THE PREHISTORIC RECORD OF FISHES IN SOUTH DAKOTA

David C. Parris
New Jersey State Museum
Trenton, NJ 08625

Gale A. Bishop
South Dakota School of Mines and Technology
Rapid City, SD 57701

Kenneth F. Higgins
South Dakota State University
Brookings, SD 57007

SOUTH DAKOTA'S FOSSIL FISHES

Fossil evidence from many locations in South Dakota and nearby areas documents the presence of many kinds of marine and freshwater fishes of the past. South Dakota's fossil fish date back to the Paleozoic Era, approximately 500 million years ago. The fossil evidence of prehistoric fishes may include entire skeletons, or various bones, teeth, ossified structures, scales, and otoliths. However, trace fossils of fish may also be recognizable in the fossil record, including resting traces and nesting traces.

The literature lists hundreds of species and morphospecies of ancient fish or fish-types which have been identified from fossil remains discovered in South Dakota and the surrounding region. Many of the fossil fish are archived and/or displayed either at the Museum of Geology and Paleontology at the South Dakota School of Mines and Technology in Rapid City, or the Black Hills Institute of Geological Research in Hill City. More specimens have been found in western than eastern South Dakota, but this is to be expected because layers of sediment are better exposed west of the Missouri River, particularly in and around the Black Hills and Badlands regions. Furthermore, glacial deposits left by continental ice sheets of the last one million years cover much of eastern South Dakota's bedrock.

A summary of South Dakota's record of fossil fish, based on published literature and museum records is presented here. It is only a basic introduction that demonstrates the exceptional spectrum of resources resulting from 500,000,000 years of geologic time. No doubt this will be greatly increased and enhanced during future years as more evidence is found, identified, and archived for future generations.

What should you do if you find or are given a fossil fish from a South Dakota locality? First, be aware that fossils of fish or their parts from South Dakota are fairly rare and they contain insight into an as yet poorly understood geologic past. Each fossil is a piece of an information puzzle, and potentially a very important one. If possible, identify where the fossil was found, how it was

found, and any environmental or cultural features associated with it. Retain all information with the specimen, using a label. We highly recommend that you contact a specialist at a university or a museum to share the information about your fossil, and to determine if you should retain the fossil or not.

Fossil specimens of vertebrates are protected by laws and regulations wherever they are found on state, federal and/or Native American tribal trust lands; special permits are required to collect on these lands. Fossils from privately owned lands belong to the landowner, and you should get written permission to search for or collect fossils on their lands.

South Dakota has an amazing record of fossil fish that has brought international fame to our state. The oldest fish found here are essentially as old as any known in the world. They are thus among the oldest vertebrates (backboned animals) in the world as well. Many of the fossil fishes of South Dakota are from marine environments, in contrast with our basic impression of the Great Plains being remote from bodies of saltwater.

The oldest fish fossil known from the Black Hills region is called *Anatolepis* cf. *heintzi* and comes from the Bear Lodge Mountains, of Wyoming (Repetski, 1978). It is actually the oldest known fish in the world and comes from a rock formation named for Deadwood, South Dakota. Other ancient fish are preserved as fragments reported from the Whitewood Formation in the Black Hills, and are about 400,000,000 years old. Barely identifiable as fish, they are pieces of bony armor, which have been attributed to primitive, jawless fishes called agnathans. Elsewhere in the world, where more complete specimens have been found, their body shapes are seen to be vaguely fishlike, but appear unlike anything now alive. Strange to say, these bizarre creatures do have a few living relatives, one of which is still alive in South Dakota waters. The lamprey, which also lacks a true jaw, belongs to this most ancient and primitive class of vertebrates.

Another very ancient group of fishes, of which there are many living relatives, is the sharks. Modern sharks are essentially marine fishes (as are the vast majority of their extinct relatives) and thus absent from modern day South Dakota. However, the fossil record of sharks (and the related rays and skates) in South Dakota is very extensive, extending from hundreds of millions of years ago until perhaps about fifty million years ago, when marine waters receded from the mid-continent for the last time. Sharks belong to a class of vertebrates called the Chondrichthyes, meaning that they have skeletons primarily of nearly unpreservable cartilage, so the vast majority of shark fossils are represented by teeth alone.

A group of early shark forms, the bradyodonts, have been found as fossils in the Englewood Formation of the Black Hills, about 300 million years old, in rocks of the Paleozoic Era (age of ancient life). There are other occurrences of sharks later in that era, which extends until about 250 million years ago including some early shark forms known as hybodonts and edestids, later in that time interval (Cicimurri and Fahrenbach, 2002).

Bony fish (Class Osteichthyes) are also found in the older rocks of the Black Hills, most notably in the Minnekahta Limestone of Permian Age, the last period of the Paleozoic Era. Preservation of these fish is so remarkable that

whole skeletons of a fish called *Platysomus* have been found, and they are easily recognizable as fish (Hussakof, 1916).

The record of fish fossils from South Dakota is even more extensive in the next era, the Mesozoic Era (age of middle life), which is divided into three time periods, the Triassic, Jurassic, and Cretaceous. Inland seas covered what is now South Dakota for much of that time, and fish fossils occur in many of the resulting sediments. Fossils are rare in the Triassic red beds in South Dakota. However, fish fossils have been described from Jurassic rocks of the Black Hills (Eastman, 1899). The Cretaceous Period, the name indicating that it was a time of deposition of widespread chalk sediments, has a particularly outstanding record of fossil fishes. During the Cretaceous Period the Western Interior Seaway (an epeiric sea), 4,800 km long and averaging 1,600 km wide, provided a marine waterway connecting the Arctic Ocean to the Gulf of Mexico (Figure 1). What is now South Dakota would have been located near the center of this seaway. Deposits in the seaway formed three primary types of sedimentary rocks; chalk, mudstone, and sandstone. The chalk contains the remains of many kinds of microorganisms and the shales are formed from silt and clay sediments. It is within these types of rock layers that we find abundant evidence of ancient fish.

Two fish specimens have been found, preserved in three dimensions, in the Early Cretaceous Lakota Sandstone, a specimen with durable enameled (ganoid) scales from Rapid City and another named *Lepidotus lacotenus* from the hogback at Sturgis). Another of the Lower Cretaceous formations, the Mowry Shale, consists of a claystone that weathers to small fragments, and preserves abundant scales of fish (Gries, 1996) on the chips of rock.

Among the most interesting Cretaceous rock units preserving fossil fish is the Carlile Formation of the Black Hills. The Carlile Formation includes a sandstone unit, the Turner Sandy Member, which contains such vast numbers of fossil shark teeth that they would be seen by even the most casual observer. These teeth, the most abundant fossils in the sandstone, comprise 17 different kinds of shark (Capetta, 1973; Eveтts, 1979).

A particularly distinctive shark from the Carlile Shale is called *Ptychodus mortoni*, a shark with flattened, closely arranged, button-like teeth on the floor and roof of its mouth for breaking and crushing clam shells. Each tooth is peg-like and covered with a fingerprint-like series of ridges and grooves. The Carlile has also produced numerous skulls of fish associated with a fossil lobster zone (Bishop and Williams, 1986) and one three-dimensional fish, *Syllaemus hanifi,* preserved in a concretion. Concretions are rock-like masses that sometimes form on the sea bottom around decomposing animals, often preserving them in exquisite detail.

During September 2003, a South Dakota School of Mines and Technology and United States Bureau of Reclamation crew, joined by local citizens, excavated a large fish from the Carlile Shale at Belle Fourche Reservoir as a salvage collection. The fish, represented by its head and part of its vertebral column, was scattered across several meters of the ancient sea bottom in near articulation, but with the skull and parts of the vertebral column somewhat disarticulated. The fish was collected by traditional paleontological techniques: delineation of the skeleton, isolation into a block of rock containing the bones by trenching,

separation into smaller blocks that can be moved, protection of exposed bone by toilet tissue, encasement of each block within plaster impregnated bandages, flipping and closure with additional bandages, and documentation of the bones and casts in the field. The specimen was then taken into the preparation laboratory at the Journey Museum for careful removal of the rock from the bone, consolidation of the fragile bones with glue, and TLC by a museum volunteer. Once prepared it will be described, documented, and possibly published or included in an exhibit.

In the collections of the Black Hills Institute of Geological Research is a paddlefish fossil imprint from the Lance Formation of eastern Wyoming. The Lance Formation is of latest Cretaceous age and is a deposit laid down by freshwater, not marine sedimentation. Other paddlefish fossils are known from China; the only two places in the world where populations of paddlefish exist today.

The Niobrara Formation is a classic Cretaceous marl or chalk, built of the skeletal materials of phytoplankton called coccoliths. Throughout the Great Plains the Niobrara Formation is noted for its exquisite preservation of marine fossils, many of which have been found in South Dakota (Martin et al., 1998). The formation is widespread here, especially in the southeast and southwest parts of the state, although it is often poorly exposed.

One of the most famous of the fossil fish of the Niobrara Formation is the huge Bulldog Fish, *Xiphactinus audax*. A spectacular specimen is exhibited at the Museum of Geology at the South Dakota School of Mines and Technology, but a number of other specimens have been found. Its remarkable jaws are armed with huge teeth, implanted in sockets. (Most fishes have teeth fused along the bones of the jaws.) A smaller (but still impressive) relative is called *Ichthyodectes*, and it too is known from a fair number of specimens.

Another fossil fish with a bizarre anatomy is called *Enchodus*, known from several species and hundreds of South Dakota specimens. Specimens range from tiny delicate panfish sizes to forms that are more than a yard long. All have well developed stabbing teeth, the largest being a pair developed on bones of the palate! Paleontologists jokingly refer to *Enchodus* as the "saber-toothed herring".

Many of the fossil fishes of the Niobrara Formation are also found in the overlying marine rocks called the Pierre Shale. It is casually (but appropriately) called the South Dakota State Rock, not merely because it took its name from Pierre/Fort Pierre, but because it truly characterizes the state. It is widespread in both East River and West River areas, giving the gray to black color in rock exposures familiar to all travelers across South Dakota. The name is used for the formation throughout many parts of the Great Plains and eastern Rocky Mountains. Wherever it is found, montmorillonite clay comprising it is subject to change to "gumbo" when wet, creating difficulties and consternation for anyone who ventures off pavement in any weather wetter than dew. Like the Niobrara Formation, however, the Pierre Shale is of marine origin, and contains a wonderful treasure of fossil fishes.

The lower portions of the Pierre Shale have been a source of fossil fishes (and famous fossil reptiles) for many years and have yielded specimens of *Xiphactinus, Ichthyodectes, Enchodus,* and many others. The upper levels of the formation were not so well prospected and as of 1989, no fish had been reported from the upper

levels at all, except for occasional mention of vertebrae or isolated teeth (Bishop, 1981). Expeditions along the Missouri River, led by the South Dakota School of Mines and Technology, have since done much to fill that void. Several of the discoveries have been important for interpretation of fish paleobiology and age determination of rocks (biostratigraphy) nationwide.

An unusual occurrence of fossil fish preserved as part of residue in the gastric tract of a large fossil marine lizard (mosasaur), *Tylosaurus proriger*, is exhibited in its plaster jacket at the Museum of Geology in Rapid City. The jacket contains the vertebrae, pelvic and limb bones of the mosasaur (*Tylosaurus*) as well as the preserved remains of the animals (a fish, a bird and a smaller mosasaur) that it ate shortly before it died. Other fossil fish exhibited at the Museum of Geology include a fish preserved in a concretion in three dimensions (probably *Apsopelix anglicus*) collected by Lauren Hill from the Pierre Shale at Oacoma and donated by Samual Bice.

One very important discovery occurred in 1995, when members of a South Dakota School of Mines and Technology field party found a fish spine in the Pierre Shale on the Crow Creek Reservation in Hyde County. This fossil was well known from formations on the Eastern Seaboard, Europe, and Africa, and was called *Cylindracanthus*, meaning a cylindrical spine. It seemed obviously from a fish, but no other skeletal parts were known, and no one was certain even where it belonged on the fish. The South Dakota specimen, however, was better than any other, and it had well-preserved tiny teeth! After many comparisons of these teeth to those of other fish, researchers concluded that *Cylindracanthus* was related to sturgeons and paddlefishes (Parris *et al.*, 2001). Young paddlefish have similar teeth, and their skeletons are largely cartilage, unlikely to be preserved. What a nice connection to the fish of present-day South Dakota!

Fossil fish comprise the second most abundant fossil group in the Hell Creek Formation, the last of the Cretaceous sediments to be deposited, and representing primarily freshwater environments. A listing of all species from the Hell Creek Formation in the Dakotas includes nine kinds of fish, among them sharks, sawfish, rays, sturgeons, bowfins, gars, and others of less certain relationships (Pearson *et al.*, 2002).

The Cenozoic Era (age of new life) began about 65 million years ago and continues to the present. Early in this era the seas receded from the interior of the continent, and the geologic record in South Dakota has since consisted of non-marine rocks. Fish fossils are not so likely to be found in such rocks, and the famed fossil beds of the Big Badlands are not good fossil fish territory. Although a few remains of freshwater fishes have been recovered from these rocks, designated as being of Tertiary Age, they have not added much to our knowledge of the fishes of that time. Notable exceptions are the records of early catfishes, discovered in Tertiary age sediments (Lundberg, 1975). They are notable early records of a fish family that has remained of prime importance in South Dakota ever since.

The Ice Age (Pleistocene Epoch) occurred during the last one million years. It is represented by many fossil localities in South Dakota (Pinsof, 1985), one of which is the Ree Heights fish fossil site in Hand County. Based on intensive studies, Ossian (1973) described the twelve species representing five groups of

fossil fishes including minnows (Cyprinidae), catfishes (Ictaluridae), killifishes (Cyprinodontidae), sunfishes (Centrarchidae), and perches (Percidae) They are from the last stage of the Ice Age, the Wisconsinan. Most of these fossils belong to fish species still alive today. They provide a suitable introduction to the archaeological record of fish and fishing which was soon to follow in what is now South Dakota. They are among the fish families most used by the first human inhabitants here and most appreciated by South Dakota fishermen today.

PREHISTORIC INDIAN FISHERIES

Archaeological evidence suggests that native peoples were catching fish as part of their food-gathering efforts in South Dakota as early as the later stages of the Paleoindian Period, from about 12,000 B. P. to 7,000 B. P. But most of the evidence relates to time periods much closer to the present.

Bone evidence from cache pits at the Heath excavation site along the Big Sioux River in Lincoln County, South Dakota, shows native peoples were utilizing fish, turtles and frogs during prehistoric times from A.D. 500 to A.D. 1,500. Seasonal growth rings on fish scales from the Broken Kettle West excavations site in Iowa near the South Dakota border indicates fall occupation along the Big Sioux River. About A.D. 1,000 was the prime time of Initial Middle Missouri cultural development, of which nearly thirty excavation sites are known in South Dakota; most are along the Big Sioux, James and Missouri Rivers. The kinds of fish and estimates of their weight-size can be somewhat determined from bone, pectoral spine, scale, and scute evidence collected at Indian occupation sites. Based on the findings of several different researchers, we know that Indian tribes living along the rivers and creeks in South Dakota utilized a minimum of 16 different species of fish. Evidence shows that catfish were among the most commonly used species, especially channel catfish, and the next most commonly evident species were suckers, most likely white suckers and buffalo fish (which are members of the sucker fish family). Based on size and weights of specific bones and pectoral spines, evidence shows that live weights of most of the channel catfish ranged from $1^1/_2$ to 6 pounds; however, remains of one flathead catfish shows it would have tipped the scales at about 30 pounds. At the other end of the size range are minnows and bone evidence indicates that they were commonly used as food.

Undoubtedly, fish provided variety to the overall diets of American Indians as well as an important source of protein. Perforated vertebrae found at some excavation sites indicate that some fish bones may have been used as ornaments. Modified dorsal spines indicate they may have been used as awls or fasteners. How fish were used poses fewer questions than how they were caught.

The most common artifacts of pre-European fishing by Native American Indian peoples are fishhooks. Occasionally, fishhooks were made from bone by cutting a flat piece of bone into a small rectangle, cutting out the center area, then splitting the remainder down the middle of the long side resulting in two hooks. Small grooves were usually made in the longer end of hooks to enhance attachment of a cord. The short ends of the barbless hooks were sharpened to

a point. Bone fishhooks found in archaeological excavation sites or by artifact scavengers in South Dakota are usually less than 1 1/2 inches long by _ inch wide. Such hooks would only accommodate small portions of bait (if any were used) and they were probably used to catch small to medium sized fish, which as a general rule of nature are usually more abundant and easier to catch.

Larger catfish or scale fish such as northern pike, walleye or buffalo fish may have been harvested with gorge hooks, by spearing with pointed sticks, by bow and arrow methods, or by hand. Even today, large flathead catfish, up to 50 or more pounds, are caught by hand with a technique known as "noodling". To noodle for flathead catfish, one simply wades in shallow waters and hand searches for fish resting in bank holes or pockets. Fish noodling is a very popular sport in some of the lower Midwestern states today.

Smaller fish and minnows were probably taken with some kind of basketry, either in the form of a pocket drag or a catchment-holding pen. It is also conceivable that woven baskets or framed animal hides could be used to form dippers or even crude types of fish nets. Cordage imprints on pottery sherds show that native peoples were knowledgeable of how to make cord (twine) and how to attach it, perhaps they also knew how to make simple gill or other webbed nets in combination with pliable woody stems such as with willow. Published journals of the Lewis and Clark expedition in 1804 include accounts of taking 318 fish one day and nearly 800 another day in a creek with a kind of drag consisting of willows and bark. Their descriptions of the kinds of fish captured with their drag included pike, bass, fish resembling salmon trout, redhorse, buffalo-fish, rock fish, one flat-back perch, catfish and a small species of perch called silver-fish, on the Ohio River. Perhaps they were mimicking gear used by Indians along the river. Regardless, the crude gear used by Lewis and Clark's men is indirect evidence that native peoples were likely capable of taking lots of fish in the smaller streams and creeks, and probably in the larger rivers also.

Another means of obtaining fish is the salvage of dead or dying fish that have been trapped in small pools or river oxbows during droughts. Fish are also susceptible to winter-kill (oxygen depletion), injury, old-age, and disease. Often dead fish end up on beaches or riverbanks due to wind and wave action which would make them easily accessible for the taking.

The prehistory of fish and fishing in South Dakota demonstrates a venerable record, but thorough documentation is difficult. The zooarchaeologist who specializes in fish faces a daunting task, dealing with skeletons that are generally poorly articulated, frequently minute and fragile, and often lack distinctive identifiable bones. That is not to say that the tasks are impossible, but often the effort is very laborious and detailed study may not seem justified. Furthermore, in South Dakota, the record of animal bone in archaeological sites tends to be heavily dominated by large mammals, and realistically archaeologists must concentrate on the most important resources that were used by the cultures that they investigate.

Unfortunately, the remains of fish are likely to be few in number and very poorly preserved. The fish are actually under-represented in almost all cases, as amply demonstrated by the substantial numbers of fishing hooks, gorge hooks, netsinkers, and other cultural items, compared to actual fish remains. Small fish

can be eaten whole and leave scant archaeological records. Other species are difficult to enumerate, such as sturgeons, of which the few preservable bones (scutes) all look exactly alike along the entire length of the body.

The motivations of indigenous peoples for their subsistence presumably were much different from those of the sport fisherman, and nets full of minnows (mere bait fish to a sport fisherman) could have been just as important to their food supply as would any large fish, which might, in fact, require considerably greater effort to catch. In the important survey work of Bailey and Allum (1962), thirty-five of the seventy-six native species are cyprinids, many of them small minnows, potentially important resources to a hunter/gatherer society, but likely to be poorly represented in the archaeological record.

With all of the above-mentioned considerations, a good way to view the archaeological record of fish in South Dakota is by discussion of family-level groupings, since many published records were not identified to species. Probable biases in the record are readily apparent, so although all of these fish families are known in South Dakota today, not all are represented in archaeological sites.

Lampreys (Petromyzontidae). These fish have no preservable bones, and are not known from any archaeological sites in South Dakota.

Sturgeons (Acipenseridae). Although they grow to substantial sizes, much of the skeleton of sturgeons is cartilage. The bony armor (scutes) that cover the head and form several rows on the body surface are readily preserved and the family has a substantial archaeological record in much of the Northern Hemisphere, but less in the mid-continent.

Paddlefishes (Polyodontidae). Despite large size, paddlefishes also are largely lacking in durable parts, and essentially nothing is known of their use in prehistoric times.

Gars (Lepisosteidae). With a substantial skeleton and a body armor of matted enamel (ganoid) scales, the garpikes are readily preserved and easily identified in the archaeological record. Published records from South Dakota include the Buffalo Pasture and Leavitt Sites, both Arikara culture (Lehmer and Jones, 1968). The Brewster and Broken Kettle Sites in nearby Iowa also have gars (Alex, 1973).

Bowfins (Amiidae). The one living species, *Amia calva*, is of uncertain status in South Dakota according to Bailey and Allum (1962), although known to live in adjacent states. It was reported by Lees (1991) from a historical archaeology site at Fort Randall 39-GR-15), however, and this may be one situation where the archaeological record supplements current biological surveys. Much of its skeleton is highly distinctive and readily identifiable. However, it is not usually sought by fishermen, and would likely be reported nowadays only because of its unusual appearance.

Herrings (Clupeidae). Although several species occur in South Dakota, we have been unable to find any archaeological record.

Mudminnows (Umbridae). One species is known in South Dakota, but it is rare. There are no archaeological records known to us.

Pikes (Esocidae). The Northern Pike (*Esox lucius*) is native to eastern South Dakota. Having durable and distinctive skeletal elements, especially in the skull, it should be found in archaeological sites rather readily. It has been reported from

the Mitchell Site (39-DV-2) in Davison County, as well as the Brewster and Broken Kettle Sites in nearby Iowa Counties (Alex, 1973).

Mooneyes (Hiodontidae). Although the Goldeye (*Hiodon alosoides*) is a common South Dakota fish, no archaeological records are known to us. The genus was reported from the Broken Kettle Site in Iowa by Alex (1973).

Minnows (Cyprinidae). This is the most complex family for archaeological potential, with about thirty-five species occurring naturally in South Dakota, far more than any other family. However, most are small and their skeletal remains could be easily missed by even the most sophisticated means of archaeological recovery. For practical purposes, the only distinctive bones are the pharyngeals of the throat/gill region, which bear diagnostic teeth. These have been reported from some sites, for example, the Beaver Creek Rockshelter in Custer County (39-CU-779.) Martin *et al.* (1993), reporting on the faunal specimens from that locality, identified the Creek Chub (*Semotilus atromaculatus)*. Beaver Creek was known to have populations of Longnose Dace (*Rhinichthys cataractae*) and field collecting by Louise Miller in 1988 yielded shiners (*Notropis* sp.) in the creek near the excavations. Minnows were also found at the oldest archaeological site thus far investigated in South Dakota, the Lange-Ferguson Site in Shannon County (39-SH-33). It is a Clovis (Paleo-Indian) site of mammoth butchering, but other faunal remains included cyprinid pharyngeal bones, though none identifiable to species (Martin,1987). Alex (1973) reported cyprinid specimens from the Brewster and Broken Kettle Sites in Cherokee and Plymouth Counties, respectively, in Iowa. Cyprinids are so common that one might expect to find evidence of them almost anywhere near water, and the remains might be considered more environmental than cultural. However, they would be a useful food resource, easily obtained in quantity, and are typically consumed by aboriginal people. Incidentally, the Common Carp (*Cyprinus carpio*) is a member of the minnow family, but does attain a considerable size. It is not native to North America and should not be expected in prehistoric sites.

Suckers (Catostomidae). This family of common fishes has once of the best archaeological records in South Dakota. Most records probably are of *Catostomus commersoni*, the White Sucker, which is found throughout the state. Catostomids have comb-like toothed pharyngeal bones, which are readily preserved and easily identified. Many species were considered by indigenous peoples to be good food fishes. Records of the White Sucker include Beaver Creek Rockshelter (39-CU-779), reported by Martin *et al.,* 1993)). Catostomids were found at the Smiley Evans Site (39-BU-2) and Deerfield Site (39-PN-214), reviewed by Sundstrom (1995-1996). A well-documented record for the East River is the Bloom Site in Hanson County (39-HS-1), reported by Haug *et al.* (1994). Alex (1973) reported catostomids from the Mitchell Site: White Sucker (*Catostomus commersoni*), Redhorse (*Moxostoma carinatum*), and Buffalo Fish (*Ictiobus*), and from the Twelve Mile Creek Site in Hutchinson County (*Ictiobus*). She recorded numerous catostomids from her two Iowa sites as well, Brewster and Broken Kettle.

Catfishes (Ictaluridae). The freshwater catfishes have substantial archaeological records wherever they occur, and South Dakota is no exception. This is unsurprising, because many of the skeletal elements are highly diagnostic of the family, and some species reach huge size, and thus have very durable bones. Even the

tiny madtoms have identifiable pectoral spines. Catfishes are almost universally regarded as excellent food fishes, and they are abundant and readily caught by a variety of methods.

It would appear that the archaeological records of catfishes in South Dakota could be reviewed and upgraded. There are seven native species, and all are now known to be readily identifiable from the pectoral spines alone. Many published records do not identify them to species, but a review study would likely refine the identifications.

The fabled association of catfish with the Missouri River is supported by the archaeological record of that drainage. Excavations associated with the River Basin Surveys produced many records of catfishes from village sites, as noted by Lehmer (1971), and some produced large numbers of specimens, such as the Buffalo Pasture Site and Leavitt Site (Lehmer and Jones, 1968). The multi-component Crow Creek Site (39-BF-11) yielded catfish remains from 23% of the features of the Crow Creek occupation and from 6% of the Wolf Creek occupation features (Kivett and Jensen, 1976).

Ictalurids, notably the Channel Catfish (*Ictalurus punctatus*) were the principal fauna recorded by Alex (1973) at the Twelve Mile Creek Site ((39-HT-1), and also at the Mitchell Site, where the Black Bullhead (*Ictalurus melas*) was also found. Various catfishes also were prominent in the collections from Brewster and Broken Kettle, her two Iowa sites. The afore-mentioned Bloom Site (39-HS-1) included catfish remains (Haug et al., 1994). Large catfishes would seem to be particularly susceptible to angling by gorge hooks, probably a widespread aboriginal technique, so the presence of such artifacts in a site would suggest use of catfish.

Eels (Anguillidae). Although eels are excellent food fish and readily caught by anglers, there are no records of them in archaeological contexts from South Dakota. Reportedly, they did not ascend commonly into the upper drainages of the Missouri and Minnesota Rivers even in the past. They are readily identifiable from some bones, but small specimens would be difficult to collect and identify. There is only one species native to the area (*Anguilla rostrata*).

Killifishes (Cyprinodontidae). We have found no archaeological records of any of the three native species.

Codfishes (Gadidae). The one native species, the Burbot, (*Lota lota*) has no reported archaeological occurrences known to us.

Sticklebacks (Gasterosteidae). The one native species, *Culaea inconstans,* has no archaeological record in South Dakota. Despite its distinctive and readily recognized spines, it is small and uncommon, and would not be expected as a favored food fish.

Trout-Perches (Percopsidae). We have found no archaeological record of the one South Dakota species, *Percopsis omiscomaycus*, which is native only to East River drainages.

Basses (Serranidae). The White Bass (*Roccus chrysops*) is the only native member of the family and was only found in the East River drainages. It has no archaeological record from South Dakota known to us. There was some evidence of the species at the Broken Kettle Site in Iowa (Alex, 1973).

Sunfishes (Centrarchidae). This family includes the well known Smallmouth

and Largemouth Basses (which are of doubtful status in South Dakota prior to modern introductions), as well as a number of small panfishes, such as bluegills and crappies. Although greatly favored by anglers, and considered good food fishes, the archaeological record is very sparse. Even the smaller species have no doubt been widely introduced to waters where they were not native. The majority of the skeleton is not very easily identifiable nor diagnostic, but the scales are easily recognized as belonging to the family. Careful archaeological analyses might assist the ichthyological record by establishing the original ranges of the nine species now found in the state, but at present there is not much known. Evidence of centrarchids was found at the Mitchell Site by Alex (1973), who also noted their presence at the Brewster Site in Iowa. Evidence was minimal, however, since only one identifiable element was found at each site.

Perches (Percidae). Among South Dakota's most favored sport fishes, the eight species now found here include the Sauger (*Stizostedion canadense*), Walleye (*Stizostedion vitreum*), and Yellow Perch (*Perca flavescens*). Although readily taken by sport fishermen of the present, they might have been much more difficult for the aboriginal inhabitants to catch in large numbers. Walleye and/or Sauger (*Stizostedion* sp.) were present in the Mitchell Site, as reported by Alex (1973), who noted *Stizostedion* in her two Iowa sites as well. Other perches, presumably smaller species, may be found in sites, but the more fragile bones are not easily preserved. The perch family no doubt has provided favored resources to humans of all cultures.

Drums (Sciaenidae). The freshwater drum (*Aplodinotus grunniens*) has readily identifiable otoliths and crushing teeth on large pharyngeal bones. These are readily preserved and easily identified, as are some other portions of the skeleton. Alex (1973) noted the remains of drumfish at the Mitchell Site and at both of her Iowa sites.

In summary, fossil evidence confirms that fish have been historically present in South Dakota for millions of years. Archaeological evidence also supports that fish have been utilized as food, probably as long as humans have been in the state (circa 7-12,000 years B.P.). Future studies will help fill in knowledge gaps about the kinds and amounts of fish used by native peoples and about the kinds of gear and methods used by them to catch fish. Past regional archaeological studies highlighted larger bone fossil evidence, particularly of mammals. As such, species determination for lesser animal groups such as birds, herptiles and fish have been directed to those species with easier diagnostic elements. A regional reference collection with bone, spines, scutes and otoliths from all possible fish species past and present would greatly facilitate future archaeological studies. Hopefully, future studies will be more holistic in nature.

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