BREEDING HABITS OF BOMBAY ELASMOBRANCHS

By

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CONTENTS.

INTRODUCTION.

The present paper is a record of an examination of gravid females of twenty species of sharks and rays from the Bombay waters, which the authors carried out during the quinquennium from 1940 to 1944. The observations, set forth in a tabulated form, are chronologically arranged and describe the various stages of gestation as well as salient features of embryonic development. As a result of these observations, it has been possible to add notes of a generalised nature on the breeding habits of these species.

Observations on more or less similar lines by such authors as Alcock (1890, 1892), Woodmason and Alcock (1891), Southwell (1910) Southwell and Prashad (1919) and Mahadevan (1940) are sketchy and scarcely contain a complete account of the life-history of even one form. These gaps are, to a considerable extent, filled by our account.

Scoliodon palasorrah (Cuvier).

Date of capture.	Length of parent female.	Total No. of embroys.	Length of embroys.	Remarks.
28-9-42	25″	1+2=3	112 mm.	Intermediate pregnancy; embryos enclosed in shell-membrane sacs devoid of any liquid; yolk-sac, with little yolk, folded all over its face to form rudimentary placental connection with uterine trophonema; appendicula long, thread-like and much-branched.
9-10-42	24·0″	2+1=3	63 mm.	Intermediate pregnancy; rudimentary placenta present even at this stage.
16-11-42	24·0″	2+1=3	63 mm.	
17-11-42	25·5″	1+2=3	33 mm.	Early pregnancy; embryos enclosed in water-filled shell membrane sacs; spiracles and branchial filaments present; appendicula very short.
17-11-42	27·25″	3+2=5	110 mm.	Intermediate pregnancy.
11-1-44	26·0″	1+3=4	256 mm.	Preparturition stage; left ovary with three big, oval eggs each 12 mm. ×13 mm. and full of bright yellow yolk; 'entire' placenta.
10-10-47	25·5″	2+2=4	126 mm.	Intermediate pregnancy.

The species does not appear to grow beyond 30″ in length, the maximum length recorded being 27·25″ The smallest adult male, with well-developed fusiform claspers measured only 22″ in total length. Observations of the female show that only the left ovary is present and the largest ovarian egg measures 12 mm. ×13 mm. It is ovoid in shape and contains bright yellow yolk. Mahadevan (1940) states, however, that both the ovaries are present and that the largest ovarian egg measures only 3 mm. to 4 mm. in diameter. The nidamental gland consists of two spirally twisted horns. Ordinarily, the minimum number of offsprings at a time is three, two from one uterus and one from the other. At birth, they measure from 275 mm. to 300 mm. in total length. The peak of parturition period appears to be January and February. The foetal placenta is of the 'entire' variety. The maternal placenta in advanced stages of pregnancy is a more or less circular bunch of highly vascular, close-set plaits and folds of the uterine mucous membrane in the posterior part of the uterine compartment—the trophonematous cup—this being definitely elevated above the general surface of the uterine mucosa so as to look like a flowery mass borne on a thalamus.

Scoliodon walbeehmi (Bleeker).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
29-10-42	31·5″	0+2=2	237 mm.	Advanced pregnancy ; right uterus abortive, with only a shell-membrane tuft; foetuses enclosed in shell-membrane sacs ; 'entire' placenta; short thin; appendicula with rounded tips.
15-12-43	31·5″	..	..	Post-pregnant stage; each uterus with one compartment and one atrophying trophonema; only left ovary present and the biggest ovarian egg round 20 mm. in diameter and with yellow yolk.
10-10-47	30·25″	0+2=2	45 mm.	Right uterus abortive with, two barren shell membrane tufts; embryos enclosed in water-filled sacs; appendicula in the form of rounded disc-like knobs.

This species does not appear to grow beyond 37″ in total length. The smallest adult male measured only 29″ in total length. In the female only the left ovary is present and a fully mature ovum measures about 20 mm. in diameter. The nidamental glands are exactly similar to those of *Scoliodon palasorrah.* Embryos are enclosed in shell membrane sacs and the placental cords bear short, close-set and flattend appendicula with rounded and bifid extremities. Foetuses in advance stages of development are faithful replicas of their parents except for the fact that the margins of their teeth are entire and not roughened as in the adult. The number commonly born at a time is two, one from either uterus or both from one uterus, the other uterus being abortive. The parturition period appears to be sometime in November and December. The placenta formed is of the 'entire' variety.

Hypoprion macloti (Müller & Henle).

Date of capture.	Length of parent female.	Total No.of embryos.	Length of embryos.	Remarks.
7-2-42	33″	1+1=2	412 mm.	Advanced pregnancy; shell membrane sacs enclosing embryos without any liquid at this stage; no appendicula on placental cords; 'entire' placenta.
22-9-42	30″	1+1=2	27 mm.	Early pregnancy; embryos enclosed in water-filled sacs of shell membrane; spiracular slits and branchial filaments present; no placenta at this stage.
5-11-42	33″	0+1=1	187 mm.	Intermediate pregnancy; right uterus with only an unfertilized egg enclosed in shell membrane; shelly sacs of embryos devoid of any albuminous liquid; rudimentary placental connection present.

Hypoprion macloti (Müller & Henle)—*contd.*

Date of capture.	Le gth of parent female.	Total No. of embryos.	Length of embroys.	Remarks.
18-2-43	34″	..	..	Pregnant condition; only right ovary with five big oval eggs; each 20 mm. ×19 mm. and with golden yellow yolk; uteri showed readiness to receive eggs.
22-11-43	35″	1+1=2	237 mm.	Intermediate pregnancy.
29-2-44	34″	1+1=2	425 mm.	Advanced pregnancy.
2-3-44	34″	1+1=2	450 mm.	,, ,,

The species is a small one and does not grow beyond 36″ in total length. Males seem to attain maturity when only about 27″ in total length. Only the right ovary is present. Mature eggs are oval in outline, full of bright yellow yolk and the largest measures 20 mm. ×19 mm. Unlike *Scoliodon palasorrah* and *S. walbeehmi*, each nidamental gland consists of two coiled horns. The commonest number of young ones born is two, one from either uterus and at birth, they measure from 450 mm. to 500 mm. in total length. The foetal placenta is of the 'entire' variety. Males of this species are very common and constitute 95 % of the quantity landed. Females are rare.

Carcharinus limbatus (Müller & Henle).

Date of copture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
21-12-42	5′-9″	3+2=5	144 mm.	Intermediate pregnancy; left uterus also contained an unfertilized egg; branchial filaments present; spiracles absent; rudimentary placenta formed.
22-12-42	6′	1+1=2	575 mm.	Preparturition stage; right uterus also contained an unfertilized egg and the left a degenerating embryo; 'entire' placenta.
17-5-43	5′-4″	..	..	Post-pregnant condition; compartmental walls no longer visible.
22-9-43	5′-2″	3+3=6	225 mm.	Intermediate pregnancy; no pigmentation yet developed in the embryo.
4-11-43	6′	2+2=4	225 mm.	,, ,,
27 8-43	5′-4″	3+3=6	175 mm.	,, ,,
5-11-43	5′-9″	2+2=4	190 mm.	Each uterus also contained an unfertilized egg.
21 1-44	5′-7″	3+3=6	400 mm.	Advanced pregnancy.
29 2-44	5′-9″	3+3=6	475 mm.	,,
11-4-44	5′-9″	..	..	Post-pregnant condition.

The species grows to a length of about 6'. The smallest adult female measured 5'-2" in total length and the smallest adult male only 4'-8" Only the left ovary is present ; the mature egg measures about 25 mm. in diameter and possesses yellow yolk. Throughout their intrauterine life, the embryos are enclosed in water-filled sacs of shell membranes which afford protection to the embryos. The number commonly born at a time is six, three from each uterus and at birth they measure about 24" in length. The peak of parturition period in Bombay waters appears to be January, February and March. The placenta formed is of the ' entire ' variety.

The species is cosmopolitan in its distribution, appearing in tropical and subtropical seas. Nichols and Breder (1927) state that breeding females of this species measure from 5' to 5'-6" in total length and 'are ready to be released in April in the Bay of Florida'

Carcharinus melanopterus (Quoy & Gaimard).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
28-11-40	9'- 2"	9+9=18	550 mm.	Advanced pregnancy ; foetuses enclosed in water-filled shell membrane sacs ; 'discoid, placenta ; no appendicula on placental cord.
17-1-41	10'	6+6=12	600 mm.	„ „
26-9-41	8'	..	..	Pre-pregnant condition ; only left ovary with small, pea-sized and colourless eggs.
17-2-42	8'- 9"	5+5=10	550 mm.	Advanced pregnancy.
19-2-42	9'- 4"	..	..	Pre-pregnant stage ; left ovary with 30 big ripe eggs from 38 mm. to 50 mm. in diameter.
29-4-42	10'	6+6=12 eggs.	..	Each uterus with six spindle-shaped eggs enclosed in shell membranes.
20-5-42	9'-10"	6+5=11	120 mm.	Early pregnancy ; only one compartment in the left uterus contained an unfertilised egg ; embryos enclosed in water-filled shell membrane sacs ; spiracles present ; no placenta at this stage.
11-2-43	10'- 2"	9+9=18	775 mm.	Advanced pregnancy ; foetuses still enclosed in water-filled sacs ; firm placental connection.
28-4-43	10'- 2"	..	..	Post-pregnant stage ; uteri reduced in size with sagging walls and atrophying trophonementa ; ovary with pea-sized, pale ova.
6-1-44	9'- 4"	..	..	Post-pregnant condition ; left ovary with 24 big eggs 37 mm. in diameter ; uteri empty, without compartments and containing degenerating fragments of shell membranes.
9-5-44	10'- 2"	7+6=13	70 mm.	Early pregnancy ; the uteri also contained a few unfertilized eggs and some barren shell membrane tufts ; sexes differentiated even at this stage.

The maximum length of the species recorded by us is 10′-2″ Females attain maturity when about 8′ long. Alcock (1890) described a gravid female of *C. melanopterus* as being only 5′ in length. It is very likely that Alcock's species was not *C. melanopterus* but some other shorter form such as *C. limbatus* or *C. sorrah.* Only the left ovary is present and functional. The mature ovarian egg is round and measures from 37 mm. to 50 mm. in diameter. As many as 30 ripe eggs may be produced at a time. The commonest number of young ones produced is 12, six from each uterus and at birth, they measure from 750 mm. to 900 mm. in total length. Sexes of the embryos are differentiated externally as early as 80 mm. stage. The parturition period appears to extend from December to March. Throughout their intrauterine life, the embryos are enclosed in water-filled sacs affording protection to the embroys. Even in advanced stages of pregnancy, the uterine compartments are more or less transverse in disposition and in this respect the condition resembles that in *Galeocerdo tigrinus* (Sarangdhar, 1943). The foetal placenta is of the 'discoid' variety.

Carcharinus sorrah (Müller & Henle).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
13-3-42	4′- 3″	2+2=4	512 mm.	Advanced pregnancy; only left ovary present with small pale ova not bigger than peas; foetuses enclosed in water-filled sacs; 'discoid' placenta.
12-3-43	4′- 0″	3+3=6	425 mm.	Advanced pregnancy.
4-11-43	4′- 2″	3+2=5	225 mm.	Intermediate pregnancy; rudimentary placenta formed while yolk-sac still contains thin, lemon-yellow yolk.
5-11-43	4′- 3″	2+2=4	275 mm.	Intermediate pregnancy; tips of pectorals and lower lobe of caudal just becoming blackish.
21-1-44	4′- 3″	2+1=3	475 mm.	Advanced pregnancy.
29-2-44	4′- 8″	3+3=6	425 mm.	,, ,,
1-3-44	4′- 4″	3+2=5	500 mm.	Advanced pregnancy ; left uterus also contained an unfertilized egg.
2-5-44	4′- 3″	2+1=3	550 mm.	Parturition stage.

The species does not appear to grow beyond 5′ in total length, adult females commonly ranging from 4′-0″ to 4′-6″ in total length. Only the left ovary is present and functional. The number of young ones commonly born at a time is six and measure at birth about 600 mm. in total length. Throughout their intrauterine life, they are enclosed in water-filled sacs of shell membranes. The delivery period extends from March to May. The characteristic blackening of the tips of the fins begins to be noticeable when the embryos are 275 mm. long. The shortest adult male with stout, well-developed claspers measured 3′-7″ in length. Embryos develop 'discoid' type of placenta.

Carcharinus menisorrah (Müller & Henle).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
29-10-42	35·5″	1+1=2	80 mm.	Intermediate pregnancy; only left ovary present; largest ovarian egg 18 mm. in diameter and with bright yellow yolk; embryos enclosed in shell membrane sacs devoid of liquid; basal wall of yolk-sac with minuto folds which form placental connection with uterine trophonema; no appendicula.
2-11-42	32·5″	0+1=1	62 mm.	Early pregnancy; right uterus contained an unfertilized egg; embryo enclosed in shell membrane sac with little albuminous liquid; embryonic spiracles and branchial filaments present; no placental connection.
12-11-42	29″	0+1= 1	212 mm.	Advanced pregnancy; right uterus abortive; 'entire' placenta.
24-11-42	33″	1+1= 2	350 mm.	Parturition stage.
12-5-43	34″	1+1= 2	163 mm.	Intermediate pregnancy.
21-11-43	35″	1+1= 2	275 mm.	Advanced pregnancy.
5-12-43	34″	0+1= 1	325 mm.	Advanced pregnancy; right uterus abortive.
28-2-44	34″	1+1= 2	325 mm.	,, ,,
29-2-44	35″	1+1= 2	300 mm.	,, ,,
6-3-44	34″	1+1= 2	375 mm.	Parturition stage.

Mature specimens, both male and famale, of this species do not exceed 3′ in length, although Day (1878) records that it attains 12′ or more in length. The smallest adult female measured 29″ in total length while the smallest male recorded measured only 27″ Only the left ovary is present and functional and the largest ovarian egg measures about 18 mm. in diameter. The usual number of young ones born is two, one from either uterus, although occasionally the right may be abortive. The foetus at birth measures from 350 mm. to 400 mm. in total length. The period of parturition in Bombay waters is fairly long, extending from November to March or even April. The placenta formed is of the 'entire' variety.

Carcharinus temminckii (Müller & Henle).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
8-8-42	5′- 3″	4+4= 8	27 mm.	Early pregnancy; embryos enclosed in water-filled shell membrane sacs; spiracles and branchial filaments present; no appendicula.
19-8-42	4′- 9″	4+4= 8	43 mm.	Early pregnancy; sexes not yet distinguished externally.
5-2-42	5′- 0″	4+4= 8	375 mm.	Advanced pregnancy; embryos still enclosed in water-filled shell-membrane sacs; 'discoid' placenta.
30-4-43	4′-10″	4+4= 8	450 mm.	Advanced pregnancy.
5-5-43	5′- 0″	4+4= 8	525 mm.	,, ,,
12-5-43	5′- 4″	4+4= 8	575 mm.	,, ,,
9-10-43	4′- 7″	5+3= 8	128 mm.	Intermediate pregnancy; embryos in water-filled sacs; yolk-sacs still containing yolk but rudimentary interdigitating placenta formed; sexes distinguished externally.
11-10-43	4′-3″	4+2= 6	375 mm.	Advanced pregnancy.
27-1-44	4′-11″	1+3= 4	306 mm.	,, ,,
28-1-44	4′-10″	2+2= 4	350 mm.	,, ,,
29-2-44	4′-11″	4+4= 8	375 mm.	,, ,,
13-4-44	4′-8″	4+3= 7	462 mm.	Advanced pregnancy; left uterus also contained an unfertilized egg encolsed in shell membrane.

The species does not seem to grow beyond 5′-6″ in total length, the maximum length so far recorded being only 5′-4″ The minimum length of an adult female recorded is only 4′-3″ The adult males are comparatively shorter than females, the smallest adult male thus far recorded being only 3′-9″ in total length. Only one ovary is present and functional. The biggest ovarian egg is about 10 mm. in diameter. The commonest number of young ones produced at a time is eight, four from each uterus and at birth they measure from 450 mm. to 600 mm. in total length. Throughout their intrauterine life, they are enclosed in water-filled sacs of shell membranes which afford additional protection to the embryos. The peak period of parturition in Bombay waters is before the outbreak of the monsoon, *viz.*, April and May. The placenta formed is of the 'discoid' variety. Males and females in this species appear to be equally distributed.

Galeocerdo tigrinus Müller & Henle.

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embroyos.	Remarks.
15-12-41	12′	18+18=36	70 mm.	Early pregnancy ; besides the 18 embryos 4 compartments from each uterus also contained 4 unfertilised eggs ; no pigmentation yet.
17-1-42	13′-1″	21+21=42	500 mm.	Advanced pregnancy ; foetuses enclosed in water-filled sacs of shell membranes ; no placenta formed.
4-5-43	12′-9″	14+13=27	725 to 750 mm.	Parturition stage ; no placenta ; the left uterus also contained one unfertilised egg.
21-10-43	9′-3″	14+15=29	200 mm.	Intermediate pregnancy ; branchial filaments present ; no pigmentation yet.

The species has so far, been observed to grow to a maximum length of 13′-1″ in Bombay waters. Its developmental stages have been described in detail by Sarangdhar (1943 ; 1946). It is a prolific breeder and brings forth any number from 27 to 44 young ones at a time the latter number being by far the most common. It is a non-placental form and the yolk in the yolk-sac suffices to bring about the complete intrauterine growth, thus not necessitating the formation of a placenta. Throughout the intrauterine life, the embryos are enclosed in water-filled sacs of shell membranes which afford protection to the embryos. At birth, the foetuses measure about 750 mm. in length and have the characteristic tiger-like markings on their backs. The yolk-sacs and umbilical cords are completely absorbed before birth.

Hemigaleus balfouri Day.

Date of caputre.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
16-10-42	32″	3+1=4	135 mm.	Intermediate pregnancy ; shell membrane sacs disintegrated ; yolk-sacs with very little yolk and with walls folded all over its face to form a placenta ; umbilical cords with thin thread-like appendicula.
24-11-42	33″	2+2=4	200 mm.	Advanced pregnancy ; 'entire' placenta.
9-11-43	23″	1+1=2	115 mm.	Intermediate pregnancy ; placenta formed.
9-11-43	25″	1+0=1	145 mm.	Intermediate pregnancy ; the left uterus contained two abortive tufts of shell membranes.
29-2-44	31″	1+1=2	175 mm.	Advanced pregnancy.
15-10-47	26″	1+0=1	112 mm.	Intermediate pregnancy.

The species does not grow to beyond 36″ in total length the maximum length recorded being 33″ and the minimum length of an adult female being only 23″ The commonest number of young ones born is two, one from each uterus and their length at birth is from 200 mm. to 225 mm. Female foetuses predominate. The placental condition is established early and the placenta formed is of the 'entire' variety. The peak of parturition period appears to be February and March. As in *Scoliodon sorrakowah*, the shell membranes enclosing the embryos undergo early degeneration, most probably nutritive and supply additional nutriment to embryo.

Sphyrna blochii (Cuvier).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
1-9-41	4′-5″	4+4=8	70 mm.	Early pregnancy; embryos enclosed in shell membrane sacs with clear albuminous liquid; each oculo-narial expansion shorter than its width; branchial filaments present; umbilical cords with thin, circular, locular appendicula; no placenta formed.
11-12-41	3′-11″	3+3=6	287 mm.	Intermediate pregnancy; sacs enclosing embryos with little albuminous liquid; oculo-narial expansions curved backwards to give a horseshoe shape to the head region; rudimentary placenta formed; characteristic appendicula present.
25-2-42	4′-0″	3+3=6	362 mm.	Advanced pregnancy; oculo-narial expansions still directed posteriorly; 'entire' placenta.
28-9-42	4′-4″	3+3=6	43 mm.	Very early pregnancy (shark-like stage); in addition to the embyros, each uterus also contained 2 unfertilized eggs; no appendicula on umbilical cords.
5-2-43	3′-10″	3+4=7	325 mm.	Advanced pregnancy; right uterus also contained an abortive egg.
25-3-43	3′-11″	3+3=6	350 mm.	Advanced pregnancy.
30-4-43	4′-2″	3+3=6	350 mm.	,, ,,
17-5-43	4′-0″	3+3=6	400 mm.	,, ,,
14-7-43	..	..	..	Free-swimming young ones with fresh umbilical scars 450 mm. to 525 mm. long.

Sphyrna blochii (Cuvier)—*contd.*

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
25-9-43	3′-5″	2+2=4	66 mm.	Early pregnancy ; embryonic development arrested due, in all possibility, to the bursting of the embryonic yolk-sacs.
7-10-43	3′-9″	3+3=6	60 mm.	Early pregnancy.
7-10-43	3′-9″	3+3=6	45 mm.	' Shark-like ' stage.
23-10-43	4′-3″	4+4=8	125 mm.	Intermediate pregnancy ; unpigmented embryos enclosed in water-filled shelly sacs ; rudimentary placenta formed.
25-1-44	3′-10″	5+4=9	325 mm.	Advanced pregnancy.
4-2-44	4′-8″	5+4=9	375 mm.	„ „
28-2-44	3′-9″	3+3=6	375 mm.	„ „
6-3-44	4′-3″	3+3=6	450 mm.	„ „
11-5-44	4′-6″	..	..	Post-pregnant condition ; ovary with ova measuring 5-6 mm. in diameter and possessing yellow yolk.

The species has not, so far, been observed to grow beyond 4′-8″ in length and apparently it hardly exceeds 5″ at the most. The smallest adult female measured only 3′-5″ in length while the smallest adult male recorded was 3′-7″ in length, Only the right ovary is present and functional and the mature egg measures about 10 mm. in diameter. The number of young ones born is commonly six, three from each uterus though the maximum number so far recorded is 9. Female foetuses predominate. Newly born young ones measure about a foot and half in total length. The peak of parturition period in Bombay waters is April and May, just before the monsoon. Sexual activity appears to be the highest during the monsoon as, in September and October, immediately after the monsoon, females are in early and intermediate stage of pregnancy. The embryos during their early and intermediate stage of development are enclosed in protective water-filled shell membrane sacs but the protective liquid diminishes in quantity as pregnancy advances. The placenta formed is of the ' entire ' variety.

Gravid females of this species furiously attack one another, when they are so heavily buffeted that the yolk-sacs of the developing embryos burst and the embryos undergo abortive changes.

Rhynchobatus djiddensis (Forskål).

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
22-8-41	8′-1″	..		Prepregnant stage; both ovaries full of eggs 37 mm. in diameter; uteri empty, with smooth mucous membranes.
18-3-42	8′-8″	5+5=10	150 mm.	Intermediate pregnancy; both ovaries full of eggs ranging from 25 mm. to 62 mm. in diameter egg-cases enclosing embryos disintegrated; uterine mucous membrane with plaits and frills.
29-8-42	8′-3″	5+5=10	130 mm.	Intermediate pregnancy.
20-7-43	7′-0″	4+4=8	95 mm.	Intermediate pregnancy; shelly egg-case broken up into fragments.
26-8-43	9′-9″	3+4=7	45 mm.	Early pregnancy; 'shark-like' stage in each uterus; one egg-case enclosing embryos; egg-case compartmented.
6-10-43	8′-9″	4+4=8	157 mm.	Intermediate pregnancy.
Do	9′-2″	4+4=8	200 mm.	Commencement of advanced pregnancy.
Do	9′-5″	6+3=9	235 mm.	„ „
7-10-43	9′-7″	4+4=8	287 mm.	Advanced pregnancy.
9-10-43	9′-3″	3+4=7	437 mm.	„ „
13-10-43	9′-1″	3+3=6	..	Three eggs in each egg-case, each egg measuring 87 mm. in diameter.
12-4-44	7′-9″	..	..	Post-pregnant condition.
8-10-47	8′-3″	2+3=5	245 mm.	Commencement of advanced pregnancy.

The maximum length of this species so far recorded is 9′-9″ and the minimum length of an adult female only 7′ It is an ovo-viviparous, form. Both ovaries are present and functional and produce large-round eggs full of viscous yellow yolk. The largest ovarian egg measures about 62 mm. in diameter. Early embryos are enclosed in compartmented, leathery egg-cases formed from shell-membranes but these last only a short while and disintegrate after a certain stage of embryonic development. The smallest embryonic stage when the egg-case was already in a disintegrating condition was observed to be the 95 mm. stage. The commonset number of young ones produced is eight, four from either uterus, although the maximum recorded is 10. The maximum number of healthy embryos from a single uterus was six. At birth, they measure from 450 mm. to 500 mm. in total length. The greatest reproductive activity appears to be during the monsoon months

for, gravid females in early or intermediate stages of pregnancy are landed in August, September and October. Fishermen state that these fish are caught during these months within three to four miles off-shore indicating that the breeding grounds of this species are located quite near Bombay. The parturition period appears to be towards the end of the year.

Pristis cuspidatus Latham.

Date of capture.	Length of parent female.	Total No. of embryos.	Length of embryos.	Remarks.
15-3-43	8′-2″	4+4=8	33 mm.	Early pregnancy ; ' shark-like ' stages.
„	..	..	..	A free-swimming ; newly born young one 425 mm. long ; (including saw); yolk-sac and stalk just absorbed.
15-5-43	..	..	..	A free-swimming newly born young one 600 mm. long; yolk-sac and stalk just absorbed.
4-2-44	9′-3″	3+3=6	53 mm.	Early pregnancy ; ' saw-fish ' stage.
2-3-44	8′-1″	3+3=6	43 mm.	Early pregnancy ; rostrum just originated.
6-3-44	8′-11″	3+	537 mm.	Parturition stage ; teeth on saw not yet cut throughout the membrane enveloping them ; yolk-stalk and sac nearly completely reduced ; large internal yolk-sac.

This species has been rarely observed to grow beyond 10′ in Bombay waters, though Day (1888) records sizes of 20′, and upwards in length. It is ovo-viviparous. Both the ovaries are present and functional and a fully mature ovarian egg measures about 25 mm. in diameter. In early stages of development a number of embryos are enclosed in a soft leathery egg-case, compartmented internally. The egg-case lies in the uterus which, however, is not compartmented. The uterine mucous membrane is, however, thrown into plaits and frills, is extremely glandular and produces a milky secretion which must serve as additional nutrition to the developing embroys. Six appears to be the commonest number of young ones born at a time, three from either uterus, their total length then varying from 425 mm. to 600 mm. The parturition period in Bombay waters appears to be March, April and May. The lateral teeth on the ' saw ' are cut only after the assumption of free life.

Dasyatis uranak var. **variegatus** (Annandale).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
5-10-43	5′-2″	2	325 mm.	Parturition stage ; only left uterus well-developed and containing foetuses ; solid brown spots on back of foetuses ; yolk-stalks and sacs completely absorbed.
9-10-43	5′-0″	1	294 mm.	Advanced pregnancy ; very short yolk-stalk and sac present.
25-10-43	5′-0″	2	300 mm.	Parturition stage ; dorsal colouration of foetus as in *D. uranak*.
26-10-43	5′-0″	2	425 mm.	,, ,,

This has been rightly described by Annandale (1909) as only a colour variety of *D. uranak* (Forskål). Embryological observations reveal that the colour variation of the two forms is of a merely superficial nature, induced in certain cases by age, for the female of *D. variegatus* (with a dorsal colouration of hollow rings and an irregular network of wavy lines) invariably brings forth fully-formed young one with large round or oval dark brown or black spots) which could be described as *D. uranak*. It is at once obvious that the solid spots in the young condition (*D. uranak*) sometimes become hollowed out with age and converted into rings or wavy lines which coalesce to form the reticulum characteristic of the colour pattern on *D. variegatus*.

The maximum width across disc of this variety observed by us in Bombay waters is 5′-2″ Only the left ovary, left oviduct and left uterus are developed. A reduced nidamental gland is present above the upper pole of the left uterus. The commonest number of young ones born is two and at birth they measure from 300 mm. to 450 mm. across disc. The parturition period in Bombay waters appears to be October and November.

Dasyatis bleekeri (Blyth).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
14-11-41	42″	1	187 mm.	Parturition stage ; yolk-stalk and sac completely absorbed ; uterine mucuous membrane with trophonematous villi.
17-5-43	40″	1	152 mm.	Preparturition stage ; embryo with only a short yolk-stalk.

The maximum size recorded for this species is 42″ across disc. Only the left ovary, left oviduct and left uterus are present and functional. Only a single young one is born and brought forth at a time, its size across the disc then being about 200 mm. to 225 mm.

Dasyatis walga (Müller & Henle).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
9-9-41	9·5″	2	50 mm.	Advanced pregnancy ; only left ovary present ; ovarian egg 15 mm. in diameter.
Do.	9·4″	2	45 mm.	Advanced pregnancy ; short yolk-stalk and sac present (30-40 mm. long).
2-11-42	9·1″	2	55 mm.	,, ,,
13-1-43	10″	1	75 mm.	Parturition stage ; yolk-stalk and sac almost completely absorbed.
29-3-43	9·3″	2	50 mm.	Advanced pregnancy.

The maximum size of this species recorded is 10″ across the disc. Only the left ovary is present and the mature ovarian egg measures about 15 mm. in diameter and contains bright yellow yolk. Only the left uterus is developed and bears two embryos at a time which at birth, measure from 70-80 mm. across the disc. The uterine mucous membrane bears flat, spatulate trophonematous villi. Gravid females at full term are frequently landed during December and January. Reproductive organs on the right side are entirely absent.

Dasyatis zugei (Müller & Henle).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
9-9-41	11·75″	1	42 mm.	Early pregnancy ; very tiny unpigmented embryos with prominent yolk-stalks and sacs ; uterine mucous membrane with crowded glandular villi.
6-2-42	11″	2	112 mm.	Advanced pregnancy ; foetuses pigmented and with nearly completely reduced yolk-stalks and sacs.
29-3-43	13·25″	2	118 mm.	,, ,,
11-1-44	12·5″	2	108 mm.	,, ,,

The maximum size of this species is observed to be 13·25″ across the disc and the minimum of an adult female as 11″ across disc. Only the left uterus is developed and contains usually two embryos which, at birth measure from 112 mm. to 125 mm. across the disc. February, March and April are by far the commonest months when fully developed young ones, ready for birth are found in the wombs of gravid females. The reproductive organs on the right side are in a rudimentary state of development.

Gymnura poecilura (Shaw).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
29-10-42	43·5″	2+2=4	216 mm.	Advanced pregnancy; both uteri well-developed and containing embryos; uterine mucous membrane with glandular villi.
22-4-43	37″	0+1=1	262 mm.	Parturition stage; right uterus empty and had probably liberated its young one in the sea.
20-5-43	32″	3+3=6	212 mm.	Parturition stage.
30-12-43	31″	0+2=2	250 mm.	Parturition stage; right uterus empty and had probably delivered its contents into the sea.
11-4-44	36″	2+2=4	237 mm.	Parturition stage.

The gestation and embryonic history of a closely allied Indian species, *Pteroplatea* (Syn. *Gymnura*) *micrura* have been studied in detail by Woodmason and Alcock (1891) and by Alcock (1892). Our observations on *G. peocilura* agree in every respect with the observations of the aforesaid authors. We were not able to obtain gravid females of our species in early stages of pregnancy but Gudger (1912) records that in *Pteroplatea maclura* the eggs and early embryos are enclosed in shell membrane sacs.

The number of young ones commonly born is four, two from either uterus, and their size at birth is about 250 mm. across the disc. Their yolk stalks and sacs are completely absorbed before birth. Pale white round dots on the embryonic sac are quite conspicuous at birth. There seems to be no fixed parturition period for this species in Bombay waters.

Rhinoptera javanica Müller & Henle.

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
22-9-41	48″	1	200 mm.	Intermediate pregnancy; yolk-stalk 100 mm. long; no dorsal pigmentation; uterine mucous membrane with elongated spatulate villi.
21-7-43	43″	1	450 mm.	Parturition stage; yolk-stalk and sac completely absorbed.
12-4-44	51″	..	..	Post-pregnant condition; short villiform trophonemata also present on the mucosa of the right undeveloped uterus.

Only the left ovary, left oviduct and left uterus are developed, the right oviduct and uterus being present but in a rudimentary condition of development and non-functional. A small nidamental gland is present above the upper pole of each uterus. A single young one is born at a time and at birth measures about 450 mm. across the disc. The yolk-stalk and sac are completely absorbed before birth.

Mobula diabolus (Shaw).

Date of capture.	Width across disc of parent female.	Total No. of embryos.	Width across disc of embryos.	Remarks.
6-5-43	45″	1	400 mm.	Parturition stage ; uterine mucous membrane beset with trophonemata ; yolk-stalk and sac completely absorbed.
7-5-43	48″	1	400 mm.	,, ,,
11-4-44	50″	1	375 mm.	,, ,,

Only the left oviduct and left uterus are present. A small nidamental gland is present immediately above the upper pole of the uterus. A single young one is born at a time measuring, at birth, 400 mm. across the disc. It lies in a supine position within the uterus with its ' wings ' folded backwards and its cephalic horns folded ventrally and medially. The parturition period of this species is definitely April and May since a large number of gravid females at full term are then landed in large numbers.

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