Archaeofauna 22 (2013): 201-209

Man and the Environment in Antiquity. On the Origin of Fly Fishing in Europe

STANISLAW CIOS
ul. Stryjeńskich 6 m 4, 02-791 Warszawa, Poland
stcios@hotmail.com

(Received *2 December 2012*; Revised *7 June 2013*; Accepted *10 June 2013*)

ABSTRACT: The paper discusses the origin of fly fishing in Europe. It is postulated that fly fishing has deep historical roots, going back to an early phase of the Iron Age, given the advanced state of fishing techniques in Antiquity. It is here proposed that the key elements leading to this invention were: (1) surface feeding of trout on emerging mayflies of the Genus *Oligoneuriella* (mainly *O. rhenana*), and (2) low fishing efficiency of natural baits under such circumstances. The development of artificial flies was a result of keen observations and a good understanding of the natural environment on the part of ancient anglers, who one should consider as the founding fathers of applied entomology. It is highly probable that the invention occurred independently in various regions. On the other hand we propose that the development of large artificial flies resembling small fish, often called «streamers», followed a different path since their origin can be traced to lures developed during the Paleolithic in the Eurasian region.

KEYWORDS: HISTORY OF FISHING, FLY FISHING, *Oligoneuriella rhenana*, ORIGINS OF ENTOMOLOGY

RESUMEN: Este trabajo investiga el origen de la pesca con mosca en Europa. Se postula que este tipo de pesca tiene profundas raíces históricas que se remontan a una fase temprana de la Edad del Hierro dado el avanzado estado de desarrollo de las técnicas pesqueras en la Antigüedad. Proponemos aquí que los elementos claves que condujeron a esta invención fueron: (1) la alimentación en superficie de la trucha sobre las moscas de mayo del género *Oligoneuriella* (principalemente *O. rhenana*) así como (2) la baja eficacia pesquera de los cebos naturales en tales circunstancias. El desarrollo de moscas artificiales fue el resultado de observaciones precisas y una buena comprensión del entorno por parte de los antiguos pescadores, a quien uno podría considerar como los fundadores de la entomología aplicada. Es muy probable que esta invención se produjera de forma independiente en diferentes regiones. Por otra parte proponemos que el desarrollo de las grandes moscas artificiales que se asemejan a pequeños peces discurrió por un sendero diferente ya que el origen de éstas puede rastrearse a cebos desarrollados durante el Paleolítico en la región euroasiática.

PALABRAS CLAVE: HISTORIA DE LA PESCA, PESCA CON MOSCA, *Oligoneuriella rhenana*, ORÍGENES DE LA ENTOMOLOGÍA

INTRODUCTION

Much has been written on the oldest accounts of fly fishing (e.g. Trench, 1974; Braekman, 1980; Bark, 1994; McDonald, 1997; Herd, 2003). The focus on these works was on literature, tackle and technical aspects, as well as on the social context of fishing. Though previous researchers have made important contributions to the subject, very little interpretation of the entomological information has been ever attempted, which in our opinion is crucial for reaching a profound understanding about the origin of fly fishing.

The key questions which we pose here are: (1) how did man learned to deceive fish with artificial flies?, and (2) what environmental conditions led to the invention of one of the most ingenious ways of catching animals, especially in view of the efficiency of fly fishing? The answers to these questions allowed us to formulate a hypothesis about the origins of fly fishing. The data presented are based on our own research on the history of fishing, entomology and feeding biology of salmonids in various parts of Europe. Our fly fishing experience provided further assistance. As it will be seen, knowledge about the aforementioned elements is crucial to understand the behavior of ancient anglers, who based their inventions on careful observations of the natural environment.

ORIGIN OF FLY FISHING IN EUROPE

The oldest accounts of fly fishing on record are those in the work by Aelian (1958), who lived at the turn of the 2nd and 3rd century AD. Elsewhere (Cios, 2005) we have provided arguments in favour of interpreting the name *hippurus*, used by him, as referring to a mayfly of the Genus *Oligoneuriella* (family Oligoneuriidae). The precise determination of the species will depend on further mayfly research in Greece.

There are several species in the Genus *Oligoneuriella* in Europe, among which *O. rhenana* is the most common and widely distributed. The insect thrives (*thrived* would be a better term in view of the negative effect of human activities on its environment) in many mountain running waters, especially in the Alps, Carpathians, Balkans, Pyreneans, and some rivers of the Italian and Iberian peninsulas (it is not present on the British isles or Fennoscandia). The length of mature larvae may reach to *ca.*15 mm. During emergence, that takes place at dawn from the end of June till early September, and depending on the locality, billions of insects appear over the water, flying both up and downstream. Their nuptial flight resembles a snow storm, since the insects are whitish (such a splendid view may still be observed over the rivers Poprad and Dunajec in Southern Poland). Trout and grayling take advantage of this opportunity and gorge themselves with nymphs and adults at this time (Błachuta, 1987; Cios, 1997). From many accounts of the 19th and 20th centuries it is clear that anglers knew about these events and were keen on deceiving the fish with artificial decoys (e.g. Stasiak, 1913 a, b; De Boisset, 1939; Stölzle & Salomon, 1990). Lestage (1936) mentions that for at least 100 years anglers used the larvae themselves as bait for grayling in the rivers Ourthe and Lesse.

Ancient anglers were equally conscious that during emergence fish were gulping the insects because they could see fish surfacing to feed. Their first reaction must have been to catch fish with natural baits, either worms or some other kind of invertebrate. Probably they even tried with adults of the mayfly themselves, which –despite being relatively big– couldn't be fixed on the hook, since they disintegrate easily. Their efforts must have resulted in frequent disappointment, because during emergence, even today with technologically much more advanced tackle, fish are quite difficult to catch with natural baits.

At some stage of experimenting with different baits the ancient angler must have contrived the idea (or perhaps this was sheer luck) that an imitation of the insects would work better. There were several advantages to this solution. The imitation would last much longer on the hook. This meant a tremendous advance, since it allowed the angler to fish for a much longer time during the period of intensive feeding of fish and much more efficiently, what resulted in quicker filling up the creel. Also, the angler wouldn't need to catch the insects during darkness, what in itself was a great challenge. Finally, even when he had caught some mayflies, it was extremely difficult to place one on a hook in the darkness. By allowing him to prepare the bait during daytime the artificial fly made the angler independent from the insect.

There exist additional factors indicating importance of this insect for the ancient angler. First of

all, surface feeding of fish occurs mainly in the summer (as a result of the high availability of food in the top layer of water). This also happens to be the most convenient and pleasant time of the year for angling. Secondly, darkness is the easiest time to fool the fish. The fish aren't spooky and it is easy to approach them at a short distance (the total length of the rod and line of the first fly anglers was probably *ca*. 5-6 metres, since Aelian, 1957, mentions that Macedonians used rods 6 feet long). The presentation of the fly needn't to be perfect. Finally, it is fairly easy to make a larger size imitation of an adult of *Oligoneuriella* on a hook size 8 or even larger. This can be a simple fly made with animal hair or hackle from a cock.

In the oldest account of fly fishing on the River Stryj (presently West Ukraine), there is a reference to the use of flies made of bear hair during the emergence of *O. rhenana* (Pietruski, 1847; Dziedzielewicz, 1877). These anglers were peasants and fly fishing in this area was not a cultural import from Western Europe. It was an indigenous development with historical roots embedded deep in the past.

From the data thus far gathered it appears that fly fishing developed as an art of presenting an artificial on the water surface (i.e., a dry fly) or just below it, since primitive flies must have sunk. True wet flies came later when the angler noted that fish can also take flies in the water during periods with no surface feeding. But it probably didn't take long to realize this since trout are very easy to catch with wet flies, whenever they are abundant. In addition, downstream wet fly fishing is much easier, from a technical standpoint, than either upstream wet fly fishing or downstream dry fly fishing.

Why should have this particular mayfly played such a crucial role in the development of fly fishing? The answer to the question is simple –there is no comparable phenomenon to the emergence of *Oligoneuriella* in trout waters. People who have not seen the emergence and flight of *O. rhenana* will have problems to realize its significance for the fish and the angler. McLachlan (1881) even noted– «*such a sight as this is worth a journey from England to an entomologist*». Within such context, one should stress that research on the history of fly fishing has been dominated by students of Walton from both Great Britain and North America, for whom *O. rhenana* is an unknown species.

In the past mass emergence of mayflies in large European lowland rivers occurred also in the case of two other species: *Ephoron virgo* (Family Polymitarcidae) and *Palingenia longicauda* (Family Palingeniidae). In the United States a similar phenomenon occurred in the case of *Hexagenia bilineata* (Family Ephemeridae). But these species had no impact on the development of fly fishing due to the lack of salmonid fish in the lowland waters where the mayflies existed. Also, even in the case of some species of the genus *Ephemera* (Family Ephemeridae), most often mentioned in the modern angling literature, emergence is of a scale not comparable to that of *Oligoneuriella*.

Although Aelian (1958) referred to the mountains of Macedonia, the first artificial flies need not have been invented in this region, as is assumed by some researchers (e.g. Trench, 1974). Likewise, one should not look for one single locality as the place of origin of fly fishing. What is important is to determine the conditions conductive for such an invention. There are three that seem critical. The first one is the presence of trout (*Salmo trutta*), a voracious fish with large mouth, since no other species in European waters is so well «fitted» for primitive fly fishing (grayling (*Thymallus thymallus*) fishing probably developed later, because it requires finer tackle and much more skill on the part of the angler). The second condition is the presence of mayflies of the Genus *Oligoneuriella* (mainly the species *O. rhenana*), whose emergence is on a scale nowhere seen. The third condition is fairly easy access to the fish (i.e., within the range of the rod and line). This implied fishing in small or medium-sized running waters in the mountains. These three conditions occurred over a broad area, spanning over two thousand kilometres – from the Pyreneans, through the Alps and the Carpathians, to the Balkans. Perhaps the artificial fly was invented independently in several localities, given that under similar conditions humans tend to behave in convergently similar ways in various parts of the world.

When did the invention occur? Definitely not before the age of metal, since flies made on wood or bone hooks would be much too clumsy and inefficient. Flies made on copper hooks could work in principle, but this metal seems to be too weak for what is needed (note that fly fishing occurred in swift mountain waters, where the strong current would increase tenfold the pulling power of the fish, thus putting additional strain on the hook that would eventually straighten it). The

Iron Age should be the proper period for setting the lowermost date for the invention. Iron hooks were quite common in Europe, also in mountain regions, as evidenced in many archaeological excavations (their good state of preservation indicates that rust wasn't a problem for ancient anglers). Some of the major iron smelting areas were also located there, e.g. in Hallstatt in Austria. Therefore the invention of fly fishing should be placed somewhere in the first millennium BC, or even in the first half of this period.

Such a view would be supported by man's knowledge of advanced fishing techniques in antiquity. For example, sophisticated chains attached to hooks (Figure 1), preventing pike and other fish with sharp teeth from cutting the line, are known from the La Tène culture, which began *ca.* 450 BC. Such items were found in Switzerland (Munro, 1890, Tab. 14.3, 90.39; Heierli, 1901, Tab. 301; Vouga, 1923, Tab. XXIII.10-12). A hook, with a 20 cm long chain attached to it, was also found in Crete (Déchelette, 1908, fig. 103.1; Deshayes & Dessenne, 1959: 146, Tab. LI; Buchholtz *et al*., 1973: 171). In the ancient literature Lucian (1969: 77) refers to arming the hook with iron, so the fish will not saw it off.

Also the use of ingenious bait has deep historical roots. The oldest metal fish spoons are known from Western Russia from layers dated 600-300 BC (Nefedov, 1899). The reference to the horn of the field ox in Homer's Iliad and Odyssey (8th century BC) most likely pertains to catching catfish in regions adjacent to the Black and Caspian Seas by luring it with sound (Kurbatov, 1887; Bonnerjea, 1938) (Figure 2; no other interpretation of the horn of the field ox withholds criticism). Compound fish hooks with a fine stone shank (Figure 3) are known from the Neolithic period in Russia (Fedorov, 1937, Tab. II). Some millennia older, are lures of stones and bones (at times reported as hooks) for pike fishing, recorded from various parts of Eastern Europe (Figure 4) (Ebert, 1913, Abb. 10; Neprina, 1991; Selirand & Tõnisson, 1984: 20). Equally ingenious are small feeder cages used by the ancient Egyptians (Daumas, 1964, fig. 3, 5-7) (Figure 5). These techniques indicate that the use of artificial bait has a long history and the idea of luring fish was known on a very large territory.

Therefore, inventing an artificial fly early in the Iron Age doesn't seem far fetched. On the contrary – it seems highly logical, given the state of the fishing technology in ancient times.

FIGURE 1
Hook with chain (after Vouga,1923).

ANGLERS AS FATHERS OF APPLIED ENTOMOLOGY

After Aelian (1958) all major accounts of fly fishing refer to imitation of insects, in some cases even very specific ones, that today is possible to identify to Genus or Family level. In different months, different artificial flies were used, depending on the insects that fish would normally eat. This is clear from the English medieval manuscripts and the *Treatise of Fishing with an Angle* (Braekman, 1980), the Tegernsee Abbey manuscript from the end of the 15th century, Basurto's *Dialogo* from 1539 (Hoffmann, 1997), Gesner (1558: 1175, 1208) and Bergara's (1984) *Manuscrito* from 1624. Anglers not only paid attention to the insects in the water but also to those found in fish stomachs. In the old literature there even exist recommendations to study the food of the fish in order to make the best choice for bait. An indication of the past popularity of such analysis of fish stomachs was the commonly held view in many parts of Europe that fish swallowed gold. This «gold» was often nothing more than shinny pebbles from ingested caddis' cases (Cios, 2004), although at times fish do inadvertently ingest small stones, mistakenly taken for snails or caddis.

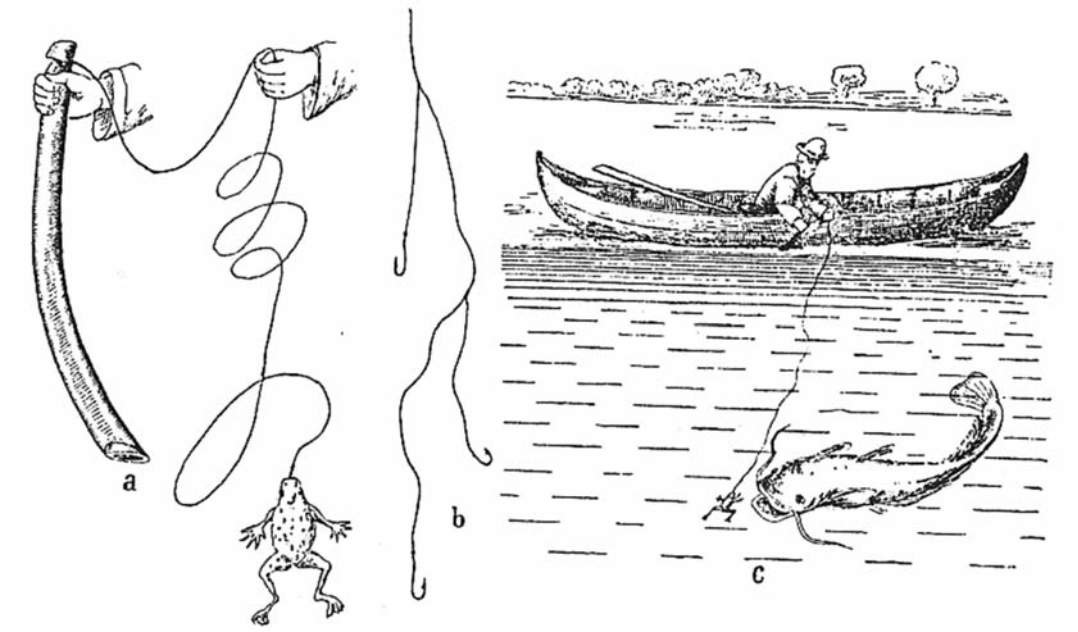

FIGURE 2
Catfish fishing with a device making sound (after Antipa, 1916).

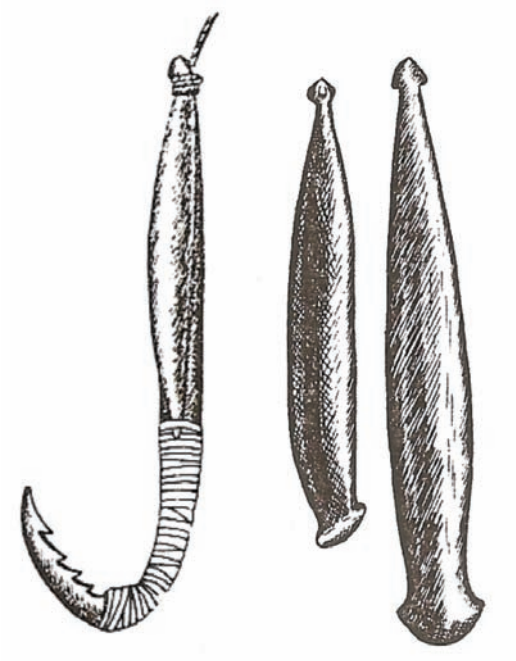

FIGURE 3
Neolithic compound fish hook with stones attached to the shanks (after Fedorov, 1937).

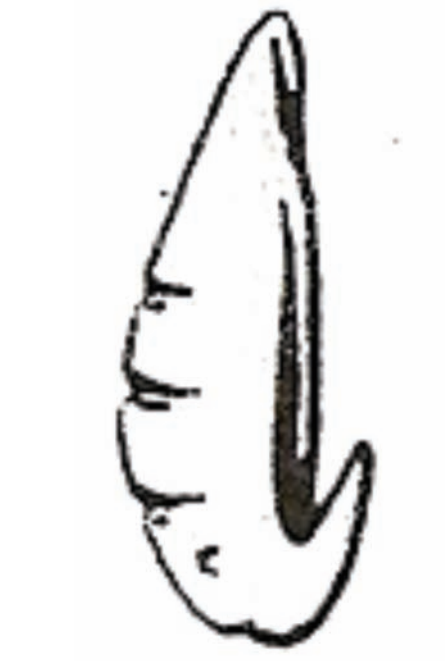

FIGURE 4
Fishhook, or rather a lure, from the stone age (after Selirand & Tõnisson, 1984).

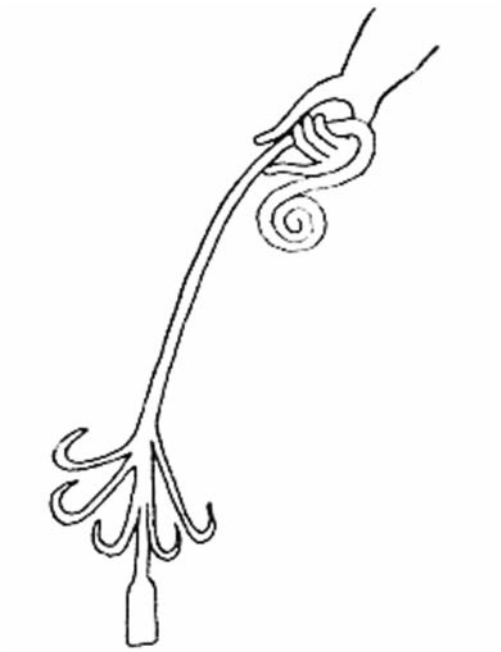

FIGURE 5
Hand-line with hooks and a feeder cage (after Daumas, 1964).

Medieval and post medieval European angling accounts incorporate no clear references to *Oligoneuriella* mayflies. Only Basurto refers to the «*little white butterflies*», which can be interpreted as mayflies. He mentions these insects as eaten by barbel (*Barbus* sp.) and trout. Basurto's account refers probably to the species *Ephoron virgo* or to species from the Genus *Oligoneuriella*, or perhaps both, given that the former is typical of waters from the barbel zone whereas the later is so closely associated with trout waters.

The ancient fly anglers were thus keen entomologists. They had to, since in the old days, and due to technical limitations, the catch didn't relied as much on progress achieved in the construction of the tackle. The best way to fill up the creel was to obtain as much detailed knowledge about the fish, their feeding habits and the natural environment as possible. Through meticulous observations and long hours spent at the water's edge these ancient anglers gained a knowledge that earns them being considered as the fathers of applied entomology.

Indeed, professional entomologists gained precious knowledge from fishermen. There are recent historical sources documenting this, but we will draw attention at this point to only two of the older contributions. The first one is by Reamur (1742), whose section titled «*Des mouches appellés Éphémères*» is a classical reference on mayflies. The second one is by Tiensuu (1935), who studied mayflies in Lake Ladoga, and stated: «*it is curious, that Polymitarcis ladogensis, which until now has been unknown to science, is nevertheless very well known to the inhabitants of Salmi. This "white butterfly", as they call it, is a signal for them that they are to go fishing for white-fish (Coregonus albula L.). One only gets a good prey of white-fish while this insect is swarming*». In England the term mayfly was coined and used by fisherman long before it was adopted by entomologists (Mosely, 1937). A similar situation happened in Poland with the name «jętka» first recorded in the 16th century as a natural bait for fish. Mayflies belong to the earliest well-known insects to man (Soldán, 1997).

DEVELOPMENT OF FISHING WITH STREAMERS AND BIG WET FLIES

The information presented so far concerns fishing with artificial flies on the water surface, usually termed dry fly fishing. Large artificial flies that fish in the water, often as imitations of small fish, probably followed a different evolutionary path.

The oldest verbal account of such bait is again to be found in Aelian (1958) namely, feathers attached to a hook that were used to catch predatory fish from boats in the sea. A similar bait was known in South-East Asia. In a travel account around Borneo in 1598-1601 one can read that «*ces pescheurs peschent avec des cordelettes, ausquelles sont certaines plumes & hamecons, continuellement retirans a soi poisson*» (i.e., «*These fishermen fish with lines to which feathers and hooks are attached, repeatedly taking fish*») (Noort, 1610: 48). This is accompanied by a drawing on which one can see six boats. In four of them there are two persons, and in the remaining two, three. From each boat a single line is let out by the person sitting in the rear part. At the end of the line is a bait, consisting of two feathers. There are several newer accounts of this method in this region (e.g. Aldaba, 1932; Talavera & Montalbán, 1932; Legand, 1950). A bait of feather has been known for a long time also in Eastern Europe to catch a predatory species of cyprinid, the asp (*Aspius*

aspius) (Plater, 1861: 526; Terleckij, 1876: 310; Sapunov, 1893: 254; Nikoforovskij, 1895: 509; Sabaneev, 1960: 526). One or more feathers, in particular those from geese, were attached to a hook and pulled just under the water surface, where the asp catches small fish. At times pieces of red cloth were also attached at the end of the hook. A piece of white cloth could also be used instead of the feather. But all these elements are newer developments.

Fishing with a bait of feathers was done mainly from a rowing boat. This is understandable, because it was difficult to make a cast, and may imply that fishing in rivers or from the bank is a later development, the result of technical progress in the tackle.

These accounts, although spanning a period of almost two millennia and several thousand square kilometres, may in fact have a common source – Northern Eurasia. Indeed, it seems highly probable that the roots of this method could be traced to the Palaeolithic. During winter time, stone and bone lures, resembling small fishes, were suspended in the water. When the predatory fish approached, it would be speared. Such lures are known from a Neolithic site in the Kežma region by the River Angara near Lake Baikal (Okladnikov, 1952). They are almost identical to lures used in historic times over a broad area – by the Samoyeds along the River Ob and the Eskimos on Baffin Land (e.g. Pallas, 1787: 167; Boas, 1907: 26).

The next step in the development of the lure consisted on adding a sharp point to it. The incentive might have been the sight of a fish attacking the bait. This allowed catching fish at greater depths. In this way the compound hook was created which in some cases was interpreted as a ready bait to catch predatory fish (Bibikov, 1959; Muurimäki, 1992). According to Anell (1955: 194-204) the oldest and most primitive compound hooks were found in the Lake Baikal region and from there they spread to other parts of the world.

The next step came when it was realized that such lure/bait could not only fish in a perpendicular manner, but also horizontally, while being drawn behind the boat. As the hooks improved (they became finer and lighter), with time the ancient angler realized that it was much easier to construct the lure with the incorporation of some soft elements. These could be a piece of hairy skin from a stag, as is still seen (Kulemzin & Lukina, 1977) or a simple feather, especially in places where metal hooks were used. Thus, although hooks with feathers seem to be an invention from the Age of metals, an earlier appearance cannot be momentarily ruled out, especially when it comes to predators featuring large mouths as is the case in Northern Eurasia of the Pike (*Esox lucius*) and the Perch (*Perca fluviatilis*).

Big salmon flies seem to be a fairly modern invention. In English angling literature, they are recorded for the first time in the 17th century, though Herd (2003), states that streamers have their roots in the 1880s. Although there is a lack of sound evidence on the use of such flies on the continent in historic times, the relation between the feather «flies» used in antiquity and the streamers of modern times does not seem improbable. This is an issue deserving further research, provided that some old unknown verbal accounts will be brought to light.

CONCLUSIONS

Artificial flies have deep historical roots. Their origin should be traced at least to the early phase of the Iron Age. Their development is a result of both a long study and a good understanding of the natural environment, especially fish and insects, on the part of ancient anglers. Anglers were a social group with some of the most thorough knowledge about the natural sciences, because success in fishing relied so much on such a deep understanding. Their acquaintance with the biology of mayflies, in particular, might well deserve them the title of fathers of applied entomology as we proposed here (anglers made substantial contributions to our knowledge of many non-flyfishing mayflies, especially *Ephoron virgo*, but this is beyond the scope of this paper).

Although historical sources from other parts of the world are scarce, they nevertheless seem to point to an independent development of fly fishing, or rather the principles of this fishing method, in other regions of the world. Since times immemorial North American Indians have used hair, plant fibers or small pieces of skin as bait and hook simultaneously (the hair got entangled in the teeth of trout, enabling the angler to pull the fish out of the water) (e.g. Ross, 1849: 132-133; Nomland, 1935; Driver, 1939). This same concept of a spider-web bait was used in kite fishing in some

parts of the Western Pacific, so the method probably has deep historical roots, with a yet undefined place of origin. In this respect it is necessary to note that in the Far East of Eurasia the natives caught salmonids with artificial flies. In Arseneev's (1951: 333-334) 1927 account of travels in the River Amur basin there is an interesting account of an Oroch catching grayling with a fly made of hair from wild boar (Cios, 1998). In Japan artificial flies were sold in the 1600s (Kelleher & Ishimura, 2011). These cases cannot be considered as cultural imports from Europe. Due to scarcity of information from the Far East it is difficult – at this stage of the research – to put forward any definite thesis on the development of fly fishing in these regions.

It is highly probable that a lot of valuable information, buried beneath thick layers of soil or historical dust, still await discovery by archaeologists and historians. Especially promising areas in this quest are Central, South-Eastern and Eastern Europe, as well as the Far East. The reason lies not only in the potential of finding new historical sources, but also in the fact that many of these fishing techniques appear to have originated in Eurasia and later spread to other regions.

REFERENCES

Aelian 1958: *On the characteristics of animals*. Transl. by A.F. Scholfield, London.

Aldaba, V.C. 1932: Fishing methods in Manila Bay. *Philippine Journal of Science* 47: 405-421.

Anell, B. 1955: Contribution to the history of fishing in the southern seas. *Studia Ethnographica Upsaliensa* 9.

Antipa, G. 1916: *Pescăria şi pescuitul in România*. Bucureşti.

Arseneev, V.K. 1951: *Skvoz tajgu*. Moskva.

Bark, C.V. 1994: *A history of flyfishing*. Merlin Unwin Books, Ludlow.

Bergara, J. 1984: *El manuscrito de Astorga*. Flyleaves, Copenhagen.

Bibikov, S.N. 1959: Raskopki v navese Fatma-Koba v 1956 godu. *Kratkie Soobščenia Instituta Arheologii* (Kiev) 8: 114-121.

Blachuta, J. 1987: *Tempo wzrostu i pokarm lipienia* Thymallus thymallus *(L.) z Kaczawy, Nysy Kłodzkiej i Dunajca*. PhD thesis, Natural History Museum, Wrocław University.

Boas, F. 1907: The Eskimo of Baffin Land and Hudson Bay. *Bulletin of the American Museum of Natural History* 15.

Bonnerjea, B. 1938: On the «horn of the field ox». *Notes and Queries* 174: 347-348.

Braekman, W.L. 1980: The treatise on angling in The Boke of St. Albans (1496). *Scripta, Mediaeval and Renaissance Texts and Studies* 1.

Buchholtz, H.-G.; Jöhrens, G. & Maull, I. 1973: Jagd und Fischfang. *Archaeologia homerica* 2.

Cios, S. 1997: Note sur l'alimentation des truites de l'Aoos (Grèce). *Truites, Ombres et Saumons* 178: 19-20.

Cios, S. 1998: Grayling fishing – historical notes. *Journal of the Grayling Society* 13(2): 36-37.

Cios, S. 2004: Caddis as precious as gold, or was gold found in the stomachs of trout and grayling in the old times? *Trichopteron* 12: 1-11. (in Polish with and English summary).

Cios, S. 2005: The identity of the insect *hippurus* in Aelian's *De natura animalium*. *Polish Journal of Entomology* 74: 479-483.

Daumas, F. 1964: q uelques remarques sur les representations de pêche à la ligne sous l'ancien empire. *Bulletin de l'Institut Français d'Archéologie Orientale* 22: 67-85.

De Boisset, L. 1939: *Les mouches du pêcheur de truites*. Librairie des Champs-Élysée, Paris.

Déchelette, J. 1908: *Manuel d'archéologie préhistorique Celtique et Gallo-Romaine*. Paris.

Deshayes, J. & Dessenne, A. 1959: Fouilles exécutées a Mallia. *Études crétoises*, 9.

Domantay, J.S. 1940: Tuna fishing in southern Mindanao. *Philippine Journal of Science* 73(4): 423-434.

Driver, H.E. 1939: Culture elements distributions. X. *University of California, Anthropological Records* 1(6): 297-433.

Dzięciołowicz, J. 1877: Wycieczki po wschodnich Karpatach. I. Rys ogólny, podgórska dolina Prutu, Słobódka leśna, Kołomyja, Kniaździwór i Peczyniżyn. *Pamiętnik Towarzystwa Tatrzańskiego* 2: 40-67.

Ebert, M. 1913: Die baltischen Provinzen Kurland, Livland, Estland 1913. *Praehistorische Zeitschrift* 5: 498-559.

Fedorov, V. 1937: q uelques particularités des engins de pêche en pierre néolithiques. *Sovetskaâ arheologija* 3: 101-112. (in Russian with a French summary).

Gesner, C. 1558: *De piscium et aquatilium animalium natura*. Tiguri.

Gurina, N.N. 1991: *Rybolovstvo i morskoj promysel na kolskom poluostrove*. In: Gurina, N.N. (ed.): *Rybolovstvo i morskoj promysel v epohu mezolita – rannego metalla v lesnoj i lesostepnoj zone vostočnoj Evropy*: 164-181. Leningrad.

HEIERLI, J. 1901: *Urgeschichte der Schweiz*. z ürich.

HERD, A. 2003: *The fly*. Medlar Press, Ellesmere.

HOFFMANN, R.C. 1997: *Fishers' craft and lettered art: Tracts on fishing from the end of the Middle Ages*. University of Toronto Press, Toronto.

KELLEHER, K.C. & ISHIMURA, M. 2011: *Tenkara*. Lyons Press.

KROEBER, A.L. & BARRET, S.A. 1960: Fishing among the Indians of Northwestern California. *University of California, Anthropological Records* 21(1).

KULEMz IN, V.M. & LUKINA, N.V. 1977: *Vasŭganskovahovskie hanty v konce XIX – načale XX vv*. Tomsk.

KURBATOV, A. 1887: Užene ryby v Suvalskoj gub. i na Nemane. *Priroda i ohota* 9: 70-74.

LEGAND, M. 1950: Contribution à l'étude des méthodes de pêche dans les territoires Français du Pacifique sud. *Journal de la Société des Océanistes* 6(6): 141-184.

LESTAGE, J.A. 1936: La présence dans les eaux belges de l'ichtyoparasite *Cystobranchus respirans* Trosch. *Annales de la Société Royal Zoologique de Belgique* 66: 127-132.

LUCIAN 1969: Transl. by A.M. Harmon. Vol. III. London.

MCDONALD, J. 1997: *The origins of angling*. Lyons & Burford, New York.

MCLACHLAN, R. 1881: *Oligoneuria rhenana*. *Entomologists Monthly Magazine* 17: 163-164.

MOSELY, M.E. 1937: Mayflies. A consideration of anglers' and entomologists' claims to a popular name. *Salmon and Trout Magazine* 88: 220-228.

MUNRO, R. 1890. *The lake-dwellings of Europe*. London.

MUURIMä KI, E. 1992: Sukupolvien ketju. *Saarijärven museon julkaisuja* 3.

NEFEDOV, F.D. 1899: Žurnal raskopkov proizvedennyh v Prikamie letom 1894 g. *Materâly po arheologii vostočnyh gubernij* 3: 55-72.

NEPRINA, V.I. 1991: *Rybolovstvo v mezolite-eneolite Ukrainy*. In: Gurina, N.N. (ed.): *Rybolovstvo i morskoj promysel v epohu mezolita – rannego metalla v lesnoj i lesostepnoj zone vostočnoj Evropy*: 109-115. Leningrad.

NIKOFOROVSKIJ, N.Â. 1895: *Očerki prostonarodnogo žitâ v vitebskoj Belorussii*. Vitebsk.

NOMLAND, G.A. 1935: Sinkyone notes. *University of California Publication in American Archaeology and Ethnology* 36(2): 149-178.

NOORT, O. van 1610: *Description du penible voyage fait entour de l'univers*. Amsterdam.

OKLADNIKOV, A.P. 1952: Novye neolitičeskoe nahodki na Angare, v rajone der. Kežmy. *Sovetskaâ arheologija* 16: 320-326.

PALLAS, P.S. 1787: *Histoire des découvertes faites par divers savans voyageurs, dans plusieurs contrées de la Russie & de la Perse, relativement à l'histoire civile & naturelle, à l'économie rurale, au commerce, ecc*. T. 3. Berne.

PIETRUSKI, K.S. 1847: Odpowiedzi na pytania zawierające w sobie plan krótki do jednostajnego opisu [...]. *Rozprawy c.k. galicyjskiego towarzystwa gospodarskiego* 2: 128-162.

PLATER, A. 1861: *Opisanie hydrograficzno-statystyczne Dźwiny zachodniej, oraz ryb w niej żyjących*. Wilno.

REAUMUR, R. 1742: *Memoires pour servir à l'histoire des insectes*. Vol. 6. Paris.

ROSS, A. 1849: *Adventures of the first settlers on the Oregon or Columbia river*. London.

SABANEEV, A.P. 1960: *Žizn i lovlâ presnovodnyh ryb*. Kiev.

SAPUNOV, A. 1893: *Reka zapadnaâ Dvina*. Vitebsk.

SELIRAND, J. & Tõ NISSON, E. 1984: *Through past millenia. Archaeological discoveries in Estonia*. Tallinn.

SOLDá N, T. 1997: Mayflies (Ephemeroptera): one of the earliest insects groups known to man. In: Landolt, P & Sartori, M. (eds.): *Ephemeroptera & Plecoptera*: 511-513. Biology-Ecology-Systematics, Fribourg.

STASIAK, L. 1913a: Pstrąg. *Okólnik Rybacki* 30(1-2): 2-15.

STASIAK, L. 1913b: Obława na łososia. *Okólnik Rybacki* 30(3): 34-42.

STö LZ LE, A. & SALOMON, K. 1990: *Die Kunst und die Grundlagen des Fliegenfischens*. Nürnberg.

TALAVERA, F. & MONTALBá N, H.R. 1932: Fishing appliances of Panaz, Negros, and Cebu. *Philippine Journal of Science* 48: 429-483.

TERLECKIJ, P. 1876: *Žizn ryb v naših rekah i ozerah*. S.-Peterburg.

TIENSUU, L. 1935: On the Ephemeroptera-fauna of Laatokan Karjala (Karelia Ladogensis). *Acta Entomologica Fennica* 1(1): 3-23.

TRENCH, C.C. 1974: *A history of angling*. Hart-Davis, Macgibbon.

VOUGA, P. 1923: *La Tène*. Leipzig.