ON THE DISTRIBUTION OF THE FRESHWATER EELS ON JAVA.

By

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In the most recent of his contributions towards the biology of the freshwater eels [1]) J. SCHMIDT turns his attention to the distribution of the Indo-Pacific species and comes to very interesting conclusions again. In the first place he lays stress on the desirability of a better distinction of the different species inhabiting the Pacific. Just as with the two Atlantic species it will be necessary to take into account such statistical characters as, in the first place, the number of vertebrae to separate the closely allied species and to get out of the fairly chaotic state in which the classification here remains. A first step in this direction has been made by WEBER [2]), but further researches will be necessary to complete the work.

SCHMIDT himself has now set to work on this subject, which indeed could not be in better hands. The results will be no doubt of great value and their publication is eagerly looked forward to. It has become evident already that the number of Indo-Pacific species is at any rate considerably higher than that of the Atlantic species which is now restricted to 2. It is estimated by SCHMIDT as being at least 16.

Provisionally SCHMIDT now gives a survey of what is known about the distribution of the Pacific freshwater eels and the conclusions arrived at are interesting in several respects. SCHMIDT e.g. emphasizes the scarcity or absence of freshwater eels in the Indo-Malayan shallow region, whereas all round about said region these eels are very common.

A similar phenomenon may be noted in Japan. A study of the official catch statistics reveals that the largest quantities of eels are found on the Pacific shores, much more than on the coasts facing the Japan Sea; more than twenty times as many, indeed, on the Pacific side than on the other. And on the western shores of the Japan Sea round about Vladivostok and farther north, eels are entirely absent. Evidently this must be accounted for by the assumption that the Japanese eel (*Anguilla japonica*) does not breed in the Japan Sea but some-

[1]) SCHMIDT, J., 1925, On the Distribution of the Freshwater Eels throughout the World. II. Indo-Pacific Region. D. Kgl. Danske Vidensk. Selsk. Skrifter, Naturvidensk. og Mathem. Afd., 8. Raekke, X, 4.

[2]) WEBER, MAX, 1912, Versuch einer Revision der indopacifischen Anguillidae Zool. Jahrb. Suppl XV, 1. Band.

where in the western Pacific, so that the young elvers reach the Japanese shores from the Pacific side.

In the Indo-Malayan region the same phenomenon appears to be more pronounced still. SCHMIDT points out that we may conclude from the available data that freshwater eels are not known on the Malay Peninsula and about the Gulf of Siam. With regard to Sumatra, Borneo and Java it seems probable that *Anguilla* occurs mainly or exclusively along the coasts facing the deep sea, rarely or not at all on those facing the shallow sea surrounded by these islands, by the Malay Peninsula and Cochinchina. The explanation of this phenomenon evidently lies again in the peculiar mode of propagation of the freshwater eels. However, as SCHMIDT points out, we then have to assume, that the larvae of the Indo-Malayan species are considerably inferior in migratory power to those of the Atlantic species. "For if these elvers [1]) were able to migrate through shallow water to the same extent as those of the North Sea region, then eels would have been common over great parts of the Indo-Malayan shallow region."

Regarding Java SCHMIDT says: "Altogether, I have been able to localise about 25 records of occurrence of *Anguilla* in Java. The majority are from the south coast, the western part of the west coast and the north coast (west of 108° E). There are, however, also some farther east along the north coast, as for instance Kuningan at about 108° 30' E., and Ambarawa (between Semarang and Magelang). I would point out that in this connection it is of course not the position of the find which is of interest, but the point of the coast at which the river the eel must have ascended flows out into the sea. As a matter of fact, it is often difficult to determine, from the maps at my disposal, what rivers drain the localities noted. Some of the places far up in the interior might, to judge from my map, equally well be drained to the north or south".

In a note the author remarks a.o.: "I take this opportunity of suggesting that zoologists resident in Java might interest themselves in the question as to the "density" of eels in the different parts of the island. A comparition between the middle portion of the north coast, for instance, and the corresponding section of the south, would be of considerable value".

This suggestion has been the starting-point of an enquiry of which the results are given here. I have distributed a number of circulars all over Java, addressed especially to the native regents of the regencies and to a number of wedanas and assistant-wedanas of the districts and the smaller villages, a few also to European government-officials, engineers, planters etc. They were invited to make enquiries among the fishermen of their regency, district or dwelling-place regarding the occurrence of freshwater eels, of which the Malay, Javanese and Sundanese names were given. Moreover a figure was included showing an

[1]) (Note of SCHMIDT): "Not until the elver stage is reached do eels migrate through shallow sea areas; never in the larval stage. When the latter, coming in from the ocean depths, arrive on the coastal banks (the 200 m. line) they stop there, and do not continue their journey through the shallow water until later, when they have turned into elvers".

Anguilla mauritiana and stress was laid on the presence of pectoral fins, generally called the "ears" by the natives, as a distinctive of the true eels from the "lindung" (Mal.) or "welut" (Jav.), *Monopterus albus*, which is very common in the mud of the sawahs. In this way I hoped to prevent confusion with the latter form and I believe I have perfectly succeeded in this. The native fishermen themselves know quite well the difference between these two kinds of fishes.

Still another possibility of confusion presented itself. At first I sent the circular especially to the larger localities situated in the plains, near the mouth of the rivers or at least along their lower course. I expected to get negative answers at least from the central part of the north coast. But, contrary to this, statements more than once came in that eels did occur there, and especially in the lower course and near the mouth of the rivers. Meanwhile I had learnt from quite a number of other answers, which often gave many details on the occurrence, the habits and the catch of freshwater eels, that these eels are to be looked for more especially in the upper part of the streams, in and near the mountains. Here they live in holes and under stones and also in the deeper parts (leuwi, Sund., kedung, Jav.) of these mountain streams. It was often emphasized that freshwater eels occur only in the upper course of the rivers and are absent in the lower course where they are caught only when freshets (bandjirs) caused by heavy rainfall drag the fishes down in a more or less stunned condition. Afterwards, therefore, I sent my circular especially to the wedanas of the smaller villages near or on the mountains, situated near the mountain streams from which the larger rivers take their origin. The information gathered in this way proved very valuable, the more so, as in these smaller villages more attention is probably paid to the inhabitants of the rivers than in the larger towns.

Reverting now to the positive answers from the middle part of the north coast, I soon suspected that they referred to eels belonging to other genera than *Anguilla* and frequenting brackish water and the river mouths. I therefore asked some of my correspondents to send me a number of these eels. Among the material received in this way from different parts of the North coast of Central Java there proved to be not a single *Anguilla*. They all belonged to *Pisoodonophis boro* and *Muraena polyuranodon*, whereas from Pemalang I also received *Macrotrema caligans*, which had not yet been found in the Dutch East-Indies. From this it was evident that in gathering my informations, I had to guard not only against confusion of *Anguilla* with *Monopterus* but also against confusion with the above species inhabiting the river mouths. This was an additional reason to direct my circulars afterwards especially to the localities along the upper course of the rivers.

Although nearly all my information was provided by people with very little or no zoological knowledge at all, yet the results of the enquiry are very satisfactory and give a clear insight into the occurrence of the freshwater eels in Java. The two common species are the mottled *A. mauritiana* and the smooth

species which WEBER identified with RICHARDSON's *A. australis*, but which according to SCHMIDT must be separated from the latter species on account of the distinctly lower number of vertebrae (109 — 110, against 112 — 113, in *A. australis*). SCHMIDT therefore calls it *Anguilla bicolor* M. CL. We must refrain provisionally from making a distinction between these two species from the information received by me as this could be made only by a zoologist. The natives, it is true, also distinguish very clearly two or even more species. But this distinction applies partly to the size of the eels and so cannot be sufficiently relied upon.

Uling kembang seems to be a very general name for the mottled *A. mauritiana*. "Kembang" (flower) seems to be used in general for things or animals which are decorated or mottled, as e.g. in "penju kembang" (*Chelonia mydas*) on account of the mottled shields. Together with uling kembang the names uling andjing, uling asu and uling kirik, all meaning the "dog-eel", are often mentioned as indicating a different species, perhaps *Anguilla bicolor*. This species is often considered as being haram (unclean) by the Mohammedans and its flesh then is no more eaten than dog's flesh. Further the uling is said to be larger and evidently older than the lumbon or sidat, whereas the very large specimens are known as pelus. In other letters again the uling is described as a very large pelus. Also the word lembu is used for very large specimens (Tasikmalaja, Djatiroto). There seems to be much confusion in the use of the names moa, sidat, larak, lubang or lumbon, gateng, uling or olling, pelus and lembu.

Most of my correspondents, however, agree that the freshwater eels may attain a large size. The comparison with the girth of the stem of a penang palm is repeatedly made. In this respect the Javanese eels seem not inferior to those of Celebes where WEBER examined a sample of a length of 1620 mm with a girth of 430 mm. One of my correspondents (cf. below) mentions a sample from Java with a lenght of about 160 cm. and a girth of 40 cm.

One cannot wonder, then, that these eels have made a great impression upon the mind of the natives and that they have given rise to all kinds of stories and superstitions. Thus large specimens are sometimes said to attack people bathing in the rivers and even kidnap young children. New-born children are said to be the favourite food of the large eels and the latter are even supposed to make predatory expeditions on land in search of them. In doing which they leave behind them a slimy trail. If in a native house the birth of a child is expected, people often sprinkle ashes in front of the door to prevent the lubang from entering! With its slippery body it cannot pass over the ashes.

As mentioned above, the eels live especially in the upper course of the rivers, under stones and in holes. They are said to become so large in these holes, that they cannot come out anymore. Then, according to the natives, they are fed by the smaller eels but in the end they are struck by lightning and thus meet their death!

The result of my enquiry proved to be a complete confirmation of what might be expected after SCHMIDT's suggestions. Freshwater eels are present in all the rivers of the south-, the west- and the eastcoast. As to the north-coast they are found only in the most western and the most easterly part. In the part between 180° and 112° 40′ E they are totally absent in the rivers, and people do not know them. In the Tjimanuk they do not occur anymore, just as little in the Kali Solo or Bengawan-river, nor in any river of the north coast between these two.

This is shown on the map which accompanies this article. The places whence positive evidence was received are indicated by a +, those with a negative answer with a ○, whereas a ⊕ indicates that eels are present but rare. The numbers correspond with those of the alphabetic list at the end of this article.

We will now consider the north coast only and follow this from west to east.

The regent of Serang (nr. 95) sent me a copy of a report by the wedana, from which I quote the following passages:

"Information from the fishermen has taught that lubang lives wherever there are rivers with running and cold water, as e.g. in the Tjibanten as far as Karangantu [1]), but as soon as the water becomes mixed up with salt water lubang is no longer caught but larak [2]) only. In lake-Dano [3]) the lubang can live because the water runs through, but it cannot live in marshes (rawah[2]) and lakes (situ[2]) where the water is stagnant".

The ways of fishing lubang and a few superstitions connected with it are then described, showing that this fish is well-known here.

Going east we next come to the Tji Udjung. The regent of Lebak (Rangkasbitung) wrote to me that, according to a report received from the head of the district of Parungkudjang, freshwater eels occur in the upper course of the rivers Tji Udjung, Tji Liman and Tji Lemer where, as a rule, they have their abode in holes and pits of the banks, among numerous stones. They are caught especially in the dry monsoon when there is little water in the rivers.

Next comes the Tji Durian. The wedana of Djasinga reports that l u b a n g is indeed present in the upper course of this river, though not in great numbers.

The Tji Sedane and the Tji Liwong both run along Buitenzorg in their upper course. It is a well-known fact that eels are not seldom found there. Mr. A. MÜHLNICKEL, e.g., writes:

"Having always lived at Buitenzorg as a child I know that the rivers there, viz. the Tji Sedane, the Tji Liwong and also the Tji Balok, contain eels". From personal information I know that the ponds of the Botanical Garden among other fishes contain eels and have heard other records of large l u b a n g being caught there (at the Museum also one is found from Buitenzorg).

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1) Near the mouth.
2) Probably *Pisoodonophis.*
3) A marshy lake west of Serang draining into Sunda Strait.

The assistant-resident of Tangerang also confirms the occurrence of eels in the Tji Sedane and sums up a number of "l e u w i" where they are caught. They do not appear to be very common. Thus it is considered a particularity that during the last few years such a l u b a n g has been caught no less than three times in a "l e u w i" near kampong Tjihuni.

On the Tji Bekasi I got information from Bekasi and Tjibinong. The wedana of Bekasi writes to me that after his enquiries eels appeared to occur indeed in the Tji Bekasi, but rarely. Tjibinong mentions the occurrence of eels in the Tji Keas, one of the affluents, without giving details.

We now come to one of the larger rivers of Java, the Tji Tarum, with its affluents the Tji Karang, Tji Beet, Tji Kao, Tji Somang, Tji Kundul, Tji Sokan, Tji Widaj, Tji Sankui, Tji Tarik a.o.

From the information received from several localities situated on this river it is evident that eels still occur here but are far from common.

From Tjibarusa I got information that eels do occur in the Tji Karang and the Tji Pamingkis, but very rarely; only from time to time one is caught.

The wedana of Krawang writes that eels occur in the Tji Beet and the Tji Geuntis in certain l e u w i in the upper course near the mountains.

The regent of Krawang, living at Purwakarta, sends me various information collected by the p e n g h u l u-landraad from which it is evident that the l u b a n g is quite well known there. He says that the m o a lives in the muddy, brackish water near the mouths of the rivers (evidently meaning *Pisoodonophis* and *Muraena*) and the l u b a n g in the streams with clear water and many stones, near the mountains. The latter may attain the size of a penang stem and is then called "o l l i n g".

Lubangs are especially fished for with the rod in the Tji Tarum upstream near Kandangsapi, but not many are caught. Near Purwakarta, in the Tji Kao and its tributaries and in the upper course of the Tji Herang (a river to the east of the Tji Tarum) they are hardly ever found.

The wedana of Tjikalongkulon writes that in the Tji Kundul and its tributaries eels are hardly ever found, and the wedana of Tjikalongwetan that they are met with in the Tji Somang, especially in the upper course, under big stones and in holes in the banks.

The regent of Tjiandjur writes that in his regency l u b a n g s are common in the rivers running to the south coast and less common in those belonging to the basin of the Tji Tarum.

According to the wedana of Tjibeber l u b a n g s are said to occur in the upper course of the Tji Kondang, an affluent of the Tji Sokan. He had, however, tried in vain to procure some.

We now come to the upland plain of Bandung where the eels seem to be still rarer than in the lower course of the Tji Tarum. The regent of Bandung writes that they are only very sporadically met with in the Tji Tarum and its tributaries within the regency of Bandung. This is confirmed by a few other reports. Thus the wedana of Tjimahi says that they are extremely rare in the

Tji Mahi and the Tji Beureum, and are hardly known among the people there.

From Soreang (on the Tji Widaj), Bandjaran (on the Tji Sankuj) and Rantjaekek (Tji Tarik, Tji Keruh) the answers were completely negative.

It is possible that the extreme scarceness of lubang in the rivers of the plain of Bandung must be partly accounted for by the presence of one or more narrow falls at the transition from the upland to the plain.

In the rivers east of the Tji Tarum the eels evidently get rarer and rarer until they are totally absent in the Tji Manuk.

The wedana of Djatisari, on the Tji Herang, reports that eels are unknown in his resort (cf. Purwakarta!).

With regard to the Tji Lamaja, however, I dispose of information from a planter, Mr. N. De Zwaan, who writes: "There occurred a few in the Tji Bajawak, a tributary of the Tji Lamaja. The bottom of the upper course consists of tjadas and the eels are found in the slits and holes in it".

On the Tji Asem I got information from the wedanas of Kalidjati and Segalaherang. The former writes that eels are unknown in the Tji Bodas, a tributary of the Tji Asem, whereas the latter reports that eels do occur in the upper course of the Tji Asem, but rarely.

That eels occasionally be met with even in the Tji Punagara is evident from a letter by Mr. A. W. Spennemann, of Pegadenbaru, near Subang. He spoke about the eel question with Mr. F. G. Eisinger, a great lover of shooting and fishing, who knows nearly all the rivers of the Pamanukan- and Tjiasem-estates where he has lived for 40 years. Mr. E. told him that in the year 1910 natives caught a big eel in the Tji Panjairan, a muddy tributary of the Tji Punagara. It had a length of about 160 cm. and a circumference of about 40 cM. Mr. E. never saw an eel caught in any of the other rivers there, though he always examined the catches of the natives and enquired where the fishes, and especially such a rare fish as the eel, had been caught. Whenever he met with an eel, the answer was always: from the Tji Panjairan. He never saw one from the Tji Lamaja or the Tji Asem and their affluents.

The assistant-wedana of Tjisalak also reports that eels do occur in the Tji Punagara and its affluents but are caught very seldom.

That they are also found in the Tji Lamatan, a tributary of the Tji Punagara, is evident from what my friend Mr. Ch. Beets told me. In the year 1914 he was staying at the pasangrahan at Subang when a big l u b a n g happened to be caught in the ditch just behind the pasangrahan. This ditch belongs to the basin of the Tji Lamatan.

Mr. Spennemann further mentions a legend which seems to confirm the report of the wedana of Segalaherang. In the upper course of the Tji Asem there is a waterfall called Tjurukagung and at the foot of it a deep basin has been gradually hollowed out in the t j a d a s by the water falling from a height of about 20 metres. According to the natives living there there is a gigantic lubang in this basin, which has been living there since time immemorial in a hole which it cannot leave anymore as it has become too big to

get out. The natives are afraid to fish there and fear that they will be seized by the lubang and dragged into the hole. This legend shows that the lubang at least is not unknown among the people there.

From the Tji Manuk onward the evidence drawn from extensive information becomes fully negative. It seemed to me of interest to get as exhaustive information as possible about the Tji Manuk and I therefore sent my circular to no fewer than twelve localities situated along the upper and lower course of this river. Thus I got information from the regent of Indramaju, the wedana of Djatibarang, the assistant-wedanas of Bangodua and Djatitudju, the wedana of Tomo, the regent of Sumedang, the wedana of Tandjungsari, the wedana of Darmaradja, the regent of Garut, the wedana of Tjikadjang, the regent of Madjalengka and the kapala-district of Talaga. The answers all agreed perfectly in this respect that neither in the Tji Manuk itself nor in any of its tributaries as e.g. the Tji Peles (Tomo, Sumedang, Tandjungsari), the Tji Deres (Madjalenka) and the Tji Lutung (Talaga) eels are ever caught. Only the regent of Indramaju, at the mouth of the Tji Manuk, mentions the occurrence of "olling" and "larak" in the rivers in his regency. At my request he sent me a number of them and, as might have been expected, they all proved to belong to the species *Pisoodonophis boro* and *Muraena polyuranodon*.

As may be seen from the chart eels are absent in all the rivers of the north coast east of the Tji Manuk on to Madura Strait. Whenever the presence of eels is reported it is always from the mouth of the rivers and when examined they proved to belong to the two brackish water species mentioned above. Interesting is such information as was received from Tjandiroto which is situated quite near the origin of the Kali Progo (south coast) and of the Kali Lutut, a tributary of the Kali Bodri (north coast). The wedana promptly reports that eels (sidat, pelus or uling) are numerous there, but only in the Kali Progo, whereas they are lacking in the Kali Lutut.

It is only in Madura Strait that the eels appear again. The great rivers Kali Solo or Bengawan river and the Kali Brantas seem to form the transition.

Regarding the Kali Solo I got information from the chief engineer of the Solo-valley works Mr. SNELL and from the patih of Bodjonegoro, the wedana of Djatirogo (on the Kali Kening), the regents of Ngawi, Madiun, Magetan, and Ponorogo (all on the Kali Madiun and its tributaries), the assistant-residents of Sragen, Surakarta (or Solo), Bojolali and Klaten, and the district-officers (controleurs) of Wonogiri. These again got their information from quite a number of wedanas of smaller villages along the river and its tributaries. All the answers were negative, eels being unknown there. Only those from Bodjonegoro seem to leave room for the possibility that a single eel may stray into the Solo-river. The patih sends copies of reports made by the wedanas of Baurena, Kalitidu, Tambakredjo and Padangan, who all agree that eels are unknown in their resorts. The patih himself, however, writes that eels are known at Bodjonegoro and sums up three kinds but what he says about them is not very clear.

One of the engineers under Mr. Snell cites a mantri who contends that formerly he saw two kinds of eels near Plosolanang, a kampong quite near Bodjonegoro. One of these species was edible, the other, uling asu, was not eaten by the people. The petingi of Ngampel, quite near Plosolanang, has seen an uling caught of the former variety. The fish, however, was not eaten.

About 1918 the lock-keeper of Kerdjo, to the south-west of Babat, saw a kind of eel caught near the weir, evenly coloured and with "ears". As people had never seen such an animal before and did not know the name, it was set free again !

From this it seems sufficiently evident that, if ever an eel penetrates into the Solo-river, it is only quite exceptional and we may reckon this river among those in which eels are not found.

A striking contrast is offered again by certain mountain streams rising on the Merapi. Those rising on the west side of this volcano all join the Kali Progo, a river of the south coast, in which eels are common. Those rising on the east slope join the Kali Demak, the Kali Serang and the Kali Solo, all rivers of the north coast without eels. On the south side of the Merapi we have kalis joining the Kali Opak (south coast) and joining the Kali Dengkeng, a tributary of the Kali Solo. In the former eels are found, which do not occur in the latter. Thus we have the Kali Opak and the upper course of the Kali Dengkeng running close near each other and parallel to each other from the south slope of the Merapi. The former is mentioned by the assistant-resident of Djokjakarta among the rivers in which eels are found. In the latter they do not occur according to the assistant-resident of Klaten.

Between the Solo River and the Brantas we still have the smaller Kali Lamong. The wedana of Ngimbang reports that no uling is found in this river.

We then come to the Brantas. I got information from the regents of Bangil, Djombang (at Ngandjuk on the Kali Widas or Lengkong), Kediri, Tulungagung, the patih of Trenggalek (Kali Gajam), the assistant-wedana of Benda (Kali Benda), the regent of Blitar, the wedana of Wlingi, the wedana of Sengguruh (at Kepandjen), the regent of Malang and the wedana of Turen.

Several of the answers were negative, viz. those from Bangil, Ngandjuk, Kediri, Trenggalek, Benda, Kapandjen and Malang. Others, however, show that eels are not entirely absent in the Brantas. Thus the regent of Djombang writes: "One may say there are no eels in the Kali Brantas; from time to time only people catch one, but extremely rarely".

The regent of Tulungagung writes: „In the Kali Brantas there are no uling or lumbon. There are, however, in my resort five mountain streams rising on mount Wilis, viz. the Kali Song, Klantur, Babakan, Badjalpitjisan and Tjatut. In the largest of these, the Kali Song, and only in this one, lumbon may be caught. There are many big stones in it and amidst these big stones the lumbon lives. People living along the upper course of the Kali Song

(sub-district of Pagerwodjo, district of Kalangbret) don't like to catch the lumbon as they think it holy (angker) and its capture might bring about misfortune and sickness. In the lower course, however (sub-district of Kauman, district of Kalangbret), people are keen on catching it when they see it under the large weir of Blader. It is caught from time to time only by the fishermen fishing for "ikan mangut". Some details are further given of the way the lumbon is caught, showing that this fish is quite well-known here, although rare.

The regent of Blitar writes: "In the regency of Blitar the freshwater eel is met with very rarely only. About once a year it is found in the Kali Gendjong, a tributary of the Brantas. It is known here as gateng. As a rule it lives in a hole in rivers with stones and may attain a size of 1 — 1½ metres and a circumference of 4 dm.

The wedana of Wlingi reports that in the Kali Lekso no eels are found. He also, however, mentions the Kali Barek or Gendjong (cf. above) as a place where eels are sometimes caught. During the last two years two specimens have been caught of a length of 1 — 1½ metres. People here call them uling (cf. above!).

The wedana of Turen reports that eels are found in the Kali Lesti, but very rarely.

A friend of mine, finally, told me that he had caught freshwater eels at Kediri, during a banjir (strong current and high water as a consequence of heavy rains, resulting as a rule in the death or stupefaction of many river-fishes).

It is evident from all this that a few freshwater eels penetrate into the Brantas and the most probable assumption seems to be that this occurs through the most southerly mouth, near Bangil, the Kali Porong.

The regent of Bangil himself, however, reports that neither in the Kali Brantas nor in any other river in his regency have freshwater eels been found.

Between Bangil and Probolinggo there are a number of smaller streams as e.g. the Kali Welang, Kali Puspo and Kali Bades. To get as exhaustive evidence as possible about this transitional region, I wrote to the wedanas of Pandakan, Purwosari, Puspo and Sukapura The answers were all negative, no eels being known there. Perhaps this must be partly accounted for by the presence of weirs and high waterfalls. Thus the district-officer (controleur) of Probolinggo, Mr. van Mourik, wrote to me that e.g. Sukapura will probably never have known the "oling" as there are waterfalls of a height of 20 - 40 metres between this village and the sea, which prevents the eels from swimming up. In this way it seems possible to explain that eels are unknown in the whole mountain district of Tengger.

The regent of Probolinggo writes that a few years ago uling were not rare and were often caught in the Kali Legundi. But since the weirs of Waringin and Pakis have been built, they have soon been exterminated and are now rare or — according to a letter from the district-officer — even entirely absent.

The assistant-resident of Kraksaan reports that in the Kali Pandanlaras

and also in the Kali Rondoningo uling kembang occurs and is considered as a delicacy by the natives.

In the residency of Besuki, which occupies the most easterly extremity of Java, eels are common everywhere, as is evident from the reports from Situbondo, Bondowoso, Djember and Banjuwangi.

Among the places where freshwater eels are said to occur BLEEKER mentions Kuningan and Ambarawa as is cited by WEBER and DE BEAUFORT also. Both places are situated near the upper course of rivers of the north coast in central Java, viz. the K. Sanggarung and the K. Tuntang. I therefore asked for special information from the wedanas of Kuningan and Ambarawa. The former answered that freshwater eels in his district are found only in the Tji Djolang (south-coast!), the latter that these eels do not occur there and are absent e.g. in the large marsh of Rawah Pening.

A circumstance which in future will no doubt have a great influence on the occurrence of eels in the rivers of Java is the building of large weirs in an ever increasing number of these rivers, for irrigation purposes. It seems hardly possible for the eels to ascend these weirs, which present an equally unsurmountable obstacle as the great water-falls. The absence or scarceness of eels in the upper course of several rivers must no doubt be partly accounted for in this way. Thus Mr. VAN MOURIK writes to me concerning the rivers near Probolinggo : "Formerly there were in several places native dams which in case of freshets (banjirs) broke down from time to time, allowing the eels to swim up-stream. At present, however, these have all been replaced by stone weirs which shutt off the upper course definitively".

That the results obtained by this enquiry are also of practical value will be evident. They show in the first place that it will be of no use to endeavour to introduce eels in waters where they are absent now, unless the elvers or young eels were to be introduced every year anew. I have heard e.g. of an attempt made by the Chinese landlord of the Tegalwaroe-lands, along the Tji Tarum, to introduce freshwater eels into the marshes there, which, of course, has had no permanent result.

A question worth consideration is whether it would be possible, and whether it would pay, to provide the eel-less streams and lakes of the north coast of Java with elvers gathered on the south coast, in a similar way as is often done in France and Italy. Before the war arrangements were even made for shipping elvers annually from the Severn in England to Germany. This question would repay the trouble of a closer investigation into the value of the eel-fishery of Java.

With regard to the island of Madura I wrote to the regents of Bangkalan, Pamekasan and Songenep and, afterwards, to the wedanas or assistant-wedanas of Guluk-guluk, Tendjui, Tanahmerah and Sempar. The answers, however, were few and did not say much. The regent of Pamekasan writes that there is no eel-fishery in his regency and the wedana of Guluk-guluk that eels are not known in the Kali Saronggi. Now, if anywhere on Madura, eels might be expected

in this most easterly river of Madura. From Songenep, Tendjui, Sempar and Tanahmerah I got no answer, which at any rate renders it more probable that they are not known there than the reverse.

The regent of Bangkalan finally reports that in his section eels occur in the Kali Billapora, subdistrict of Sotjah. It can, however, hardly be believed that these are true freshwater eels. If eels, as we have seen, are absent in the Kali Solo, it seems hardly acceptable that they should occur in a Madurese stream closely opposite on the narrow strait separating Madura from Java. It would be worth a closer investigation by some resident of Madura, to find out if an occasional eel does not from time to time come up the Madurese streams.

Finally I got information from the only European inhabitant of the island of Bawean, north of Surabaja, being the custom-house officer, that eels are unknown there both in the mountain streams and in the crater lake Kastobo which contains shrimps only.

Concluding we may say that the eel-population of Java shows a similar distribution as that of Japan, the contrast between the two opposite coasts being evidently still more pronounced in the case of Java where eels are absent in the rivers of by far the largest part of the north coast.

As SCHMIDT has rightly observed the larvae of the tropical eel species must be assumed to be inferior in migratory power to those of the species of the temperate regions. No doubt, this may be partly accounted for by the higher temperature. In studying the development of pelagic fish eggs and larvae I have found that in general this proceeds about three times as fast in Indian waters (temperature ± 28° C.) as in European waters (average temperature of the North Sea ± 10° C.), if we compare closely allied species (e.g. of the genera *Engraulis*, *Clupea*, *Caranx* a.o.). This, no doubt, will hold also for the development and metamorphosis of the elvers. STRUBBERG [1]) has shown that the rate of metamorphosis depends chiefly on the temperature. The higher temperature will exert an accelerating and, consequently, an abbreviating influence on the life of the Indian elvers, so that the distance too which can be covered during their migration must be shorter. On the other hand it is, of course, quite possible that in this respect there are specific differences also, of the same nature as that between the American and the European eel. The migration of the larvae of the former takes one year, that of the latter three years, which cannot be explained by differences of temperature.

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[1]) The Metamorphosis of Elvers as influenced by outward Conditions. Some Experiments. Medelelser fra Kommissionen for Havundersögelser, Serie Fiskeri, Bind IV, nr. 3, 1913.

SUMMARY OF THE INFORMATION.

In the Malayan names **oe** should be pronounced as **u**. The numbers refer to those of the chart. The places whence positive evidence was obtained are indicated in the chart by +; ○ means negative evidence; ⊕: eels rare.

1 *Ambarawa* (wedana)
No eels in the Rawah Pening.

2 *Balaradja* (wedana)
Found in the lower course of the Tji Mantjeuri.

3 *Bandjaran* (wedana)
In the Tji Sankoej (tributary of the Tji Taroem) no freshwater eels.

4 *Bandjarnegara* (regent)
Common in the Serajoe and several other rivers, on stony bottom. The big ones are known as oeling, the smaller ones as peloes.

5 *Bandoeng* (regent)
Very sporadically in the Tji Taroem and its affluents ; more common, people say, in the lower course.

6 *Bangil* (regent)
Neither in the Kali Brantas nor in other rivers.

7 *Bangodoea* (ass. wedana)
Unknown in the Tji Manoek.

8 *Banjoewangi*
Here I have seen a few specimens of *A. mauritiana* on the fish-market myself. A specimen of $7\frac{1}{2}$-8 K.G. was caught on the estate of Bajoekidoel. It was called oeling kedel.

9 *Bawean* (Isle of)
Unknown.

10 *Bekassi* (wedana)
Found in the Kali Bekassi, but rare.

11 *Benda* (ass. wedana)
Do not occur in the Kali Benda.

12 *Blitar* (regent)
Very rare; caught in the Kali Gendjong (affluent of the Brantas) about once a year. Known as gateng, lengtn 1 — $1\frac{1}{2}$ metres.

13 *Blora* (regent)
Neither in the Kali Loesi nor in other rivers of the regency (a.o. tributaries of the Kali Solo).

14 *Bodjonegoro* (patih)
Several wedanas (Baoereno, Kalitidoe a.o.) report that freshwater eels are unknown. The patih himself is not very clear.
A section-engineer of the Solo-valley works reports that in 1918 the lock-keeper of Kerdjo saw an eel caught at the weir evenly

coloured and with ears. As people had never before seen such an animal and did not know the name it was set free again. See also text, p. 325.

15 *Bojolali* (ass. resident)
No freshwater eels in the tributaries of the Solo-river.

16 *Bondowoso* (ass. resident)
Found in the Kali Sampean ; known as oeling kembang and oeling rabet. Size considerable.

17 *Brebes* (regent)
Neither in the Kali Pemali nor in the Kali Djoebang or other rivers.

18 *Buitenzorg*
Found in the Tji Sedane (cf. Tangerang), Tji Liwoeng and Tji Balok.

19 *Cheribon*
Mr. Ament told me that his father formerly hatched eels in a pond near Cheribon. They were, however, introduced from Banjoemas!

20 *Darmaradja* (wedana)
Not found.

21 *Djasinga* (wedana)
Found, but not many.

22 *Djatibarang* (wedana)
No eels in the Tji Manoek and its affluents.

23 *Djatirogo* (wedana)
No eels in the Kali Kening (tributary of the Kali Solo) or in other rivers.

24 *Djatisari* (wedana)
Unknown.

25 *Djatitoedjoe* (ass. wedana)
No eels in the Tji Manoek and its tributaries.

26 *Djember* (ass. resident)
Occur in the Kali Bedadoeng, Kotok, Majang and their tributaries, but not near the mouth, on account of the crocodiles found there! Known as oeling kembang (1 — 1½ metres), oeling kirik and oeling rongong (when very big, like the stem of a penang palm).

27 *Djokja* (ass. resident)
Found in the rivers of the south coast a.o. the Kali Progo, K. Opak, K. Oja a.m.o.

28 *Djombang* (regent)
Very rare in the Kali Brantas.

29 *Dongko* (ass. wedana)
Occur in the rivers of the South coast, not in the affluents of the K. Brantas.

30 *Doro* (or *Dara*) (wedana)
Unknown.

31 *Garoet* (regent)
Unknown in the Tji Manoek. Found in the rivers of the south coast, such as Tji Kaengan, Tji Sanggiri, Tji Beloek, Tji Laki, Tji Lajoe, Tji Rantjong, Tji Kandang.

32 *Goeloek-goëloek* (Madoera, wedana)
Unknown.

33 *Goenoengkentjana* (wedana)
Found in the Tji Oedjoeng, Tji Lemer and Tji Limau.

34 *Grissee* (regent)
Absent.

35 *Indramajoe* (regent)
Eels met with in the mouth of the Tji Manoek. The specimens sent proved to belong to *Pisoodonophis boro* and *Muraena polyuranodon.*

36 *Japara* (controleur) (district-officer).
No eels in the Kali Wisa and other rivers.

37 *Kajen* (wedana)
Weloet *(Monopterus)* only, in the marshes of the upper course of the Kali Djoeana.

38 *Kalidjati* (ass. wedana)
Unknown in the Tji Bodas (side-river of the Tji Asem ; cf. Segalaherang !).

39 *Kaloran*
Common in the Kali Progo, Kali Tingal and tributaries.

40 *Karanganjar* (regent)
Common everywhere. Called peloes, when large oeling.

41 *Keboemen* (regent)
Occur in the upper course of the Loek Oelo.

42 *Kediri* (regent)
Not found in the Kali Brantas and affluent rivers.
Mr. Hompes, of the Zoological Garden of Surabaja, however, told me that he had caught freshwater eels in the Brantas at Kediri during a freshet (banjir).

43 *Kendal* (regent)
No eels in the Kali Bodri and other rivers.

44 *Kepandjen* (wedana of Senggoeroeh)
No eels in the district of Senggoeroeh.

45 *Klaten* (ass. resident)
No eels in the Kali Dengkeng (tributary of the Kali Solo.)

46 *Koedoes* (regent)
No freshwater eels.

47 *Koeningan* (wedana)
Only in the Tji Djolang, not many.

48 *Kraksaan* (ass. resident)
Occur in the Kali Padanlaras and K. Rondoningo. Known as oeling kembang.

49 *Krawang* (wedana)
In certain leuwi's of the Tji Beet and Tji Geuntis, in the upper course.

50 *Lamongan* (section-engineer)
In the mouth of the rivers only (this evidently relates to *Pisoodonophis* or *Muraena*), unknown in the upper course of the Kali Solo.

51 *Lawang* (ass. wedana)
No eels in the sub-district of Lawang. According to several headmen of dessas very common in the rivers from the south slope of the Smeroe-mountain, from South-Malang to Loemadjang.

52 *Loemadjang* (patih)
Found in the Bondojoedo and Djatiroto, but not near the mouth. Known as oeling kembang, oe. andjing and oe. loembon or gringsing.

53 *Loeragoeng* (wedana)
No eels in the Kali Senggarong. They are met with, however, in the Tji Djolang, Tji Monte and Tji Tiis (affluents of the Tji Tandoei, which flows to the south coast).

54 *Madioen* (regent)
In the regency of Madioen no eels.

55 *Madjalengka* (regent)
Never found in the Tji Deres (affluent of the Tji Manoek).

56 *Madjenang* (wedana)
Occur in the upper course of the Tji Djaloe (affluent of the Tji Tandoei). Also in the rawahs (marshes).

57 *Magelang* (regent)
Found in the Kali Progo, Elo and Gending, and other affluents of the Kali Progo. Attains a large size, up to $1\frac{1}{2}$ metres; is then called oeling (when smaller : peloes).

58 *Magetan* (regent)
In the whole district (basin of the Kali Madioen, cf. above) no eels.

59 *Malabar* (Mr. Bosscha)
Mr. Bosscha mentions a big loebang recently caught in the Tji Laki, about 1300 metres above sea-level. He could get no evidence of the occurrence of these animals in the Tji Taroem.

60 *Malang* (regent)
No eels in the Metro- and Brantas-river.

61 *Mendoet* (ass. wedana)
Occur in the Kali Progo and all its tributaries, as: Kali Elo, Pabelan and Blongkeng. The big ones are called oeling, smaller ones peloes.

62 *Menes* (wedana)
Occur in several rivers.

63 *Ngandjoek* (regent of Berbek)
No eels in the Kali Widas or Lengkong, Koentjir and Kedoengpedet (tributaries of the Brantas).

64 *Ngawi* (regent)
No eels in the Kali Solo, Kali Madioen and tributaries.

65 *Ngimbang* (wedana)
No eels in the Kali Lamong.

66 *Pagelaran* (ass. wedana)
Occur in the Tji Djampang.

67 *Pamekasan* (Madura, regent)
No eel-fishery.

68 *Pamotan* (wedana)
Eels unknown.

69 *Pandakan* (wedana)
No freshwater eels in the kali.

70 *Parakan*
Occur in all the tributaries of the Kali Progo.

71 *Pati* (regent)
No eels in the Kali Djoeana.

72 *Patjitan* (patih)
Occur in the Grindoeloe and tributaries, in the Lorok and Soekoredjo. Known as oling or gateng. Sometimes considered as being holy.

73 *Pegadenbaroe* (Mr. Spennemann)
In 1910 a big eel of 160 cm. length and 40 cm. girth was caught in the Tji Panjairan, a tributary of the Tji Poenegara. For legend about a large loebang in the Tji Asem cf. text.

74 *Pekalongan* (regent)
Eels occur in a number of kalis, near the mouth only. A number of them were sent to me ; they appeared to belong to *Pisoodonophis boro* (called "oeling") and *Muraena polyuranodon* (called "peloes").

75 *Pemalang* (controleur) (district-officer).
Only near the mouth. A sample appeared to consist of *pisoodonophis boro* and *Muraena polyuranodon*, together with *Macrotrema caligans* ("toenang").

76 *Ploembon* (wedana)
Eels unknown.

77 *Poerbalingga* (regent)
Not rare in the Kali Klawang (with tributaries Soso and Ponggawa); known as peloes or oeling.

78 *Poerwakarta* (regent of Krawang)
Rare in the Tji Taroem. Hardly ever in the Tji Kao and the upper course of the Tji Herang.

79 *Poerwodadi* (regent of Grobogan)
No eels in the Kali Loesi.

80 *Poerwokerto* (regent)
Occur in the Kali Logawi, Bandjaran and Peloes (nomen est omen).

81 *Poerworedjo* (regent)
Occur in the Kali Kedoengpoetri and Bogowonto. The elvers swim up the rivers from the middle of April to the end of July. (From Pelaboean Ratoe I got a sample caught June 20th. 1925).

82 *Poerwosari* (wedana of Poerworedjo, near Bangil)
Unknown in the Kali Welang.

83 *Poespo* (wedana of the district Tengger)
No eels.

84 *Ponorogo* (regent)
No eels.

85 *Probolinggo* (regent ; controleur, district-officer).
Formerly common in the Kali Legoendi. After the weirs of Waringin and Pakis have been made, they have become rare.

86 *Pringsoerat*
Found in the Kali Elo and Moerang (affluents of the Kali Progo), not so very many.

87 *Rangkasbitoeng* (regent of Lebak).
Found in the upper course of the Tji Oedjoeng, Tji Liman and Tji Lemer.

88 *Rantjaëkek* (ass. wedana)
No eels the Tji Tarik and Tji Keroeh, tributaries of the Tji Taroem.

89 *Rembang* (regent)
No eels in the Kali Soelang (cf. Soelang).

90 *Salatiga* (ass. resident)
Eels don't occur in the Kali Toentang (affluent of the Kali Demak).

91 *Sedan* (wedana)
Eels unknown.

92 *Segalaherang* (wedana)
Rarely caught in the Tji Asem.

93 *Selabintanah* (Mr. Mühlnickel)
Eels of the size of a child's arm are caught in the Tji Pelang affluent of the Tji Mandiri) even at a height of 3200 feet above sea-level.

94 *Senggoeroeh, Gondanglegi* (wedana of Poerworedjo, near Bangil)
Gateng occurs in the rivers of the south coast, not in the upper course of the Brantas and its tributary Kali Lesti (cf. Toeren).

95 *Serang* (regent, wedana)
Occur in the Tji Banten, but not found in the brackish water near the mouth.

96 *Singaparna* (ass. wedana)
Fairly common in the Tji Woelan (cf. Tasikmalaja).

97 *Sitoebondo* (ass. resident of Panaroekan)
Occur in all the rivers a.o. the Kali Sampean (cf. Bondowoso) and tributaries.

98 *Soebang* (wedana, Mr. Beets)
The wedana, understanding that I had asked to send me eels, wrote that he had not yet succeeded in procuring one. Mr. Beets told me that in the year 1914 when staying at the pasangrahan he happened to assist at the catching of a big loebang in the ditch behind the pasangrahan, which belongs to the basin of the Tji Poenegara (cf. Pegadenbaroe).

99 *Soekaboemi* (cf. 93)
From verbal information I learned that eels are common in the rivers between Soekaboemi and Tjisaat, e.g. in the Tji Pelang and Tji Goenoeng, all affluents of the Tji Mandiri.

100 *Soekadana* (wedan of Tjiomas)
Found in the Kali Dano, lake-Dano and the Tji Banten (cf. Serang).

101 *Soekapoera* (wedana of the Tengger-district).
No oeling at all in the Tengger-district.

102 *Soelang* (wedana)
No eels in the Kali Soelang (cf. Rembang).

103 *Soemedang* (regent)
No eels (Tji Peles, affluent of the Tji Manoek).

104 *Solo* (ass. resident)
No eels.

105 *Soreang* (wedana)
No eels in the district (Tji Widaj, neae Bandoeng).

106 *Sragen* (ass. resident)
No eels in the regency.

107 *Talaga* (kapala district)
No eels in the Tji Loetoens.

108 *Tandjoengsari* (wedana)
No loebang in the Tji Peles and its tributaries Tji Herang and Tji Soegan, just as little as in the Tji Keroeh and Tji Tarik (affluents of the Tji Taroem).

109 *Tangeraug* (ass. resident)
Only in the Tji Sedane, but few, in deep holes.

110 *Tasikmalaja* (regent)
Found in the Tji Tandoei and Tji Woelan.

111 *Tegal* (regent)
No freshwater eels in the Kali Goeng, K. Maribaja, K. Gangsa a.o.

112 *Tegatombo* (wedana)
Information confirming that from Patjitan, with a little chart showing that eels occur in most of the rivers.

113 *Tegalwaroe* (verbal information)
The Chinese landlord Tan has tried to introduce eels into the marshes where they did not occur, but without succes.

114 *Temanggoeng* (regenti)
Common in the Kali Progo.

115 *Tjandiroto* (wedana)
Only in the Kali Progo, not in the Kali Loetoet (north coast).

116 *Tjiamis* (regent)
Eels occur in the Tij Tandoei and nearly all other rivers in the regency. Known as loebang tjangkring (yellowish) and loebang keneuk (black). May grow very large.

117 *Tjiandjoer* (regent)
Found in the Tji Taroem, but not many. Common in the rivers of the south coast.

118 *Tjibaroesa* (ass. wedana)
Rare in the Tji Pamingkis and Tji Karang; from time to time only one is caught.

119 *Tjibeber* (wedana)
Found in the upper course of the Tji Kondang (affluent of the Tji Taroem).

120 *Tjibinong* (mantri-police)
Found in the Tji Keas.

121 *Tjikadjang* (wedana)
No eels in the Tji Manoek. Found in the Tji Sanggiri (south coast).

122 *Tjikalongkoelon* (wedana)
Hardly ever in the Tji Koendoel (affluent of the Tji Taroem); have never been caught there.

123 *Tjikalongwetan* (wedana)
Found in the Tji Somang, especially in the upper course.

124 *Tjilimoes* (wedana)
Neither in the Tji Manis nor in other rivers.

125 *Tjilosari* (East of Cheribon, verbal information)
Eels unknown.

126 *Tjimahi* (wedana)
Very rare in the Kali Tjimahi and Tji Beureum (tributaries of the Tji Taroem); hardly known among the people.

127 *Tjisalak* (ass. wedana)
Found in the Tji Poenegara and its tributaries, but caught very rarely.

128 *Tjiwaringin* (verbal information)
Eels unknown.

129 *Toeban* (regent; section-engineer)
According to the regent eels were met with only in the lower course of the Kali Djati, K. Merakoerak and K. Lohgoeng. The samples

sent at may request again proved to belong to the species of *Pisoödonophis boro* and *Muraena polyuranodon* (cf. nrs. 35, 74 and 75) According to the section-engineer of Bodjonegoro eels are not known in the section of Toeban.

130 *Toeloengagoeng* (regent)

No eels in the Kali Brantas. They occur, however, from time to time in one of the five affluents from the Wilis, viz. the Kali Song.

131 *Toeren* (wedana)

Rare in the Kali Lesti (affluent of the Brantas).

132 *Tomo* (wedana)

No eels in the Tji Peles.

133 *Trenggalek* (patih)

No eels in the Kali Bendo (cf. Benda) and the Kali Gajam (tributaries of the Brantas).

134 *Wlingi* (wedana)

No eels in the Kali Lekso. They are caught from time to time in the K. Barek (another tributary of the Brantas), some 2 in the course of 2 years. They are known as oeling.

135 *Wonogiri* (controleur) (district-officer.).

Found in the Kali Ojo and other rivers of the south coast, but not in the Kali Solo. They are called gateng.

136 *Wonosari* (ass. resident)

Eels occur in the Kali Ojo (affluent of the Kali Opak), K. Pramboetan (id. of the K. Ojo) and K. Djirak, all of the south coast. They are not found in certain affluents of the K. Ojo (?) and in the K. Dengkeng, a tributary of the K. Solo.

137 *Wonosobo* (regent)

Especially in the upper course of the Kali Serajoe and K. Toelis. Five species are enumerated the oeling being the largest.