SURVEY REPORT

Final

MONITORING OF *Crocodylus porosus* POPULATION IN KAIMANA AND ARGUNI BAY, FAK-FAK DISTRICT, IRIAN JAYA

(Data compiled from 1990, 1991, 1992, 1993, 1994, 1996, 1998)

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INTRODUCTION

The people of Indonesia have historically used crocodiles for a variety of non-commercial purposes. In the past ten years, commercial collection from the wild has threatened the population status of Indonesian crocodiles. As pressure from the commercial hunting is continuous, the successful conservation of Indonesian crocodiles will depend on the constant monitoring of their populations. Irian Jaya is one of several provinces in Indonesia which historically accommodate unknown numbers of commercial crocodiles such as *Crocodylus porosus* (Webb and Jenkins, 1991).

Thorough monitoring of the crocodile population (*C. porosus)* in Kaimana and Arguni Bay (see Appendix 1), Irian Jaya has been conducted from 1990 to 1994 and in 1996 and 1998. No survey took place in 1995 and 1997. In 1988 and 1989 (Sorondanya *et al.*, 1989) population surveys were conducted by the FAO-PHPA team (Webb and Jenkins, 1991), however no river-distance information was provided, therefore these cannot be used comparatively.

In crocodile population surveys, the states of weather and water tidal conditions, and riverside vegetation are very important (Messel *et al.*, 1981). The ideal conditions for a good survey are during a totally dark moon with low tide and clear sky. However, such ideal conditions are not always present, thus weather variation should be noted.

Records of time frame, weather conditions and habitat, during past and present surveys are shown in Tables 1, 2 and 3.

Table 1. Time frame of each survey of *C. porosus* populations in Kaimana and Arguni Bay.

Year	Month	Number of sites	Total length of survey	Conducted by	Literature source
1988	N/A	N/A	N/A	FAO-PHPA	Webb and Jenkins (1991)
1989	February	5 R, 1 L	N/A	PHPA	Sorondanya *et al.* (1989)
1990	February	5 R, 1 L	58.5*(36.7)	FAO-PHPA	Rumbarar (1990)
1991	October	5 R, 1 L	58.5*(36.7)	PHPA	Anonymous (1994)
1992	December	5 R, 1 L	58.5*(36.7)	PHPA	Anonymous (1994)
1993	June	5 R, 1 L	58.5*(36.7)	PHPA	Anonymous (1994)
1994	December	1 R, 1 L	37*(22.57)	PHPA	Anonymous (1994)
1995	No survey	-	-	-	-
1996	January	1 R, 1 L	37*(22.57)	LIPI	Anonymous (1996)
1997	No survey	-	-	-	-
1998	December	5 R, 1 L	107.5	LIPI	Present report

* Data have been corrected due to miscalculation on the map reading (number in parentheses indicates an actual value). R= river, L= lake.

Table 2. Weather conditions during previous years and present survey.

River/Lake	Weather description
Barusa River	
February 1990	Full moon, cloudy sky, shower, difference in high and low water tidal was high
October 1991	Full moon, clear sky with no clouds, difference in high and low water tidal was medium
December 1992	Dark moon, difference in high and low water tidal was medium, low water tidal started at 15:00 p.m. and high water tidal started at 19.00 p.m. Survey started at 19.55 p.m., finished at 21.30 p.m.
June 1993	Dark moon, difference in high and low water tidal was high. Low water tidal started at 15.00 and high water tidal started at 22.00 p.m. Survey started at 20.00 p.m.
December 1994	No survey
1995	No survey
January 1996	No survey
1997	No survey
December 1998	Dark moon, clear sky and windy, difference in high and low water tidal was low, low water tidal started at 19.00 p.m. and high water tidal started at 22.00 p.m. Survey started at 21.45 p.m., finished at 22.59 p.m.
Gasawi River	
February 1990	Dark moon, difference in low and high water tidal was high, cloudy sky
October 1991	Full moon, difference in low and high water tidal was medium, clear sky, no clouds
December 1992	Dark moon, difference in low and high water tidal was medium, low water tidal started at 16.00 p.m., high water tidal started at 20.00 p.m. Survey started at 19.25 p.m. finished at 21.27 p.m.
June 1993	No information
December 1994	Dark moon, difference in low and high water tidal was low, shower to heavy rain. Survey started at 20.02 p.m.
1995	No survey
January 1996	Full moon, clear sky, foggy, high water tidal during the survey.
1997	No survey
December 1998	Dark moon, difference in high and low water tidal was low, low water tidal started at 19.00 p.m. and high water tidal started at 22.00 p.m. Survey started at 18.55 p.m., finished at 22.10 p.m.
Garawa River	
February 1990	Full moon, difference in low and high water tidal was high, cloudy sky, heavy rain
October 1991	Full moon, difference in low and high water tidal was high, clear sky
December 1992	Dark moon, low water tidal at 18.00 p.m., high water tidal at 22.00 p.m. Survey started at 20.05 p.m.
June 1993	No information
1994	No survey
1995	No survey
1996	No survey
1997	No survey
December 1998	Dark moon, cloudy sky, showers to heavy rain, difference in low and high water tidal was low, low water tidal started at 19.00 p.m. and high water tidal started at 22.00 p.m. Survey started at 23.40 p.m., finished at 24.23 p.m.
Kamabu River	
February 1990	Full moon, difference in low and high water tidal was low, heavy rain
October 1991	Full moon, difference in low and high water tidal was high, clear sky
December 1992	Dark moon, low water tidal started at 18.00 p.m., high water tidal started at 22.00 p.m. Survey started at 20.05 p.m.
June 1993	No information

1994	No survey
1995	No survey
1996	No survey
1997	No survey
December 1998	Dark moon, difference in low and high water tidal was low, low water tidal started at 18.00 p.m., high water tidal started at 22.00 p.m. Survey started at 22.25 p.m., finished at 23.03 p.m.
Buruai River	
February 1990	Full moon, difference in low and high water tidal was medium, cloudy sky, heavy rain
October 1991	Full moon, difference in low and high water tidal was medium, clear sky
December 1992	Dark moon, low water tidal started at 24.00 p.m. Survey started at 02.30 am., finished at 03.55 am.
June 1993	Dark moon, eastern wind, difference in low and high water tidal was high. Low water tidal started at 15.00 p.m. and high water tidal water started at 22.00 p.m. Survey started at 20.00 p.m.
1994	No survey
1995	No survey
1996	No survey
1997	No survey
December 1998	Dark moon, cloudy sky and windy, difference in low and high water tidal was low, low water tidal started at 18.00 p.m., high water tidal started at 22.00 p.m. Survey started at 18.50 p.m., finished at 21.30 p.m.
Suwiki Lake	
February 1990	Full moon, clear sky, difference in low and high water tidal was medium
October 1991	Full moon, lake condition was flooding, clear sky
December 1992	Dark moon, difference in low and high water tidal was low, low water tidal started at 18.00 p.m. Survey started at 21.55 p.m., finished at 24.25 p.m.
June 1993	Dark moon, difference in low and high water tidal was high, low water tidal started at 18.00 p.m. Survey started at 21.00 p.m.
December 1994	Dark moon, difference in low and high water tidal was low, shower to heavy rain. Survey started at 19.30 p.m.
1995	No survey
January 1996	Full moon, clear sky, foggy, high water tidal during the survey.
1997	No survey
December 1998	Crescent moon, cloudy sky, showers to heavy rain, low water tidal started at 18.00 p.m., high water tidal started at 22.00 p.m. Survey started at 18.55 p.m., finished at 20.10 p.m. and then continued at 04.00 a.m. to 05.20 a.m.

Table 3. Habitat descriptions

River/Lake	Descriptions
Barusa River	Barusa River was a small river, as a branch of Gasawi River. Total length of the river was 5 km and the width about 30 meter. Riverside vegetation was dominated by *Nipa* sp.
Gasawi River	Gasawi River was a big river. The width of the river was about 20 meter. Riverside vegetation was dominated by mangrove, followed by *Nipa* sp and scatter forest trees. In several patches there was a floating water plant *Hanguana malayana*.
Buruai River	Buruai River was the biggest river in the sites that we surveyed. The width of the river was about 50 meter. Riverside vegetation was dominated by mangrove, followed by *Nipa* sp and scatter forest trees.
Garawa River	Garawa River was a small river and shallow. Total length of the river was 1,5 km and the width was about 15 meter. Riverside vegetation were dominated by mangrove
Kamabu River	Kamabu River was a small river and shallow. Total length of the river was 2 km and the width about 15 meter. Riverside vegetation were dominated by mangrove

Suwiki Lake	The dominant vegetation in the lake was *Nipa fructicans* and *Rhizophora* spp. Along the lakeside there were found as well in a large density of *Nipa fructicans*, *Rhizophora* spp, *Barringtonia* spp, *Ficus* spp and *Callophylum* spp.

METHODOLOGY

1. Technique

The survey was conducted using spotlighting night counts, following Messell *et al*. (1981). A halogen torch was used, powered by 6 DD batteries, 7.2 volt, 0.85 ampere. When a crocodile eye was torched, it reflected a specific reddish color. As the crocodile eye was spotted, an attempt was made to approach the crocodile in order to estimate the body length. The survey started from up river to down river, except Barusa, Kamabu, Garawa Rivers and Suwiki Lake. All of distance measurement were guided by a 1:100.000 map (coordinate between $03^0$00'00"S to $04^0$00'00"S and $133^0$00'00"E to $134^0$00'00"E) and GPS. Total river length being surveyed was 107.5 km.

2. Species

The crocodile being surveyed was *C. porosus*, known locally as Buaya Muara. Category of age was Hatchling (H; < 50 cm total length), Juvenile (J; 50-150 cm total length), Adult (A; > 150 cm total length) and Eyes only (EO). The number of *C. novaeguineae* was also monitored, particularly in Gasawi River (Table 5B).

3. Locality

The area being surveyed was the rivers flowing into Kaimana and Arguni Bays, Irian Jaya, consisting of the Barusa, Kamabu, Garawa, Buruai and Gasawi Rivers and Suwiki Lake.

4. Time

Previous surveys (Table 1) were usually in December. Thus, for consistency, surveying started on 15 December and concluded on 24 December 1998.

5. Team

The survey was lead by Hellen Kurniati (LIPI) accompanied by Yunus Rumbarar (PHPA) as her colleague. The boat operator was Mr. Mampioper (Tairi Village, Kaimana, Fak-fak District).

6. Vessels

The areas surveyed varied from large to small rivers and lakes, therefore the vessels being used varied in size. In big rivers (Buruai and Gasawi Rivers) a long boat with 25 HP engine was used, at other locations a canoe was used (Suwiki Lake, Barusa, Kamabu and Garawa Rivers).

7. Weather conditions

Since weather conditions affect the number of crocodile being spotted, weather condition was noted in each river (Table 2)

8. Interview with local people

Interview with local people was conducted to determine the number of crocodiles being harvested each year in each river we surveyed.

9. Data analysis

Statistical analysis was performed with SAS 6.03 using proc regression and proc mean in PC.

SURVEY RESULT

Results from the present study compared with the previous year per locality are shown in Tables 4 to 9, however the *C. novaeguineae* population was detected only in Gasawi River (Table 5b).

Result of data analysis is shown in Table 10. To clarify the population trend for each locality, it is also shown in a graphic form (Figure 1 to 6).

Table 4. Spotting night count survey of *C. porosus* population in Barusa River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03^{0}33'14"S 133^{0}20'25"E	03^{0}32'11"S 133^{0}20'07"E	5	1	1	0	5	7	1.40
1991	Oct	03^{0}33'14"S 133^{0}20'25"E	03^{0}32'11"S 133^{0}20'07"E	5	0	0	1	1	2	0.40
1992	Dec	03^{0}33'14"S 133^{0}20'25"E	03^{0}32'11"S 133^{0}20'07"E	5	0	2	1	5	8	1.60
1993	Jun	03^{0}33'14"S 133^{0}20'25"E	03^{0}32'11"S 133^{0}20'07"E	5	6	3	2	8	19	3.80
1998	Dec	03^{0}33'14"S 133^{0}20'25"E	03^{0}32'11"S 133^{0}20'07"E	5	0	1	0	3	4	0.80

Table 5A. Spotting night count survey of *C. porosus* population in Gasawi River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	1	2	4	10	17	0.71
1991	Oct	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	2	3	1	15	21	0.87
1992	Dec	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	6	7	4	13	30	1.25
1993	Jun	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	27	2	6	34	69	2.87
1994	Dec	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	2	5	0	9	16	0.67
1996	Jan	03^{0}28'11"S 133^{0}18'46"E	03^{0}33'07"S 133^{0}20'12"E	24	0	0	1	26	27	1.12
1998	Dec	03^{0}25'12"S 133^{0}18'08"E	03^{0}33'07"S 133^{0}20'12"E	39	2	4	1	7	14	0.36

Note : The starting point of surveys in 1990, 1991, 1992, 1993, 1994, 1996 was at Amoha and finished at Tairi Village. Whereas survey in 1998 was started at Kasua and finished at Tairi Village.

Table 5B. Spotting night count survey of *C. novaeguineae* population in Gasawi River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only (This survey).

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1998	Dec	03^{0}25'12"S 133^{0}18'08"E	03^{0}28'11"S 133^{0}18'46"E	15	0	4	0	2	6	0.40

Note 1: The starting point of the survey for *C. novaeguineae* was at Kasua and finished at Amoha.

Note 2: The first time we spotted a definite *C. novaeguineae* (from body length identification) was approximately 3 km from the starting point. This record was followed by EO before sighting another animal that could be positively identified as *C. novaeguineae*. As the river was fresh water where we spotted the EO and the EO was between two definite *C. novaeguineae* sightings, we included the two EO data as *C. novaeguineae* along the 15 km surveyed area.

Table 6. Spotting night count survey of *C. porosus* population in Buruai River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03^{0}36'19"S 133^{0}14'12"E	03^{0}33'14"S 133^{0}19'57"E	13	0	0	0	0	0	0.00
1991	Oct	03^{0}36'19"S 133^{0}14'12"E	03^{0}33'14"S 133^{0}19'57"E	13	3	0	0	3	6	0.46
1992	Dec	03^{0}36'19"S 133^{0}14'12"E	03^{0}33'14"S 133^{0}19'57"E	13	1	0	0	6	7	0.54
1993	Jun	03^{0}36'19"S 133^{0}14'12"E	03^{0}33'14"S 133^{0}19'57"E	13	3	0	0	0	3	0.23
1998	Dec	03^{0}37'57"S 133^{0}10'20"E	03^{0}33'14"S 133^{0}19'57"E	47	0	0	2	4	6	0.13

Note：The starting point of surveys in 1990, 1991, 1992, 1993, 1994, 1996 was at Guriasa Village and finished at Tairi Village. In 1998 started at Kakowoi and finished at Tairi Village.

Table 7. Spotting night count survey of *C. porosus* population in Garawa River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}25'15"E	1.5	5	0	0	0	5	3.33
1991	Oct	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}25'15"E	1.5	3	0	0	0	3	2.00
1992	Dec	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}25'15"E	1.5	0	0	1	3	4	2.67
1993	Jun	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}25'15"E	1.5	0	0	0	0	0	0.00
1998	Dec	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}25'15"E	1.5	0	1	0	1	2	1.33

Table 8. Spotting night count survey of *C. porosus* population in Kambabu River.

H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}24'50"E	2	0	0	0	1	1	0.50
1991	Oct	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}24'50"E	2	2	1	0	1	4	2.00
1992	Dec	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}24'50"E	2	0	2	0	2	4	2.00
1993	Jun	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}24'50"E	2	3	2	0	3	8	4.00
1998	Dec	03^{0}30'38"S 133^{0}25'12"E	03^{0}31'30"S 133^{0}24'50"E	2	0	1	1	0	2	1.00

Table 9. Spotting night count survey of *C. porosus* population in Suwiki Lake.
H=hatchling; J=Juvenile; A=adult; EO=eyes only.

Year	Month	GPS coordinate		Distance (Km)	Result				Number of crocodile	Density
		Start	Finish		H	J	A	EO		
1990	Feb	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	2	0	0	10	12	0.92
1991	Oct	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	3	0	1	13	17	1.87
1992	Dec	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	3	9	3	11	26	2.00
1993	Jun	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	1	0	2	45	48	3.69
1994	Dec	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	0	6	2	89	97	7.46
1996	Jan	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	0	19	2	62	83	6.38
1998	Dec	03°19'38"S 133°48'22"E	03°19'38"S 133°48'22"E	13 circuit	3	6	1	72	82	6.31

Note on exposed river and lake shores in December 1998:

a) Gasawi, Buruai, Barusa Rivers and Suwiki Lake

The survey commenced at low tide and was conducted on an incoming tide. However, because the surveys coincided with wet season heavy rains, the water level, even at low tide, was sufficiently high so as not to result in any exposed bank. This condition equates to the zero line as described by Messel *et al.* (1981, page 73).

b) Garawa and Kamabu Rivers

Although the tidal water differences were low, the river conditions (ie water depth) were relatively shallow, so at low tide the root systems of the riverside plants could be seen. Long exposed banks occurred in this area during low tide (the lowest exposed bank at the lowest tidal water level approximately +50 cm).

Table 10. The mean, SD, SE of *C. porosus* densities in 6 survey areas. Linear regression analysis was used to describe the mean trend of the data over time. Slope indicate the direction (+=Increasing; - =decreasing) and magnitude of the mean trend in density; R^2 = the proportion of variation in the density explained by the variable time (years); and P = the probability that the relationship is due to change.

River/Lake	Mean	SD	SE	Slope	R^2	P
Barusa	1.60	1.32	0.59	0.2200	0.0695	0.6682
Gasawi	1.12	0.82	0.31	-0.0404	0.0111	0.8217
Buruai	0.27	0.22	0.10	0.0030	0.0004	0.9732
Garawa	1.87	1.28	0.57	-0.6000	0.5474	0.1529
Kamabu	1.90	1.34	0.60	0.3000	0.1250	0.5594
Suwiki	4.09	2.61	0.99	1.0946	0.8176	0.0052*

*Significant at the $P < 0.05$ level

DISCUSSION AND PROBLEMS

1. Barusa River

The regression equation (Y=0.22X+0.94) for Barusa river shows a non significant result (p=0.6682) with a very low R-square (R^2=0.0695), indicating no conclusive evidence for population change. The mean density over 5 years was 1.60 with the SD =1.32 and SE= 0.59. The high value of SD indicates extreme fluctuation of the value being observed between years of monitoring. The trend of Barusa river *C. porosus* density was increase from year 1 to year 4 and sharp decrease in the last monitoring year (5).

2. Gasawi River

The regression equation (Y= -0.0404+1.2829) for Gasawi river shows a non significant result (p=0.8217) with a very low R-square (R^2=0.0111). The mean density over 7 years study was 1.12 with the SD =0.82 and SE=0.31. Gasawi river density declined from year 4 of observation, onward with a sharp drop in density in year 5 of observation.

3. Buruai River

The regression equation (Y=0.003X+0.263) for Buruai river shows a non significant result (p=0.9732) with a very low R-square (R^2=0.0004). The mean density over 5 years study was very low

compared to other places, 0.27 with the SD =0.22 and SE=0.10. The Buruai river density tended to be stable and low.

Although the Buruai river population was consistently low compared to other areas being surveyed, the 1998 survey indicated a decline in its density. In general, the population density in Buruai River tends to be stable; such low density over the years in this river was due to the river being suitable for foraging only without suitable habitat for hatchlings.

4. Garawa and Kamabu Rivers

The regression equation (Y= -0.6X+3.666) for Garawa river shows a non significant result (p=0.1529) with a low R-square (R^2=0.5474). The mean density over 5 years study was relatively high compared to other places, 1.87 with the SD =1.28 and SE=0.57. The Garawa river density showed a sharp and continuos decline in its density compared to other places.

The regression equation (Y=0.3X+1) for Kamabu river shows a non significant result (p=0.5594) with a very low R-square (R^2=0.125). The mean density over 5 years study was relatively high compared to other rivers, 1.90 with the SD =1.34 and SE=0.60. The Kamabu river density showed a steady increase on its density except for the last year of observations.

Compared with other rivers being surveyed, these two rivers had the highest density of crocodiles, although zero population was noted in the 1993 survey. These two rivers showed a decline in 1998.

Garawa and Kamabu Rivers are the shallowest rivers among the rivers being surveyed, thus in general much easier for the surveyor to count the crocodiles.

5. Suwiki Lake

The regression equation (Y=1.0946X-0.2886) for Suwiki Lake shows a significant result (p=0.0052) with high R-square (R^2=0.8176). The mean density over 7 years study was the highest value being observed among other places, 4.09 with the SD =2.61 and SE=0.99. The trend on Suwiki Lake density showed a steady increase on its density from the first survey until the last. Perhaps this was the only site observed with healthy population status.

This lake is known as the safest area for crocodiles, where no commercial hunting activities were recorded since 1994. Local people enforce their traditional law (known as *Sasi*) where harvesting can only be conducted in a wise way. This explains the increasing density over the seven years survey. A high number of EO was recorded in this survey mainly due to very dense floating plants so dense that the canoe could not approach the crocodile to estimate the body length.

Results of the present survey indicated a sharp drop in density since 1993 data. The trend from 5 survey times (with a gap for 5 years from 1993 to 1998), shows a relatively big fluctuation of the density. This was perhaps due to the different times of survey in each survey. The high density in 1993 was most likely due to the high differences in tide during that time, thus resulting in high sighting of crocodile, whereas in other years the time of survey was mainly with low differences in tide. The low density in 1998 was probably due to unsuitable weather conditions for the survey.

From interview with local people, since 1994 no hunting activity was conducted in the rivers and lakes. This was due to the moratorium act imposed by the PHPA and revoked in 1997. Soon after the moratorium was withdrawn, the skin price also dropped causing a heavy loss for hunters who conduct the collections. We were very unfortunate not to have any harvest data from the past on the surveyed areas, thus we could not be identify any sustainable conditions between the past and present.

To overcome the bias in results due to time differences between survey years we suggest repetition of the survey during the dry season, preferably in June-July 1999. From this we hope to determine whether at this season the number and density of sightings is different, especially from the areas where it was impossible to survey due to dense riverine plants.

RECOMENDATION

From these observations it can be noted that other than in Suwiki lake, all rivers have very low densities with general decline or stasis of populations (static growth trends). This indicates that for the time being, until we can get a dry season figure (the normal pattern of dry season in Irian Jaya is from June to August) on the population status; it is not necessary to stop the harvesting activity. There is also need to conduct an annual monitoring (continuous monitoring) in those rivers.

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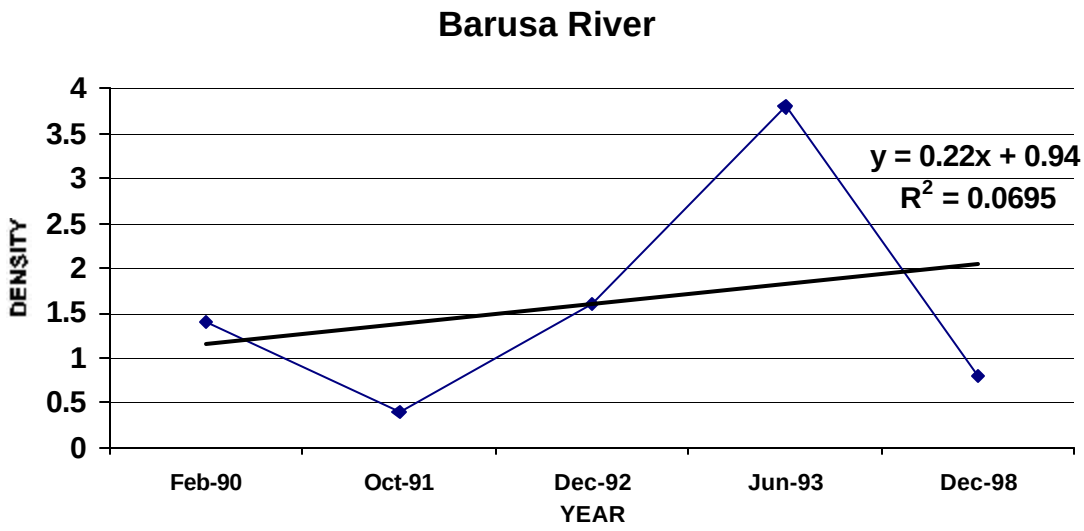


Figure 1. Graphic form of spotting night count result of *C. porosus* population in Barusa River.

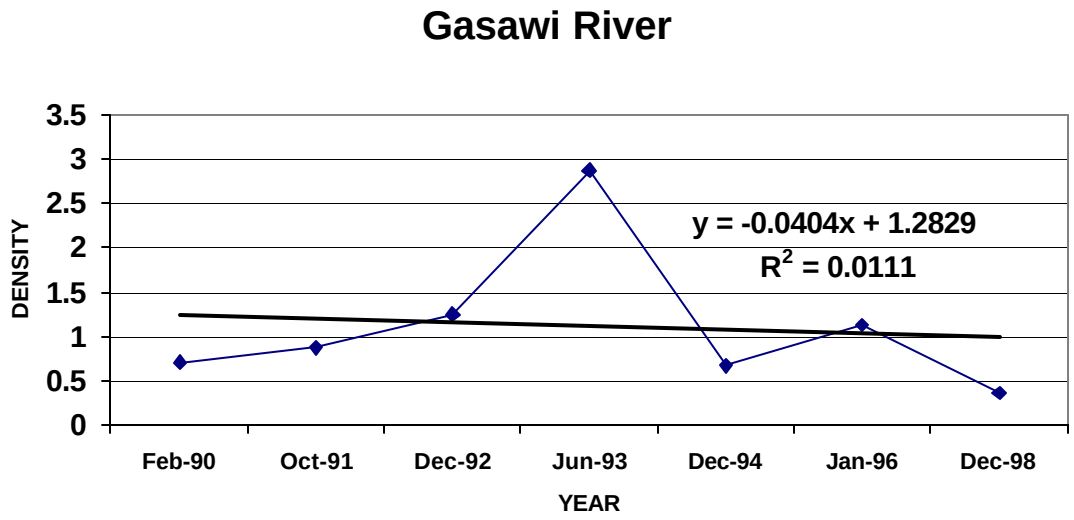


Figure 2. Graphic form of spotting night count result of *C. porosus* population in Gasawi River.

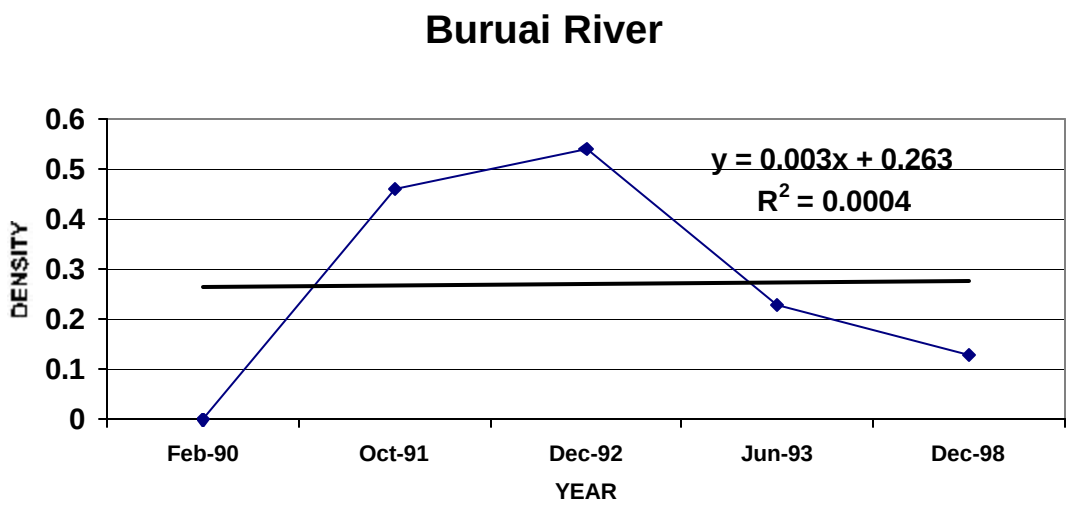
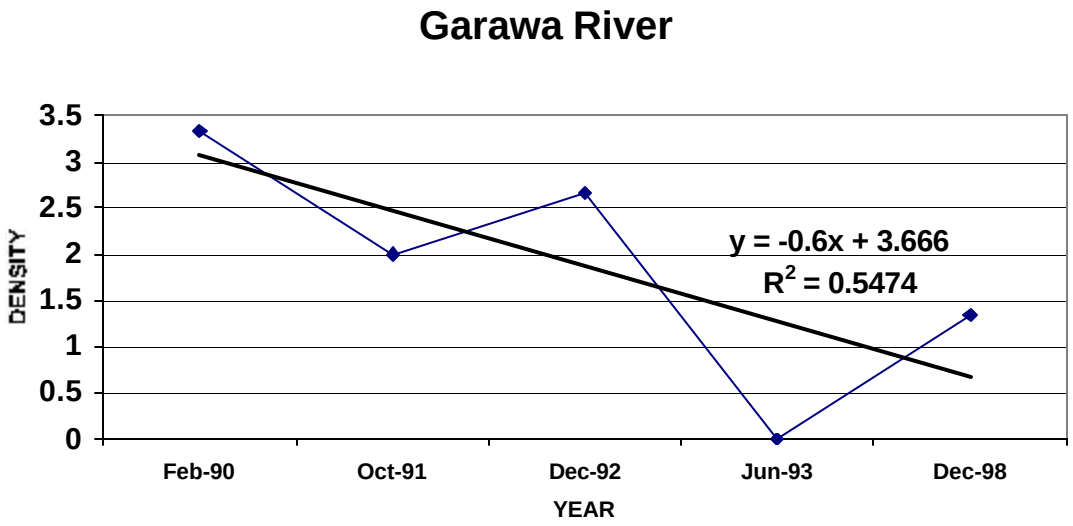


Figure 3. Graphic form of spotting night count result of *C. porosus* population in Buruai River.

Figure 4. Graphic form of spotting night count result of *C. porosus* population in Garawa River.



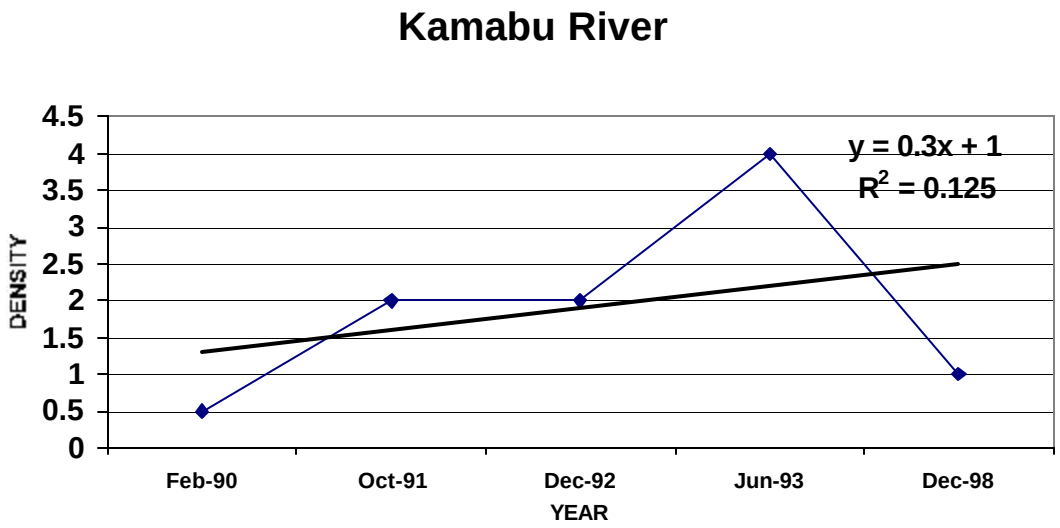


Figure 5. Graphic form of spotting night count result of *C. porosus* population in Kamabu River.

Figure 6. Graphic form of spotting night count result of *C. porosus* population in Suwiki Lake.