Aristotle’s Statement on the Reproduction of Sharks

LILIANE BODSON

Université de Liège
B-4000 Liège, Belgium

The difficulty of observation and the lack of scientific equipment did not deter ancient fishermen and scientists from watching fish and marine animals carefully and thereby increasing their knowledge of the characteristics and behavior of these organisms. The findings of these early observers, however well collected and expressed, were easily misinterpreted by later readers, who did not attempt to assess the scientific correctness of the data. Discoveries that once represented scientific achievement unavoidably turned into senseless accounts. As an example of this kind of misunderstanding, we may examine the reproductive activity of some of the small or medium-size sharks common in the Mediterranean Sea, which are often referred to as dogfish — the smooth dogfish (Fig. 1), the small-spotted and large-spotted dogfish (Figs. 2 and 3), and the thresher shark (Fig. 4).

Fig. 1. Smooth dogfish (*Mustelus mustelus*; а λεῖος γαλεός). After *Fiches FAO d’identification des espèces pour les besoins de la pêche. Méditerranée et Mer noire* (Zone de pêche 37), vol. 2 (Rome, 1971).

1. The prejudices against fish and other marine animals, apart from the dolphins perceivable in the ancient Greek tradition (see L. Bodson, *IEPA ZΩI A. Contribution à l’étude de la place de l’animal dans la religion grecque ancienne* [Brussels, 1978], pp. 45–57), have not prevailed over the increasing curiosity displayed about all living creature. See Aristotle, *Parts of Animals* I. 644b22–645a36. On the Aristotelian contribution to biology see note 15 below.

Fig. 2. Small-spotted dogfish (*Scyliorhinus canicula*; ὁ ποκίλος γαλέως). After *Fiches FAO*.


Fig. 4. Thresher shark (*Alopias vulpinus*; ὁ ἀλωπέκιος). After Bini, *Atlante*, p. 53.

The first text I shall quote is from Oppian of Cilicia and deals with dogfish in a generic sense:

Here is the marvel of the sea-roaming Dogfish. Her new-born brood keep her company and their mother is their shield; but when they

Aristotle's Statement on the Reproduction of Sharks

are affrighted by any of the infinite terrors of the sea, then she receives her children within her loins by the same entry, the same path, by which they glided forth when they were born. And this labor, despite her pain, she endures gladly, taking her children back within her body and putting them forth again when they have recovered from their fear.\(^3\)

Aelian's account (On Animals I. 17) is so similar to the above that it is either derived from it or based on a common source:\(^4\):

Directly the Dog-fish has produced its young, it has them swimming by its side, and there is no delay. But if any one of them is afraid, it slips back into its mother's womb. Later, when its fear has passed, it emerges, as though it were being born again.\(^5\)

Athenaeus attempts to be more precise by referring to particular fish by name (VII.294A):

3. Oppian, Halieutica, I.734–741 (trans. A. W. Mair, Loeb Classical Library, 1963): Θαλεία δ ἀλλάξκιον κοινὸς τόδε· τῇ γάρ ἐπουραί τέκνα νεοβλαστή καὶ σφιν σάκος ἐπλέον μὴτηρ· ἀλλ᾽ ὅτε ταρβήσῳ τά τ᾽ ἄσπετα δείωτ᾽ ἔσων ἐν πόντῳ, τότε παιδας ἐσω λαγόνεσσῳ ἐθέκετο· αὐτήν εἰσάγην, αὐτήν ὅδ᾽ ὅτε ἐθέκεν, ἐν οὐλασθον· γενόμενοι· τοιον ἐν πόνω μοτόνεσσά περ ἐμμης· ἀσπασώς τέτληκε, πολίν ὀπεθεύσαντο παιδας· ἀπλάξχος, ἀυγ δ᾽ ὁμόθεκεν, ὅτ᾽ ἀμφευνωσάι φάβοι. Little original knowledge, if any, is to be found in the poem Halieutica (Fishing), composed most probably by Oppian at the end of the second century A.D., after he had compiled the works of earlier Greek authors. For further details on the didactic poetry in Greece and Rome, see B. Effe, Dichtung und Lehre. Untersuchungen zur Typologie des antiken Lehrgedichts (Munich, 1977), esp. pp. 137–155.


5. Aelian, On Animals I.17 (trans. A. F. Scholfield, Loeb Classical Library, 1958): Κώνιν δὲ θαλασσία τεκούσα ἔχει συννέωσε τὰ σκυλάκια, ἡδί καὶ ὅδκ ἐς ἄναγολας· ἦδὲ δὲ δείη τι πολύτων, ἐς τὴν μητέρα ἐσάδου ἄσθε κατὰ τὸ ἄρθρον· ἔτο τοῦ δέως παραδομῆτο τὸ δὲ πρόδειον, ὦσπερ ὅνω ἀναστικόμουν ἄσθε. Compare with On Animals, II.55; Horapollo, Hieroglyphica, II.110, Leemans, p. 109. Aelian (c. A.D. 170–235) collected excerpts and anecdotes on the animal world from earlier and contemporary authors (Greek writers exclusively). Since he was chiefly interested in the paradoxical or moralizing behavior of animals, he takes his place among the Greek paradoxographers rather than among the zoologists.
LILIANE BODSON

The dog-fish in general spawns three times a year at most; it takes the young just hatched into its mouth and emits them again. This is particularly true of the Spotted and the Thresher Sharks. The others cannot do that because of the roughness.6

In each of these accounts the phenomenon is rightly called a marvel — “a wonder” (θαύμα), in the words of Oppian himself. Yet one must take care to distinguish between them. As described by Oppian and Aelian, the somewhat kangaroo-like care exhibited by the female, whereby the brood slips back into her womb, does not occur in dogfish nor in any other animal. It proceeds from an imaginary zoology largely prized in late antiquity, one closer to paradoxography than to science.

Unlike those texts, the process described by Athenaeus or his source is correctly, though briefly, stated. Fresh-water fish that incubate eggs in their mouths and keep them there as a protective measure after hatching, as do many of the Cichlidae family,7 and sea fish that incubate eggs in their mouths, as do Apogonidae,8 have been well


In his translation Gulick does not distinguish between the two species: small-spotted dogfish and large-spotted dogfish (Figs. 2 and 3). As a matter of fact, σουκλὸς (γαλεός), also called σκύλον, is likely to be Scyliorhinus canicula, the small-spotted dogfish. The other species, Scyliorhinus stellaris, also common in the Mediterranean, is named νεβρίας after the fawn (ὁ νεβρός) whose skin on the back is characteristically spotted. See Hesychios Λ 73.

Athenaeus (end of second century A.D. to early third century) collected an impressive number of heterogeneous excerpts from Greek poets and prosateurs as well, quoted and discussed in the framework of a banquet. Many of these texts refer to cookery, unusual dishes, and the like, including details — also zoological — on the edible species (mammals, birds, and fish).


Aristotle's Statement on the Reproduction of Sharks

documented since antiquity.\textsuperscript{9} Athenaeus' error lies in the species he names. Both small-spotted and large-spotted dogfish are oviparous. After internal fertilization, they spawn their eggs and leave them.\textsuperscript{10} As for the thresher shark, it is an ovoviviparous species that brings forth its young alive. Yet "in the strict sense of the term, parental care of the young is unknown among sharks."\textsuperscript{11}

Should future discoveries distinguish some relationship between shark females and young, it could never be what Athenaeus suggests.\textsuperscript{12} Any animal seized into a shark's jaws, even a smaller species such as the spotted dogfish, is prey; as such, it is devoured. It has already been confirmed that during the reproductive period the appetite of females is inhibited as long as they stay in the nursing ground.\textsuperscript{13} When they start feeding again, they swim to different depths — away from their young, who are able to survive on their own from the very first day. The origin of Athenaeus' misconception lies in the fact that the term γαλεός had two different meanings in ancient Greek: first, shark or dogfish, and second, Nile mouthbreeder, \textit{Sarotherodon niloticus}.\textsuperscript{14}


\textsuperscript{10} See note 2 above.


\textsuperscript{13} Wourms, "Reproduction and Development," p. 396: "Early reports of parental care based on the observation of family groups composed of mother and young are misinterpretations. It was not parental care but rather the tendency of small sharks to follow any large moving object." (The closest approach to parental care appears to involve the selection of incubation sites, already observed by Aristotle, and the specific orientation of egg capsules within the sites in case of oviparous species.) A confusion similar to that denounced by Wourms was recorded by A. E. Brehm, \textit{Merveilles de la nature. Les poissons et les crustacés} (Paris, 1885), p. 143. See note 33 below.

\textsuperscript{14} Bodson, "L'incubation bucco-pharyngienne," p. 23.

395
The latter, whose parental behavior was recorded for the first time by Herodotus, was confused with the former, whose taste was universally appreciated in the ancient world. In an effort to supply more precise data, Athenaeus (or his source) did nothing but reenforce a confusion between the two animals. Yet such a misconception resulting from homonymous names does not fully explain the origins of a tradition that credited sharks (γαλεοί), especially dogfish (κύδας), with the behavior of Sarotherodon niloticus (γαλεός) and that expanded to the point where marvelous and fictitious accounts appeared and were echoed in the works of Oppian and Aelian.

Let us turn now to the major statement extant on sharks from the ancient Greek tradition: Aristotle's chapters in Historia animalium and Generatio animalium, which L. Agassiz praised in 1871 as follows: "In reviewing the accounts given by various observers, we find that Aristotle really knew more about the [reproductive] process than all other zoologists since his time." It is worth noting that ichthyologists still mention the valuable results attained by Aristotle in a field that remains incompletely explored despite modern technology and methods.

In HA VI.10 Aristotle deals with the principle of ovoviviparity

15. Cited by P. W. Gilbert, Sharks and Survival (Boston, 1963), p. 180. Since Agassiz's time a more detailed analysis of the biological treatises transmitted under Aristotle's name has cleared up some important aspects of their genesis and has led to the conclusion that they are more extensive compilations than had been first conceived. See, for example, F. Grayeff, "The Problem of the Genesis of Aristotle's Text," Phronesis, 1 (1956), 105–122; A. H. Chroust, Aristotle. New Light on His Life and on Some of His Lost Works (London, 1973), I, xiv, 86, 162, 232, 408; a recent book wholly devoted to the genesis of the biological treatises: S. Byl, Recherches sur les grands traités biologiques d'Aristote: sources écrites et préjugés (Brussels, 1980). In the present paper all the references to Aristotle as an ichthyologist are to be understood in a synthetic way to mean the Peripatetic contribution to the zoology of fish. It is impossible to trace all his sources in such matters and to distinguish his own role from that of his informants and his successors.


Aristotle’s Statement on the Reproduction of Sharks

among sharks, skates, and rays. He outlines the general evolution of the egg and of the embryo, quoting as many as seven different genera. At the end of the same chapter he writes:

Οἱ μὲν οὖν ἄλλοι γαλεοὶ καὶ ἑξαμώσι καὶ δέχονται εἰς ἐαυτοὺς τῶν νεωττῶν, καὶ αἱ βίναι καὶ αἱ νάρκαι (ἡ δὲ ὑφή νάρκη μεγάλη περὶ ὑγιοῦντα ἔχουσα ἐν ἐαυτῇ ἐμβρυα), ὡς ἀκανθίας οὐκ εἰσδέχεται μόνος τῶν γαλεῶν διὰ τὴν ἀκανθαν. Τῶν δὲ πλατέων τρυγών καὶ βάτος οὐ δέχονται διὰ τὴν τροχίητη τῆς κέρκου.

This is commonly understood in the sense adopted by A. L. Peck:

With one exception dog-fish can both release and take in again their young: the angel-fish and the torpedo-fish can do it (a large torpedo-fish has been recorded with about eighty embryos inside it): the exception is the spiny dogfish; this is the only dog-fish which cannot take them in, and this is because of the spine. Of the broad Selachia, the sting-ray and the ray cannot take them in owing to the roughness of their tails.18

Because Aristotle says nothing about how the young are supposed to be “taken in again,” it is usually suggested that he means “by the mouth,” with references to Athenaeus and even to Oppian and Aelian.19


Yet these later authors are ineffective in explaining Aristotle’s text or in commenting on it and, as far as the philological method is concerned, are not equipped to do so. If we keep in mind that Aristotle in the same chapter 10 defines the reproductive strategy of viviparity in smooth dogfish and nonplacental viviparity in spiny dogfish (Fig. 5) — an achievement not to be matched before 1842\textsuperscript{20} — we cannot help thinking that we must at least make an attempt to study more closely the key sentence; \( \text{Ο} \) \( \text{μ} \text{έν} \ \text{ο} \text{ν} \ \text{ά} \text{l} \text{lα} \text{ι} \ \text{γ} \text{α} \text{l} \text{ε} \text{o} \text{i} \ \text{kα} \text{ι} \ \text{ἔ} \text{ξ} \text{α} \text{φι} \text{α} \text{o} \text{σi} \ \kappa \text{α} \text{i} \ \text{δ} \text{έ} \text{χο} \text{νται} \ \text{ε} \text{i} \text{ς} \ \text{ἄ} \text{α} \text{τους} \ \text{τ} \text{ο} \text{υ} \text{s} \ \text{νο} \text{ο} \text{τ} \text{o} \text{υ} \text{s} \). Three approaches are required: (1) observations on the general structure of HA VI.10; (2) analysis of some essential terms; and (3) critical comparison of the lines in question with current knowledge on the development of shark embryos.

(1) Chapters 10 and 11 both basically deal with reproductive physiology among sharks. Ovoviviparity is defined, and examples given.

Fig. 5. Spiny dogfish (\textit{Squalus acantbias}; δ \( \text{α} \text{kανθιας} \)). After Fiches FAO.

---

Peck, Aristotle. \textit{Generation of Animals} (Cambridge, Mass., 1953), p. 298: “In several of the selachia the young have the habit of swimming into the mouth of the parent for shelter. This may be the foundation of this remark; cf. also HA 565b24 ff.”; Louis, Aristotle, 87n2: “Aristote ne précise pas comment. Sans doute croit-il que les marsouins cachent leurs petits dans leur gueule.” On dolphins and porpoises see note 30 below.

Then the physiology of the female and of the male is characterized, along with the shape of the skate's egg case, the rhythms of reproduction, superfetation, a few more peculiarities observed in some species, and again — as a leitmotiv — ovoviviparity. The only discussion not directly related to the main topic concerns the female's choice made of a protected site in a sheltered area as a spawning ground. The traditional interpretation of lines 565b23–29 interrupts the unity of these chapters: in the middle of the statement, Aristotle turns from reproductive physiology to parental care. The reference is so brief that modern translators feel obliged to provide an explication of the text without any consideration of the elementary principles of biology and without attention to Aristotle's particular stylistic use of the grouped particles Οἱ μὲν ὁδὲν and οἱ δὲ.

(2) These combined particles are very common in Aristotle's biological treatises and retain their fundamental meanings: retrospective and transitional (ὁδὲν) and prospective (μὲν). "Often the μὲν clause sums up and rounds off the old topic, while the δὲ clause introduces the new one" in an attempt to amplify or explicate what has been said before. Sometimes this combination of particles connotes the author's moving from one idea to another whose connection to the previous topic may or may not be obvious. Elsewhere the particles suggest only a shade of meaning, an additional detail, even a self-correction. Yet the new idea considered is not always related to what has just been dealt with. A few lines, or a few sentences, are sometimes inserted parenthetically into the text. They are to be temporarily dissociated from the context, in order to unify the elements connected with μὲν ὁδὲν... δὲ.

The essentially scientific nature of these biological treatises led Aristotle to employ a technical style rather than aim at literary effects. As for 565b23, the particles μὲν ὁδὲν connect the end of chapter 10 (devoted to some details of the reproductive process) not with ll. b17–23 (general data concerning shark embryos) but with ll. a13–b17, which deal with the major differences in the reproductive strategy observed in spotted dogfish, skates, spiny dogfish, and smooth dogfish.

21. In HA VI, chaps. 10 and 11 only, seven occurrences.
23. See, for instance, HA VI.10–11: Αἱ μὲν ὁδὲν πρὸς ἀλλήλα διαφοραὶ τοῦτον ἔχουσι τῶν τρόπων αὐτῶν (= females), καὶ ἡ γένεσις ἡ ἐκ τῶν ὁμών. 11. Οἱ δ᾿ ἄφρενες.
Therefore, Aristotle is not turning from his subject, the reproductive biology of the female shark, to the entirely different matter of her parental care. Following his customary method of teaching, he sums up the topic just presented in a chapter wholly devoted to the reproductive physiology of the female shark.

(3) Let us proceed to the development of the shark embryo and to the core of the sentence καὶ ἐξωρίζει καὶ δέχονται εἰς ἑαυτοὺς τοὺς νεοτούς, which all translators and commentators interpret as if it were consistent with the statements later made by Oppian, Aelian, and Athenaeus.

In Aristotle’s biological works both verbs are usually compounded (ἀφιέναι, ἐξωρίζειν, εἰσδέχεσθαι) and are used either independent of or coordinated with each other. Most of their modifiers concern physical elements, such as air or water. When the trachea takes in air (δέχεται ... τὸ πνεῦμα) and releases it (ἀφιένει),24 or when marine organisms such as Ascidian take in plankton and water (δέχεται τὴν τροφὴν καὶ τὸ υγρὸν) and release them (ἀφιένει),25 there is no doubt about the back-and-forth movement. In other contexts the verbs ἀφιένειν and ἐξωρίζειν are modified by θερῶν, σπέρμα, ὄρος, κύόμα. This means that semen, sperm, eggs, embryos, or other matter is released, emitted, or expelled from the male’s or the female’s body. When considering the reproductive process itself, and not the physiological substances involved in fertilization, Aristotle uses the verb τίκτεω (compounded ἐκτίκτεω) exclusively, with the meaning of spawning,26 laying,27 or bringing forth.28

It is well known that Aristotle did not create a new technical vocabulary,29 but was satisfied with the usual terms. The words he uses acquire their own nuances from the contexts in which they are found. ἀφιένειν and δέχεσθαι εἰς, whose literal meanings are obvious, must be interpreted with this in mind.30

26. HA VI.14.568a16, 18, 19–20, 26, and so on.
27. HA VI.1.558b21, 30 and so on.
28. HA VI.18.573a1; 20.574b7; and so on.
30. In HA VI.12.556b16–17 Aristotle says: Ἐχεῖ δ’ ὄροις καὶ ἡ σφάκα αὐτῶν γάλα, καὶ θηλαζόνται καὶ εἰσδέχονται δὲ τὰ τέκνα μικρὰ ὄντα. All the modern
In the ovoviviparous species of sharks and skates, either placental or nonplacental, the development of the embryo may be outlined roughly as follows: 31

(1) Egg-cell formation in the female’s ovary;
(2) Internal fertilization;
(3) Migration of the eggs through the oviduct to the shell gland, or nidamental gland;
(4) Discharge of the egg cases into the body cavity or uterus, where the embryos are kept in separate uterine compartments for the entire period of gestation. This period varies from species to species: 10 or 11 months in the placental smooth dogfish, as long as 22 to 24 months in the nonplacental spiny dogfish.

The young are brought forth alive, fully developed, and able to go

---

translators understand that dolphins and porpoises take their young, while still small, inside them, and they comment on the way the animals should do so (see note 19). Aristotle, who pretty well understands the reproductive process in marine mammals, especially dolphins and porpoises, is also well informed on the parental care they display for several months. As has been confirmed by modern observations, the period of intensive care involves constant body contact and lasts for several weeks. Yet the social bond between mother and female offspring is measured in years. Between mother and male offspring the longest relationship that has been observed lasted for at least two years. See D. K. Caldwell and M. C. Caldwell, The World of the Bottle-Nosed Dolphin (New York, 1972), pp. 32–34; see also M. C. Tavolga and F. S. Essipian, “Behavior of the Bottle-Nosed Dolphin (Tursiops truncatus): Mating, Pregnancy, Parturition and Mother-Infant Behavior,” Zoologica (New York), 42 (1957), 11–31.

Like selachia, dolphins and porpoises do not take their young inside. In HA VI.12, the verb εἰλαθέω means “to welcome” or “to receive,” as it does in Politics, V.3.1303a35 or in Xenophon, Anabasis, V.5.6. “Both dolphin and porpoise females have milk and suckle their young; they also welcome their young who are of small size.” Indeed, when compared with the mother, newborn dolphins and porpoises look small and thin (about a third of the adult size). Within a few weeks they grow up and look like miniature adults. See M. Nishiwaki, “General Biology,” in Mammals of the Sea: Biology and Medicine, ed. S. H. Ridgway (Springfield, 1972), pp. 76–78, 118–120; E. Slijper, “Some Remarks on Gestation and Birth in Cetacea and Other Aquatic Mammals,” Hvalrådets Skrifter: Scientific Results of Marine Biological Research, Oslo, 41 (1956), 23; idem, “On Some Phenomena Concerning Pregnancy and Parturition of the Cetacea,” Bijdragen tot de Dierkunde, 28 (1949), plate XXV, fig. 15.

out on their own as experienced predators. At their final stage of development, while still in utero, they are called (to use modern terminology) “fetuses,” “embryos,” or even, by prolepsis, “the young.” 32 Aristotle intends precisely this when he mentions (Il. 565b25–26) a large torpedo fish (Fig. 6) he once observed, with about eighty young (περί ἄγγοςκοντα . . . ἐμβρυα) in its uterus. 33 When in the

32 Such a use may be observed both in general publications, such as Budker, La vie des requins, and in specialized articles. See L. Te Winkel, “Notes on Ovulation, Ova, and Early Development in the Smooth Dogfish Mustelus canis,” Biol. Bull., 99 (1950), 479; Wourms, “Reproduction and Development,” pp. 388–394.

33 Three species of torpedo fish are known in the Mediterranean Sea: Torpedo torpedo (electric ray), mentioned by Plinius the Elder, Nat. Hist., 32, 53, and usually represented on vases and mosaics; T. marmorata; and T. nobiliana. All are ovoviviparous and bring forth the young. Twenty-one embryos were once observed in Torpedo torpedo, and as many as sixty in T. nobiliana. See G. Bini, Atlante dei Pesci delle Coste italiane. I. Leptocardi, Ciclostomi, Selaci (1967), p. 134. The “Large torpedo fish” Aristotle points out is likely to be T. nobiliana, which may reach 1.8 meters in length (T. Torpedo and T. Marmorata are each about 0.6 meter). The number eighty embryos is not overestimated. Both title
Aristotle’s Statement on the Reproduction of Sharks

Previous part of the same sentence he writes καὶ ἑξαφιῶσι καὶ δέχοντοι εἰς ἑαυτῶς τῶς νεοτόνες, he is only recording what has been accurately observed by him or his informants about selachia: that they release the embryos from the shell gland to the uterus and keep them inside, instead of spawning them as do other fish or laying eggs as do birds.

There is no need to supply additional adverbs (“again,” “de nouveau,” and the like) as modern translators feel obliged to do, nor to comment on some impossible way of “again taking in the young.” Aristotle’s synthesis concerning shark embryos moving from the ovary to inside the uterus is well documented and consistent with contemporary experiments and observations, even if it has been misleading to both ancient and modern readers unacquainted with the reproductive biology of sharks. Chapter 10 of HA VI should therefore be translated:

The majority of dogfish females release the young [the embryos] and keep them inside [in the uterus]. The angelfish and the torpedo fish do the same (a large torpedo fish with about eighty embryos inside it has been recorded). The spiny dogfish is the notable exception. This is the only dogfish which cannot keep them inside, because of the spine. Of the broad selachia, the stingray and the skate cannot keep them inside owing to the roughness of their tails.

Still to be considered briefly is the distinction Aristotle makes between smooth dogfish, angelfish (Fig. 7), and torpedo fish on the one

Fig. 7. Angelfish (Squatina squatina; ἡ ἰπτέν). After Fiches FAO.

hand, and spiny dogfish, stingrays (Fig. 8), and skates (Fig. 9) on the other hand. Knowing the sharpness and, in some cases, the venomousness of the spines and stings with which those species are armed when mature, he speculates that the embryos would jeopardize the female's life and prevent her from keeping the young inside the uterus during the period of gestation. He ignores or neglects the fact that the spines of newborn spiny dogfish are cartilaginous and protectively capped, as is the sting of the common stingray. Moreover, the latter are brought forth in a "rolled position," which eliminates the risk, if any, to the female. As for the skates, they are oviparous. After

![Stingray diagram](image)

Fig. 8. Stingray (*Dasyatis dasyatis; η τρυγών*). After Bini, *Atlante*, p. 175.

Aristotle’s Statement on the Reproduction of Sharks

internal fertilization the female spawns the oblong-shaped shells (see HA VI.10.565a26), which are usually deposited on or near the sea bottom. They hatch after several days of incubation, without any further intervention from the female. In HA VI.10.565b23–29 Aristotle’s misconception or inconsistency about the reproductive patterns of sharks becomes evident in the final part of his statement, but only when he moves from direct observations and experiments to theoretical speculations.

Another misconception is to be found in the same chapter 10 about Lophius piscatorius, the angler, which Aristotle classified with selachia. (See also Generatio animalium, III.3.754a23–31.) The adult Lophius piscatorius (Fig. 10a) is a teleostean fish and therefore oviparous. The female spawns a very large number of minuscule eggs,

Fig. 9. Skate (Raja asterias; ὀ βάτος). After Fiches FAO.


up to three million (the “purple veil”). The young grow up and reach full size after thirty months (Fig. 10b, c, d).[36]

Fig. 10. Angler fish (*Lophius piscatorius*; ὁ βατράχος). a, Adult. After *Fiches FAO*. b, c, d, Juveniles. b, after hatching; c, at 11.5 mm; d, at 16.5 mm. After E. Padoa, *Fauna e Flora del Golfo di Napoli pubblicata dalla Stazione zoologica di Napoli*, 38 (1956), pp. 880–882, figs. 780–782.

Aristotle’s Statement on the Reproduction of Sharks

Thirty years ago Sarton wrote, of Aristotle’s *Historia animalium*: “The critics have devoted their attention mainly to the good pieces. It would be interesting to make a statistical analysis of the whole work and determine how often the master is right, how often wrong, and to evaluate his degree of correctness in every case.” 37 Such a project has not been undertaken.

One may wonder to what extent statistics would improve our understanding of the Aristotelian biological treatises. The fact is, however, that any evaluation of the kind Sarton suggested remains out of reach: too many zoological data in the Aristotelian corpus are still burdened with misinterpretations either inherited from antiquity or introduced by modern translators and textual annotators. 38 An extensive commentary assessing the correct statements and the discrepancies is still needed. 39 The results, if based on a careful and interdisciplinary reading of the original texts, would undoubtedly be astonishing and would contribute both to the history of natural science in antiquity and to classical studies.

**Acknowledgements**

I wish to thank Frank N. Egerton for his helpful comments and suggestions on the first version of this paper.

---


38. This poses a serious objection to Byl, who often misinterprets the zoological data in his *Recherches* (see note 15). For instance, p. 19 (on the otter in the Nile, against Herodotus, II.72); pp. 23–24 (on the Nile mouthbreeder); p. 259 (on the eggs laid by the female cuckoo); and pp. 260–261 (on mouse reproduction).

39. Compare such a project with the research suggested by J. B. S. Haldane, “Aristotle’s Account of Bees’ ‘Dance,’” *J. Hellenic Stud.*, 75 (1955), 25: “Aristotle’s biological works should be translated afresh in each generation, with a commentary by a committee of biologists.” I would rather see the investigation Haldane proposes performed as a joint contribution of classicists and biologists to the history of early biology.