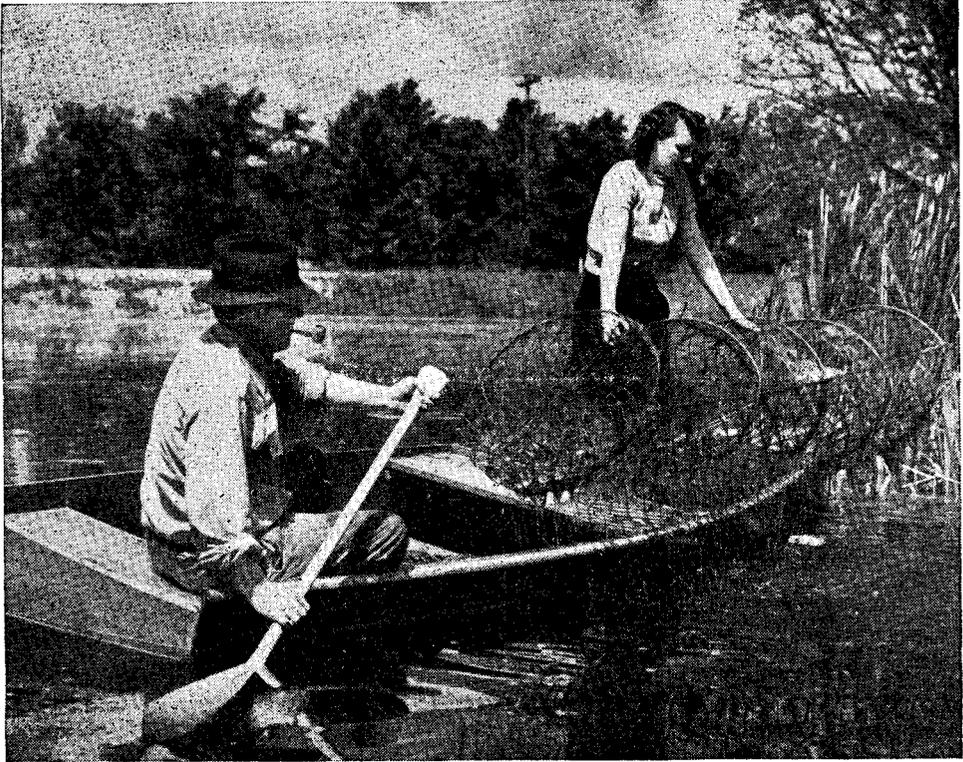


Figure 5. Lifting a turtle trap, note method of exerting pull on hoops. Copyright, The Detroit News.

a helper. Care should be exercised in taking the vicious common snapper or the alligator snapper from traps. A safe way to handle these animals is by the tail (FIGURE 7). The sharp claws of these and some others kinds must also be avoided. They may be easily transported for short distances in sacks made of stout cloth (FIGURE 8).

Another way of catching turtles, particularly applicable to the snappers, is that called "noodling" or "muddling." To get turtles in this way, one must probe or grope for them in their places of hiding or hibernation

under overhanging banks, submerged logs, in pools or streams, or in spring-fed tributaries that do not freeze over. Several hundred pounds of common snappers have been taken from very small areas by this means.

If one does not wish to move his traps from lake to lake for commercial trapping purposes, he might build any of several other types of traps limited only by his ingenuity and by legal restrictions of his state. For a starter he might try the substitution of wire fencing for seine twine on the type of trap just described. This more stationary type of trap would be admirably suited for obtaining turtles for personal use but would be



Figure 6. Turtle trap out of water. Copyright The Detroit News.

too cumbersome for a professional turtle hunter to move in numbers from one body of water to another. An individual might also hunt turtles with a spear and a jack-light (if legalized) or with a dip net, or he might try to catch them on a set line. A suitable set line is made by fastening a stout fish hook to a wire leader and this to substantial twine. The twine, about six feet long, is attached to a strong but flexible pole, about eight feet long. Such a pole should be pushed into the bottom of the water area to hold it upright and adjusted to keep the bait a few inches off the bottom. The hook is dressed with chunks of any of the baits listed for traps and will catch turtles of a size according to the hook used; within limits, the larger the hook, the larger the turtle. A still more sporting way of gathering



**Figure 7. Removing common snapper from trap. Tail hold used for safety. Copyright, The Detroit News.**

turtles in clear water is for an adept swimmer to don water goggles and to dive for them. Sizeable collections of sliders have been made with comparative ease by this means in southern latitudes.

There are several additional ways of catching turtles that may be used for reducing populations where the turtles have been shown to be undesirable. If great care is exercised to avoid the hazards of shooting over water, when such action is necessary, some turtles may be shot; certain kinds, such as most of the common pond turtles, afford targets while they bask



**Figure 8. Loading turtles in sack for transport over short distance. Copyright, The Detroit News.**

on logs; others such as the snappers and soft-shelled turtles, while they float near the surface of the water. Sometimes they may be seen in a torpid condition through clear ice and easily removed. In some situations, a low fence is practical and may easily be constructed to be non-negotiable to turtles. Such a fence erected around a small pond and having pits dug at various intervals along it to capture the turtles that come out on land will reduce a local population substantially if it is kept in operation throughout several seasons. By vigilance, in some instances, concentrated nesting areas may be found and eggs removed. Furthermore, turning over the soil, perhaps by plowing if the area is large, will unearth eggs which may be gathered and cooked for eating or transported for hatching to situations where the turtles are not undesirable.

## MARKETING

Local markets, in the northern states, can usually handle all of the turtles which trappers in the region can supply. Some such small dealers currently report that they have a ready market for all turtles that they can get, which, at present, is unfortunately few. Farther to the south, where turtles are often more abundant, it may be necessary to ship some for considerable distances to market.

Two principal approaches to the marketing of turtles thus exist. The professional trapper will select the one of these that will provide him with the greatest financial return. The choice will depend on the location and the size of the market that he can supply directly and on the location of his trapping activities, the nature of his transportation equipment, and the prices offered by wholesalers compared to the retail market.

If his personnel, equipment, scale of operations, and the location of his trapping activities permit, the trapper will probably elect to contract directly with restaurants, canneries, and small wholesalers. He will hold his turtles in a live pen (portable or stationary and preferably in running water for sanitary reasons) and will feed them fresh animal and vegetable foods. Fresh fish offal, fowl entrails, and vegetable discards are satisfactory and can often be obtained at little or no cost. Shipment of the turtles will probably be made at regular intervals. It is desirable to have a holding pen large enough to carry a sufficiently large poundage to buffer those periods when trapping success is less than shipment demands or to await favorable marketing conditions. Some fattening in live pens is advantageous and may improve the flavor of individuals from certain habitats. Most shipments are of live turtles packed in crates or light barrels with holes in them for ventilation (FIGURE 9). Packed in this way they tolerate a journey of several days, although in warmer weather some loss in weight by drying and by digestion of contained food will be experienced. Nearby markets may request dressed turtles and if so the dressed meat may be shipped iced or sharp-frozen as would be done for fish.

If the trapper cannot establish contacts with smaller individual dispensers of turtles, or if for other reasons it is impracticable to serve a



**Figure 9. Loading turtles in light barrel for shipment to market. Copyright, The Detroit News.**

more local, private trade, he can find ready outlet through larger distributors and in the markets of larger cities. Both live and dressed turtles are handled by these agencies.

Prices vary according to season and ordinarily range from approximately 4 cents to 9 cents per pound live weight and from 12 to 20 cents per pound dressed; present prices are, however, much higher. Retail prices range as high as 60 cents for a pound of dressed meat, and testify to the high regard in which turtle meat is held.

The turtle trapper can do much to expand the turtle market by doing all that he can to restore the turtle to the high and popular place that it held in the diet of earlier Americans. In the past twenty years it seems that the demand has lessened and the market has dwindled to the point where the ingenuity of the trapper in placing his wares will go a long way towards rebuilding the trade and re-vitalizing the industry. This will be an important step in meat conservation, especially in time of war.

Regarding the kinds of turtles that may be marketed there is no limit. However, in the past, the principal sales other than those of the diamond-back terrapin and sea turtles have been of the snapping turtles, the sliders, and the soft-shelled turtles. Since all other kinds are edible, use of some other medium and smaller kinds, too, should be encouraged. One must not presume, however, that the market that he intends to supply will accept any kind of turtle that he will send. He should first send samples or use other means to learn exactly which kinds will be acceptable.

### DRESSING

Dressing turtles for market or for one's own table brings up the problem of waste. If one is cleaning turtles for sale, the corollary problem of compensation in price that he should expect for marketing dressed

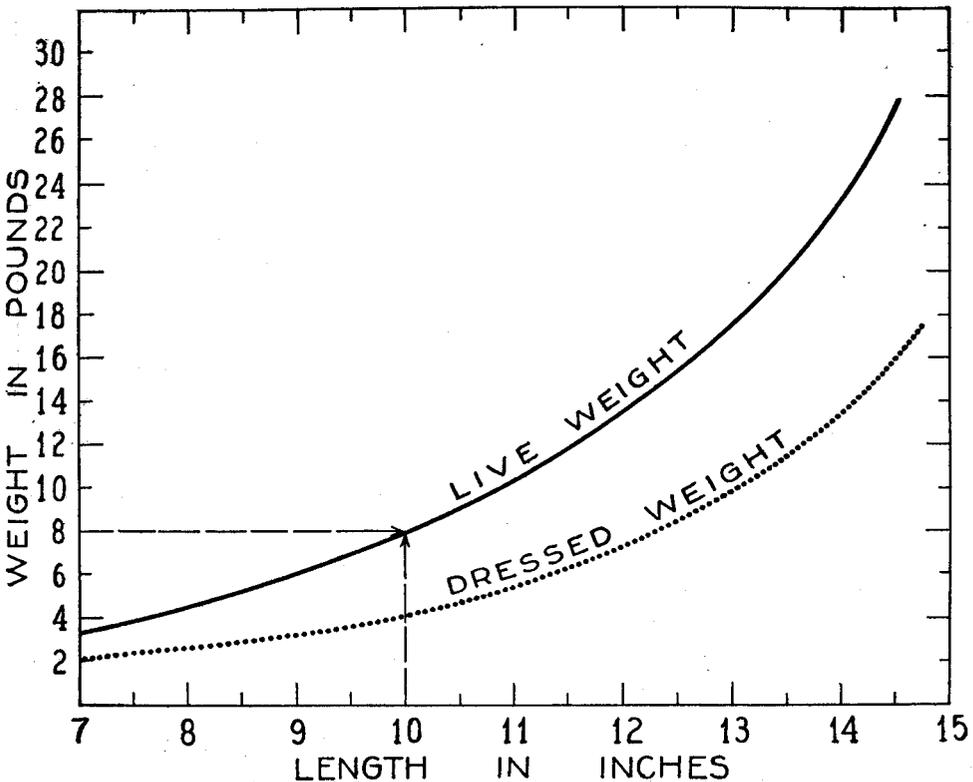


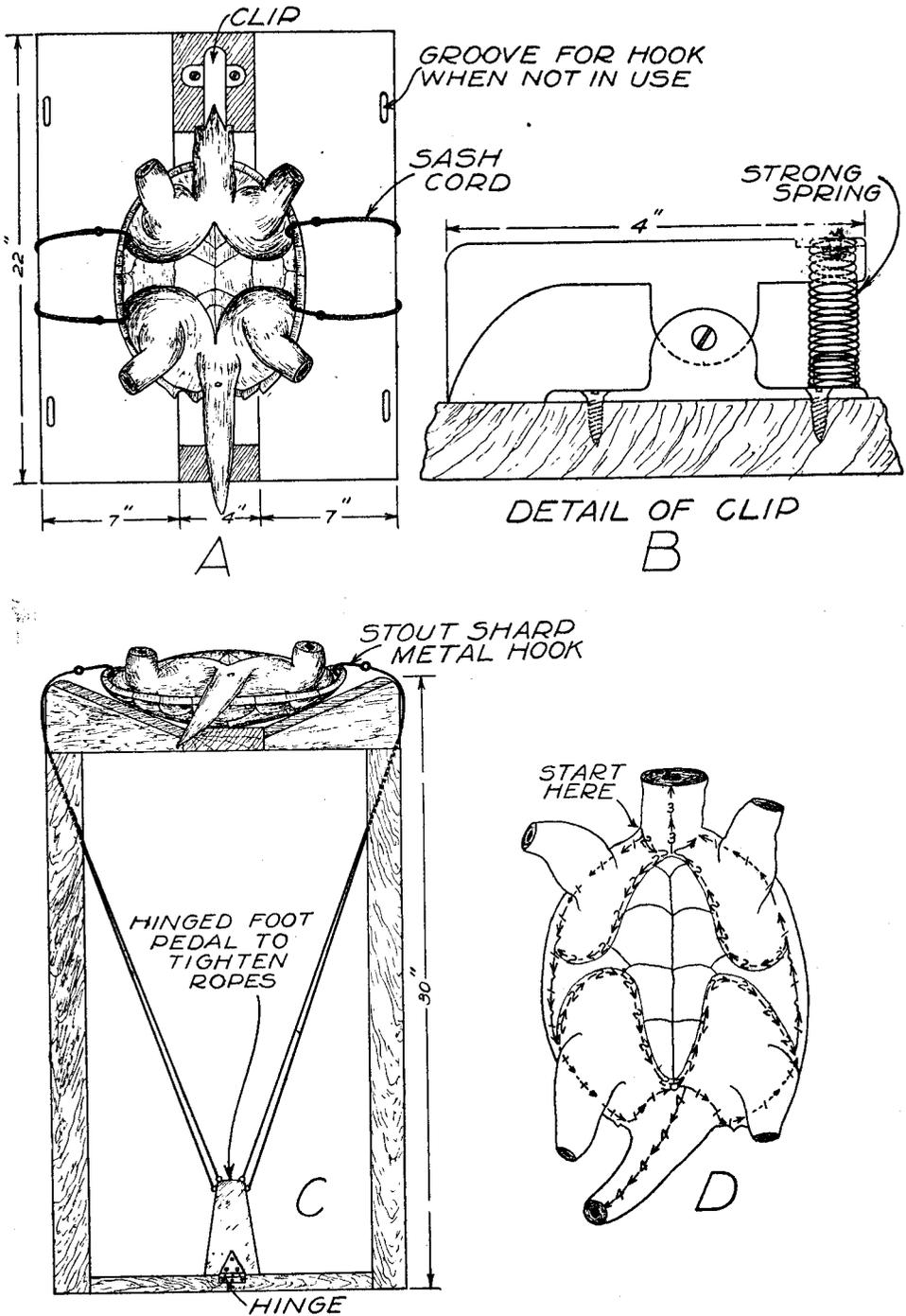
Figure 10. Relationships between length of snapping turtle (measured horizontally through shell on back) and weight alive and yield of meat (dressed weight).

rather than live animals arises. Depending on the kind of turtle, the amount of food contained in its digestive tract, the number of mature eggs present in females, and the skill of the operator, turtles dress off from one-third to two-thirds of their total live weight.

The approximate relationships among live weight, dressed weight, and length for the common snapping turtle (*Chelydra serpentina*) are shown in FIGURE 10. The solid black curved line in this figure is a free hand curve drawn through the points of average lengths and weights of 150 snappers lumped in half-inch size groups. Following the dash lines bearing arrows, one may see the method for estimating the live weight of one of these turtles if the length is known and vice versa. The length here used is the greatest overall length measured horizontally through the shell on the back, not over its curvature. Thus it may be seen that a turtle 8 pounds in weight would be approximately 10 inches long, or, conversely, a 10-inch turtle would weigh about 8 pounds. From the few records available, a dotted curve has been added to this chart to show the estimated yield of meat (dressed weight) of snappers of various lengths. A 10-inch turtle with an approximate live weight of 8 pounds would thus yield about 4 pounds of meat. This 4 pounds would not include the shell, eggs or liver, which can also be used. It seems probable that there is proportionately less waste in larger specimens than in smaller ones since these turtles tend to increase more rapidly in weight than in length as they grow older; this is illustrated by the relationships of the two curves which show how much a turtle may dress off in average handling. Soft-shelled turtles are reported to yield more meat per unit of weight than do snappers, and other kinds, less.

The actual process of dressing a turtle is easier and, with practice, faster than cleaning a chicken and as rapid as preparing a rabbit. Suggested steps are (FIGURE 11, D); (1) decapitate; (2) chop off each of the four feet to remove the hazard of being clawed; (3) fasten tail to a stationary object and cut skin from around lower edge of back shell; (4) cut off belly plate; (5) skin the quarters; (6) skin neck and tail; (7) remove quarters and neck and tail; (8) if the turtle is large, take out the digestive organs and remove the two tenderloin strips along the backbone. If a small, sharp knife is used and if care is taken to make the cuts deftly and at the joints between bones, the process is speeded considerably. Even a beginner can easily learn to do a ten-pound snapper in less than five minutes. The whole process, particularly the handling of many turtles, is facilitated by use of a frame with adjustable hooks or with some vice-like device that can be quickly and easily regulated to accommodate turtles of different sizes (FIGURE 11, A-C). For turtles other than the snappers and soft-shelled ones, a small saw or hand axe is requisite for cutting the bridge between carapace and plastron.

Removal of fat and a rinse in water completes the process of dressing. It is well to clean away all fatty tissue since it may be strongly and unpleasantly flavored.



**Figure 11. Sample equipment and method for dressing a turtle.**  
**A. Rack for holding turtles for dressing with specimen in place, plan view.**  
**B. Detail of spring clip used to hold neck in place.**  
**C. Side view of rack showing foot pedal for tightening hooks to hold turtle in place.**  
**D. Sequence of cuts used in dressing turtle; follow numbered arrows.**

The ordinary results of dressing a turtle are six chunks of meat, the four quarters, the tail, and the neck, plus the giblets. If less waste is desired, the turtle need only be skinned, the digestive organs and fat removed, and the horny scales flaked off the carapace. The turtle may then be offered for sale in its own bony shell; the bone and fragments of meat that will remain attached to the shell and the shell itself will give a good stock for broth or soup and the larger cuts of meat may be separately prepared.

### PREPARATION FOR EATING

Most kinds of turtles may be served in several ways, and, properly prepared, all are equally delectable. Epicures have many special techniques for readying turtle meat for eating; however, no complicated rituals are necessary to render delightful dishes with turtle meat since the quality of the flesh is so high. Any culinary artist of average skill can create new methods of preparing turtles for the table. A few simple, proven recipes follow; some of these are from our own experience and others have been given by SPEAKER (1942) and by CLARK and SOUTHALL (1920). Current cook-books give additional recipes.

#### Turtle-on-the-Shell

Obtain one turtle weighing between one and two pounds alive for each portion desired. Clean and skin but do not remove quarters or neck or tail from back shell. Stuff with sage dressing and replace belly shell. Wrap limbs and neck with thin bacon strips held in place with small skewers. Bake well in moderate oven. Remove belly shell and serve each turtle in its own shell as a single portion with shoestring potatoes, biscuits, and honey.

#### Turtle Cutlet

Take lean, boned turtle meat, pound like cube-steak, dip into egg, roll in meal, and fry in hot fat.

#### Turtle Sausage

Cook 2 pounds of turtle meat until tender. Season and run through food chopper. Add two eggs, make patties and drop into hot fat or fry right off of a spoon until brown.

#### Stewed Turtle With Cream

Place in a saucepan 2 tablespoonfuls of butter and 1 of rice flour, stir over fire until it bubbles, then stir in a pint of thin cream, 1 tablespoonful of salt,  $\frac{1}{2}$  tablespoonful of white pepper,  $\frac{1}{4}$  tablespoonful grated nutmeg, and a very small pinch of cayenne. Add 1 pint of pre-cooked turtle meat and stir it all over a moderate fire until scalding hot. Keeping contents of saucepan hot, but not boiling, stir in 4 well-beaten yolks of eggs. Do not boil but pour at once into tureen containing 1 tablespoonful of lemon juice.

### Turtle Drumsticks

Place alternate cubes of turtle meat and veal on skewers. Dip in thick flour and egg batter. Drop in deep, hot fat and brown rapidly. Pour off fat and add about  $\frac{1}{4}$ -inch of water to the frying pan and roast in oven at about 350 degrees F. until tender. Serve hot from a covered dish.

### Curry of Turtle

Cube one pound of turtle meat and brown in butter with diced onions. Add a diced potato, carrot, some salt, pepper, and  $\frac{1}{2}$  teaspoonful of curry powder. Simmer in a small amount of water until meat is tender. Pour over molds of cooked rice to serve.

### Fried Turtle

Brown cleaned meat in beef tallow and butter, or, if you prefer, soak cleaned meat overnight in dilute vinegar (a tablespoonful to a quart of water), rinse, and then brown. Pour off the grease, season, add a few bits of onion, enough water to cover, and simmer until the flesh begins to fall from the bones. Serve hot or cold with relishes, potato chips, and a dry wine.

## CONSERVATION OF TURTLES

The five principles currently applied to the conservation of other fishery resources are also applicable to turtles: (1) biological investigations; (2) protective legislation; (3) artificial propagation; (4) public education as to economic relations and conservation means; (5) maximum utilization of the resource compatible with the highest possible sustained yield. At the present time little progress has been made in the application of these principles to the turtle fishery although each is known to have value in sustaining yield in other sport and commercial fisheries. Most persons are acquainted with all of these conservation practices as regards our food and game fishes; a discussion of their importance to the turtle fishery follows and is designed to give impetus to the more complete expansion of this fishery.

### BIOLOGICAL INVESTIGATIONS

Biological investigations have as their principal aim the complete study of the life ways or natural history and requirements of the species concerned. Many naturalists have studied turtles and although much is known regarding various aspects of their life histories, such practical features as rates of growth, natural rates of repopulation, and sizes of existing populations are examples of aspects in general unknown. Some records have been kept on growth rate in captivity and a few workers are studying growth in nature by measuring the turtles, marking them for future recognition by cutting notches in the shell, and recapturing them on later dates to be measured again. From population estimates numbers per acre can be computed and the rate and extent of safe exploitation can be planned. In addition, knowledge of growth rate and rate of reproduc-

tion will indicate the time required to maintain an optimum supply for the fishery and may be used to compute the numbers that should be left as a breeding stock.

#### PROTECTIVE LEGISLATION

Legislation to regulate the turtle fishery obviously depends in turn on the results of biological investigations. A knowledge of the time and place of breeding, the size and number of years required to attain sexual maturity, and population densities is basic for regulatory measures. From this information open and closed seasons, size and catch limits, and types of gear may be specified. It would seem logical that except in regions where control is required, universal protection should be given during nesting season, and at other times as well, for turtles that are at present over-exploited or infrequent for other reasons. Examples of these are the wood turtle, the diamond-back terrapin, and others. Some states already have laws protecting turtles, including the kinds just mentioned, and others might do well to follow this practice for locally decimated or rare forms. Certainly turtles should be protected from all forms of wanton destruction.

Specification of legal gear is requisite for a controlled fishery. Traps for taking turtles must have sufficiently large mesh to allow for both the escape of food and game fishes and smaller turtles. In general, three to four-inch square mesh might be specified by law since it is generally suitable, although slight modifications to meet local circumstances may be necessary. In any event, conservation authorities in the region where trapping is to be done should first be consulted and their approval of mesh-size and type of trap should be obtained.

In most states no special licenses are required for turtle trapping, often only a sport-fishing license is needed. It may be desirable, at least in the better trapping areas, to have a licensing system for commercial trappers in order to obtain funds for the protection of turtles to help in assuring a successful future for the industry.

#### ARTIFICIAL PROPAGATION

Artificial propagation of fresh-water turtles either for re-stocking or for market has not been practiced in this country. No apparent need has existed as yet for the replenishment of the supply by these means and little awareness exists of the commercial possibilities of such a venture. The diamond-back terrapin has been successfully cultured under artificial conditions by the former U. S. Bureau of Fisheries, now a part of the U. S. Fish and Wildlife Service (HILDEBRAND, 1932; HAY and ALLER, 1913). Also, soft-shelled turtles have been propagated for the food market for many years in the Orient (MITSUKURI, 1905). Soft-shelled and most other North American varieties might do well under culture in the warmer parts of the United States. Turtle farming could go a long way toward alleviating any undue strain on the existing populations due to increased

utilization. Cultural methods might also be applied for the rearing of specimens for the pet shop trade and for the experimental and study needs of biological laboratories in schools and in research institutions.

If one were to culture predacious turtles such as the snappers or soft-shells, the first requisite would be to have a series of pools for the segregation of various sizes. It would appear desirable to have these pools so located that a small current of water passes through them to keep them clean. For the purpose of removing turtles with ease it would be desirable to have means for draining each enclosure, preferably into a seining box or other structure where the turtles might be concentrated for easy handling. Each cultural pool must be enclosed by a low, turtle proof fence. Bottom materials should be soft enough to a depth of several inches to provide hibernation quarters. It should also be possible to regulate the water level in order to keep it fairly constant during all seasons. One should use care not to select a site that will be washed out by the first flood waters. The number of ponds to be had depends on the species and on the sizes to be raised.

One pond for breeding adults is needed. This pond should have sloping sandy banks extending up perhaps four to five feet above water level. If this pool is secluded and the turtles undisturbed, it is likely that any species will nest although snappers are known to have shown reticence regarding nesting in captivity. Cautious daily examination of the earth banks of this enclosure during the nesting season will show the nest sites. A wire screen may be placed over each nest found in order to hold the young when they have hatched, which may be from a few to several weeks, depending on the climatic conditions. Young may be removed from under the screens and transferred to a nursery pond. At the end of the first, and of each succeeding year's growth, the turtles may be sorted according to size and placed in separate ponds accordingly. The numbers of sizes to be thus treated must of necessity depend on the number of ponds available for segregation. Isolation of the smallest ones at least is important in order to avoid cannibalism by larger ones. It may be advantageous to have a hot-house for the young to encourage growth during colder months.

If the turtle species chosen will not deposit eggs, these may be collected in nature and carefully transplanted to the rearing enclosure for hatching. Many of the details of this handling as well as of other cultural practices, including feeding, ratio of adult males to females, numbers of nesting females per unit of pond area, food and feeding techniques, and control and eradication of diseases will have to be learned by experimentation. A varied diet of plant and animal remains, a minimum of the waste from uneaten food and from feces, and slow changing of water will doubtless be great aids in the prevention of disease.

Turtle propagation of this kind might very easily be conducted in conjunction with the operation of another fishery. Coarse fishes and entrails could be used as food at little or no cost and such an operator would already be familiar with marketing techniques and existing markets. Depending on the species chosen and the length of the growing season in

the area where the turtle farm is located, it will take from a few to several years to raise turtles to a size large enough for the food market although many individuals of a size suitable for the novelty trade could easily be raised each year.

#### PUBLIC EDUCATION

In the last decade more has been done to advance public interest and support in wildlife utilization and conservation than in any such earlier period. It is obvious that the final application of innumerable technical findings depends on the angler or commercial fisherman. An examination of the bibliography at the end of this bulletin will show the reader a sample of what has been done to bring before him the factual findings of scientific investigators regarding turtles and their fishery. Similar publications on other animals are many and evidence the sound progress being made in this direction. Books and pamphlets such as these will considerably enhance the knowledge of a potential turtle hunter and should be consulted by him for details of information beyond the scope of the present paper.

#### UTILIZATION

Unfortunately gaps in existing knowledge regarding turtles make it impossible to specify maximum limits of exploitation. In certain regions, however, the rarity of some kinds is common knowledge as, for example, the wood turtle in the northeastern states. At present, then, the extent beyond which utilization may not be pressed must be defined from the observations on population levels. At no time should a carefully prepared statement from a competent naturalist be ignored.

At least for commercial turtle hunting in inland waters, the fishery is somewhat self-regulatory. It is improbable that any species of turtle in this area will become extinct by these means because the fishery would become economically impracticable before it is exhausted. However, the approach of dangerously low levels may be avoided by imposition of size limits. This may be done voluntarily by the primary handler where regulatory laws do not exist. Outlawing of novelty trade in baby turtles of kinds having potential food value would doubtless be a step in the right direction.

The cardinal principle of holding turtle exploitation for food at that level which will guarantee the highest possible perpetual yield should be universally applied. Obviously the application must vary in different parts of the country.

It is easily seen that the existing supply of fresh-water turtles, at least, can yield a very significant poundage of nourishing food for man. Although the numbers that may actually be taken may no more than supply local needs, it seems that some might be prepared for use in shipment to war ravaged lands. This would be particularly so if the demand in the United States cannot be brought up to its former high level.

## BIBLIOGRAPHY

Publications marked with an asterisk (\*) will be found particularly informative to persons desiring more information on turtles—their kinds, their ways of life, and how to tell them apart. Some of these writings may be found in your local library, others may be secured through any reliable book dealer.

- \*BARCOCK, HAROLD L. 1938. Field guide to New England turtles. *New Eng. Mus. Nat. Hist., Nat. Hist. Guides No. 2*, 56 pp.
- BISHOP, SHERMAN C., and F. J. W. SCHMIDT. 1931. The painted turtles of the genus *Chrysemys*. *Field Mus. Nat. Hist. Publ. Zool. Ser.*, 18(4): 123-139.
- BLANCHARD, F. N. 1925. A collection of amphibians and reptiles from southern Indiana and adjacent Kentucky. *Pap. Mich. Acad. Sci., Arts and Letters*, 5: 367-388.
- BLATCHLEY, W. S. 1891. Notes on the batrachians and reptiles of Vigo County, Indiana. *Jour. Cinc. Soc. Nat. Hist.*, 14: 22-35.
1899. Notes on the batrachians and reptiles of Vigo County, Indiana. II. [In] *24th Ann. Rept. Dept. Geol. Nat. Res. Ind.*, pp. 537-552.
- CAGLE, FRED R. 1941. A key to the reptiles and amphibians of Illinois. *Mus. Nat. and Soc. Sci., Southern Norm. Univ., Contrib.*, 5: i-iv, 1-32, 3 pls., 64 figs.
- \*CAHN, ALVIN R. 1937. The turtles of Illinois. *Ill. Biol. Monogr.*, 16(1-2): 1-218, illus.
- CLARK, H. WALTON, and JOHN B. SOUTHALL. 1920. Fresh-water turtles: a source of meat supply. *U. S. Bur. Fish. Doc. 889, App. VII Rept. U. S. Comm. Fish.*, (1919), 20 pp.
- \*CONANT, ROGER. 1938. The reptiles of Ohio. *Amer. Midland Nat.*, 20(1): 1-200.
- CULBERTSON, GLENN. 1908. Some notes on the habits of the common box turtle (*Cistudo Carolina*). *Proc. Ind. Acad. Sci.*, 17(1907): 78-79.
- \*DITMARS, RAYMOND L. 1936. *The reptiles of North America*. 476 pp., illus. New York.
- EIGENMANN, C. H. 1896. The inhabitants of Turkey Lake. Testudinata. *Proc. Ind. Acad. Sci.*, 5: 262-264.
- EVERMANN, B. W., and H. W. CLARK. 1920. Lake Maxinkuckee, a physical and biological survey. *Indianapolis, Dept. Cons. State of Ind.*, vol. 1.
1930. The painted turtle, *Terrapene ornata* (Agassiz) in Indiana. *Copeia*, 1930(2): 40-41.
- GRANT, CHAPMAN. 1935a. Secondary sexual differences and notes on the mud turtle, *Kinosternon subrubrum* in northern Indiana. *Amer. Midl. Nat.*, 16: 798-800.
- 1935b. Notes on the spotted turtle in northern Indiana. *Proc. Ind. Acad. Sci.*, 44: 244-247.
- HAHN, WALTER L. 1908. Notes on the mammals and cold-blooded vertebrates of the Indiana University Farm, Mitchell, Indiana. *Proc. U. S. Nat. Mus.*, 35: 545-581.
- HAY, O. P. 1892. The batrachians and reptiles of the state of Indiana. [In] *17th Ann. Rept. Ind. Dept. Geol. Nat. Res.*, pp. 410-622.
- HAY, W. P., and H. D. ALLER. 1913. Artificial propagation of the diamond-back terrapin. *U. S. Bur. Fish. Econ. Circ. No. 5*, pp. 1-14.
- HILDEBRAND, SAMUEL F. 1932. Growth of diamond-back terrapins, size attained, sex ratio and longevity. *Zoologica*, 9(15): 561-563.
- LAGLER, KARL F. 1940. A turtle loss? *Amer. Wildlife*, 29(1): 41-44.
1941. Predatory animals and game fish. *Amer. Wildlife*, 30(2): 87-90.
- 1943a. Methods for collecting turtles. *Copeia*, 1943(1): 21-25.
- 1943b. Food habits and economic relations of the turtles of Michigan with special reference to fish management. *Amer. Midl. Nat.*, 29(2): 257-312.
- MCATEE, W. L. 1907. A list of the mammals, reptiles, and batrachians of Monroe County, Indiana. *Proc. Biol. Soc. Wash.*, 20: 1-16.
- MITSUKURI, K. 1905. The cultivation of marine and fresh-water animals in Japan. *Bull. U. S. Bur. Fish.*, 24(1904): 257-290, illus.

- MYERS, GEORGE S. 1926. A synopsis for the identification of the amphibians and reptiles of Indiana. *Proc. Ind. Acad. Sci.*, 35 (1925) : 277-294.
1927. Notes on Indiana amphibians and reptiles. *Proc. Ind. Acad. Sci.*, 36 (1926) : 337-340.
- \*POPE, CLIFFORD H. 1939. Turtles of the United States and Canada. 343 pp., New York.
- \*RUTHVEN, ALEXANDER G., CRYSTAL THOMPSON, and HELEN T. GAIGE. 1928. The herpetology of Michigan. *Univ. Mich. Mus., Mus. Handbook Ser. No. 3*, 229 pp., illus.
- SPEAKER, EVERETT B. 1942. Me-Shi-Ke, the turtle, a very tasty fellow. *Iowa Conservationist*, 1(10) : 3-4.
- SPRINGER, STEWART. 1927. A list of reptiles and amphibians taken in Marion County, Indiana, in 1924-1927. *Proc. Ind. Acad. Sci.*, 37 (1927) : 491-492.
- STEJNEGER, LEONHARD, and THOMAS BARBOUR. 1943. A check list of North American amphibians and reptiles. *Fifth Ed. Bull. Mus. Comp. Zool.*, 93(1) : i-xix, 1-260.
- SURFACE, H. A. 1908. First report on the economic features of turtles of Pennsylvania. *Zool. Bull., Pa. Dept. Agr.*, 6 : 105-196, illus.
- TRUE, FREDERICK W. 1893. Useful aquatic reptiles and batrachians of the United States. *U. S. Comm. Fish and Fisheries, Fisheries and Fishery Industries of the U. S.*, Section 1, pp. 141-162.