

## (5) Total of Head Loss

Location		Coefficient of Head Loss ( $\times 10^{-6} + Q^2$ )	Head Loss (m)	
			Q (m <sup>3</sup> /s) =	27.00
			q (m <sup>3</sup> /s) =	13.50
Intake	Trashrack	1.07		0.001
	Entrance	179.07		0.131
	Others (50 %)	90.07		0.066
	Sub-Total	270.22		0.197
Headrace	Friction	23,172.44		16.893
	Bend	2,193.19		1.599
	Others (5 %)	1,268.28		0.925
	Sub-Total	26,633.91		19.416
Penstock	Before Branch			
	Friction	17,988.94		13.114
	Bend	565.93		0.413
	Branch	1,764.94		1.287
	Contraction	0.00		0.000
	Others (5%)	1,015.99		0.741
	(1) Sub-Total	21,335.81		15.554
	After Branch			
	Friction	10,681.06		1.947
	Bend	2,767.49		0.504
	Valve	30,482.74		5.555
	Others (5 %)	2,058.19		0.375
	(2) Sub-Total	45,989.48		8.382
	Sub-Total	67,325.29		23.935
Tailrace	Enlarging	797.19		0.145
	Others (5%)	39.86		0.007
	Sub-Total	837.05		0.153
Total	$\times 10^{-6} + Q^2$	27,920.13		20.354
	$\times 10^{-6} + q^2$	46,826.54		8.534
Total				28.888
Allowance (approx. 5 %)		1.44		1.412
Ground-Total ( h )				30.300

2) Calculation of Effective Head

High Water Level		477.40
Low Water Level		470.00
(1) Standard intake water level	(m)	473.70
(2) Tail water level	(m)	84.00
(3) Gross head = (1) - (2)	(m)	389.70
(4) Head loss ( h )	(m)	30.30
(5) Effective head ( H ) = (3) - (4) =	(m)	359.40

### A-II-2-1 Stability Analysis of Dam

#### 1) General

In this paper, it is to be calculated the stability against sliding on the contact plane between dambody and bedrock.

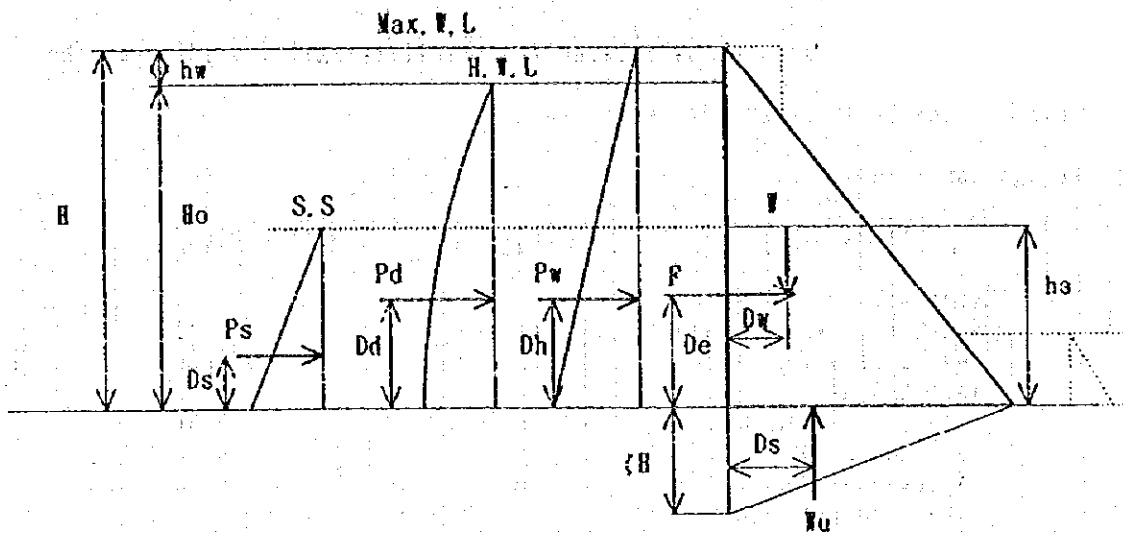
#### 2) Design Conditions

Items	Unit	Specification
<b>Reservoir</b>		
Normal high water level	EL. m	477.40
Low water level	EL. m	470.00
<b>Wave height</b>		
Wind (30 m/s. hw)	m	0.81
Earthquake (k = 0.15. he)	m	0.53
Allowance (ha)	m	0.50
(Delayed gate operation)		
Total of wave height (h)	m	2.00
<b>Sedimentation</b>		
Sedimentation surface	EL. m	460.00 (Temporary)
Unit weight (ws)	t/m <sup>3</sup>	1.10
Coefficient of sediment pressure (Ce)	-	0.50
<b>Dam properties</b>		
Type of dam	-	Concrete, gravity dam
Elevation of crest (Hd)	EL. m	479.40
Elevation of foundation (Hf)	EL. m	417.00
Dam height (h=Hd-Hf)	m	62.40
Crest length	m	114.00
Unit weight of concrete (wc)	t/m <sup>3</sup>	2.30
<b>Earthquake</b>		
Seismic coefficient (k)		0.15
Direction		Horizontal

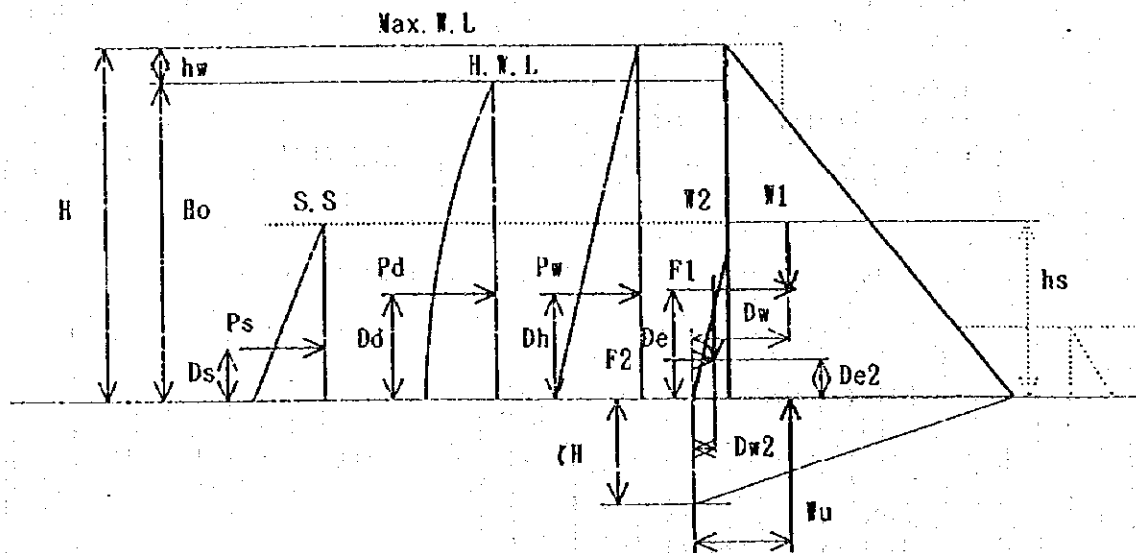
#### 3) Calculation

The calculation performs under two load conditions as below:

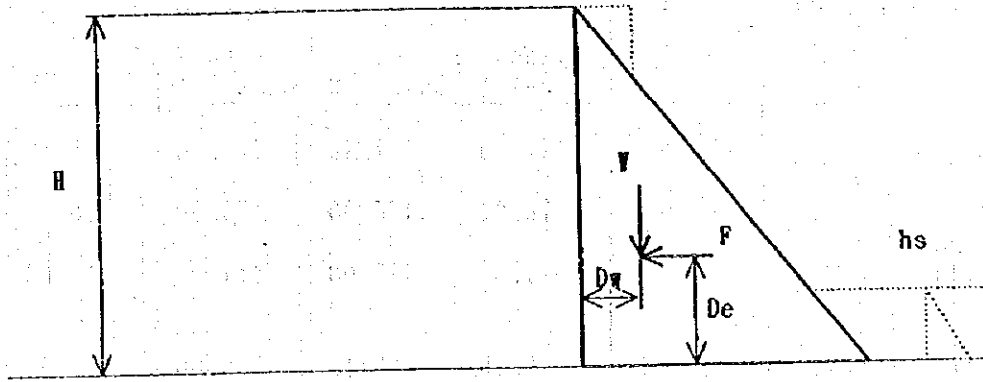
Items	After Completion	Before Completion
Water level (EL. m)	477.40	Empty
Dead load	○	○
Seismic load	Direction in the downstream	Direction in the upstream
Hydrostatic pressure	○	-
Hydrodynamic pressure	○	-
Sediment pressure	○	-
Uplift	○	-



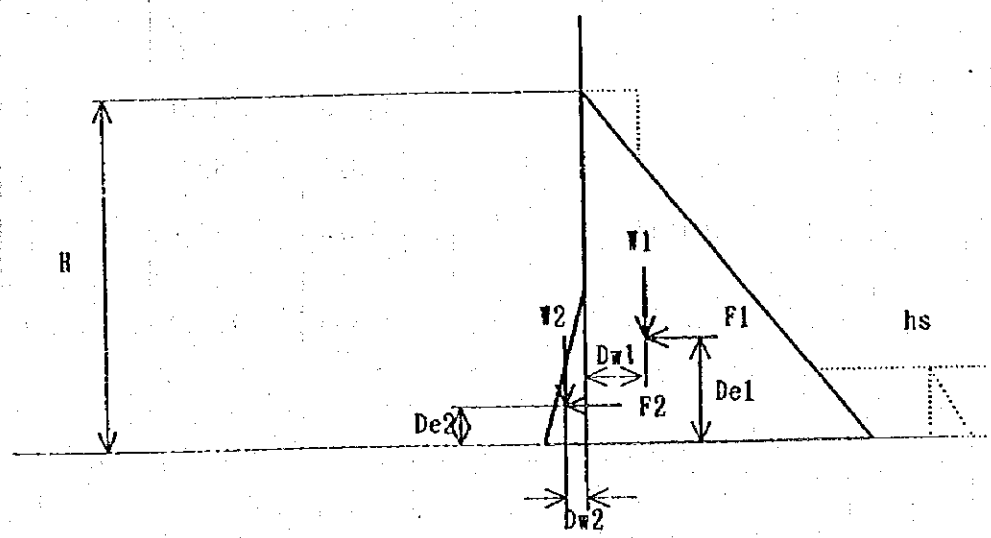
Case - 1



Case - 2  
After Dam Completion



Case - 1



Case - 2

Before Dam Completion

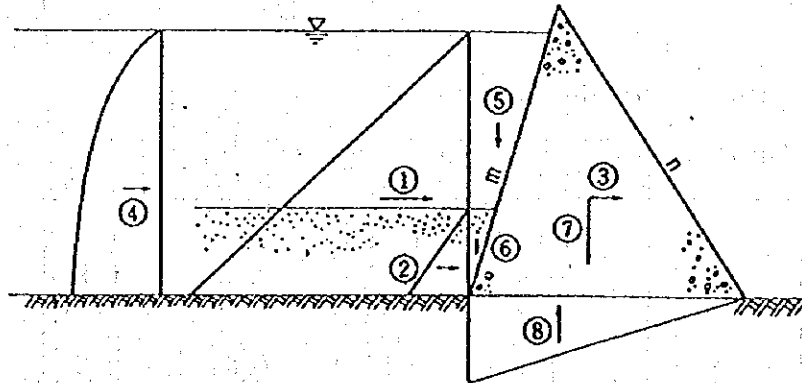
## Result of Calculation

### After Dam Completion

	Unit	Without Fillet		With Fillet		
		Case-1.1	Case-1.2	Case-2.1	Case-2.2	
H. W. L	EL. m	477.40	477.40	477.40	477.40	
L. V L	EL. m	470.00	470.00	470.00	470.00	
Foundation EL	m	417.00	417.00	417.00	417.00	
Slope						
Upstream side	m	0.10	0.15	0.00	0.00	
Downstream side	n	0.80	0.80	0.80	0.80	
Fillet						
Slope	m	-	-	0.60	0.60	
Beginning point	EL. m	-	-	450.00	440.00	
(Whole Section)						
Safety factor	F	4.34	4.57	5.34	4.96	
Stress	q2	ton/m <sup>2</sup>	129.1	121.2	110.8	112.1
	q2	ton/m <sup>2</sup>	0.4	12.5	21.6	19.0
(Half Section)						
Safety factor	F	-	11.29	8.91	6.33	
Stress	q2	ton/m <sup>2</sup>	-	6.2	58.7	85.1
	q2	ton/m <sup>2</sup>	-	20.5	-2.0	-9.5
Cross section area (Volume)	m <sup>3</sup> /m	1.752	1.850	1.884	1.716	
Priority			1	2		

(1) Loads and Moments due to Loads

Loads	Force (ton)	Acted Point (m)	Moment (M) (t-m)
<b>Horizontal Force (H)</b>			
① Hydrostatic pressure	$1/2 * \gamma_w * h^2$	$1/3 * h$	$1/6 * \gamma_w * h^3$
② Sediment pressure	$1/2 * \gamma_s * C_e * h^2$	$1/3 * h_s$	$1/6 * \gamma_s * C_e * h_s^3$
③ Seismic load	$1/2 * (m+n) * \gamma_c * k * h^2$	$1/3 * h$	$1/6 * (m+n) * \gamma_c * k * h^3$
④ Hydrodynamic pressure	$7/12 * \gamma_w * k * h^2$	$2/5 * h$	$7/30 * \gamma_w * k * h^3$
<b>Vertical Force (V)</b>			
⑤ Water weight on the dam	$1/2 * m * \gamma_w * h^2$	$1/3 * m * h$	$1/6 * m^2 * \gamma_w * h^3$
⑥ Sediment weight	$1/2 * m * \gamma_s * h^2$	$1/3 * m * h_s$	$1/6 * m^2 * \gamma_s * h_s^3$
⑦ Dam dead load	$1/2 * (m+n) * \gamma_c * h^2$	$1/3 * (2m+n) * h$	$1/6 * (m+n) * (2m+n) * \gamma_c * h^3$
⑧ Uplift	$-1/2 * (m+n) * \gamma_w * h^2$	$1/3 * (m+n) * h$	$-1/6 * (m+n)^2 * \gamma_w * h^3$



Case-1 : Dam without Fillet

(a) Study of Dam Cross Section

Basically dam cross section is calculated as following equations;

$$M/v = 2/3 * (m+n) * h$$

Whereas,  $M$  : Moment acting to the dam (t-m)  
 $V$  : Vertical force (t)  
 $m$  : Upstream side slope  
 $n$  : Downstream side slope  
 $h$  : Dam height (m) = 62.40 m

$$m+n = (b + (b^2 + 4ac)^{-0.5}) / (2 * a)$$

Whereas,  $a = \gamma_c - \gamma_w * U_p * (h_w/h)$

$$b = (\gamma_c - 2\gamma_w * (h_w/h)^2 - 2\gamma_s * (h_s/h)^2) * m + \gamma_c * k$$

$$c = (\gamma_w * (h_w/h)^3 + \gamma_s * (h_s/h)^3) * m^2 + \gamma_w * C_e * (h_s/h)^3 + 7/5 * \gamma_w * k * (h_w/h)^3$$

Weight and Height

$\gamma_c$ : Unit weight of concrete (t/m <sup>3</sup> )	2.30	6
$\gamma_w$ : Unit weight of water (t/m <sup>3</sup> )	1.00	11
$\gamma_s$ : Unit weight of sedi. in water (t/m <sup>3</sup> )	1.10	11
$h_w$ : Water depth (hw=W.L-Bf) (m)	60.40	11
$h_s$ : Height of sedimentation (m)	43.00	11
$h$ : Dam height (m)	62.40	11
$K$ : Seismic coefficient	0.15	11
$U_p$ : Coefficient uplift	0.40	11

Calculation of m and n

Coefficient	Upstream side slope (m)				
	0.00	0.05	0.07	0.10	0.15
a	1.91	1.91	1.91	1.91	1.91
b	0.35	0.31	0.30	0.28	0.25
c	1.10	1.10	1.10	1.11	1.13
m+n	0.85	0.85	0.84	0.84	0.84
Downstream side slope					
n	0.85	0.80	0.77	0.74	0.69



Case-1.1

Therefore, the dam slopes are applied as following.

Upstream side slope :  $m = 0.10$

Downstream side slope :  $n = 0.80$

(b) Study of Dam Stability in Case of After Completion

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		1,824.08		20.13		36,725
② Sediment P.		508.48		14.33		7,288
③ Seismic L.		604.51		20.80		12,574
④ Hydrodynamic P.		319.21		24.16		7,712
⑤ Water W. on Dam	182.41		2.01		367	
⑥ Seiment W. on Dam	101.70		1.43		146	
⑦ Dam body	4,030.04		20.80		83,825	
⑧ Uplift	-678.41		18.72		-12,700	
Total	3,635.73	3,256.28			71,638	64,299

$$\Sigma M = \Sigma Vx + \Sigma Hy = 135.94 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 37.39 \text{ m}$$

$$b = h * (m+n) = 56.16 \text{ m}$$

$$e = x_0 - b / 2 = 9.31 \text{ m} < b/3 = 18.72 \text{ m, O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 4.34 > F_d = 4 \text{ O.K}$$

Wheres.  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + 6 * e / b) = 129.13 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b) * (1 - 6 * e / b) = 0.35 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$



1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		375.38		9.13		3.428
② Sediment P.		27.50		3.33		92
③ Seismic L.		604.51		9.80		5.924
④ Hydrodynamic P.		65.69		10.96		720
⑤ Water W. on Dam	0.00		0.00		0	
⑥ Seiment W. on Dam	0.00		0.00		0	
⑦ Dam body	894.61		9.80		8.767	
⑧ Uplift	-145.00		8.82		-1.279	
Total	749.61	1.073.08			7.488	10.164

$$\Sigma Y = \Sigma V_x + \Sigma H_y = 17.65 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma Y / \Sigma V = 23.55 \text{ m}$$

$$b = h * (m+n) = 56.16 \text{ m}$$

$$e = x_0 - b / 2 = -4.53 \text{ m} < b/3 = 18.72 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 11.03 > F_d = 4 \text{ O.K}$$

Whereas,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + \delta * e / b) = 6.89 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b) * (1 - \delta * e / b) = 19.81 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

(c) Study of Dam Stability in Case of Before Completion (without fillet)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.						
② Sediment P.						
③ Seismic L. -1		-604.51		20.80		-12,574
④ Hydrodynamic P.						
⑤ Water W. on Dam						
⑥ Sedi. W. on Dam						
⑦ Dam body-1	4,030.04		20.80		83,825	
⑧ Uplift						
Total	4,030.04	-604.51			83,825	-12,574

$$\Sigma Y = \Sigma V_x + \Sigma H_y = 71.25 \times 10^3 \text{ tm}$$

$$x_o = \Sigma Y / \Sigma V = 17.68 \text{ m}$$

$$b = h * (m/n) = 56.16 \text{ m}$$

$$e = x_o - b / 2 = -10.40 \text{ m} < b / 3 = 18.72 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 23.91 > F_d = 4 \text{ O.K}$$

Where,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + 6 * e / b) = -7.97 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 151.49 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

Case-1.2

(without Fillet)

The dam slopes are applied as following.

Upstream side slope : m = 0.15

Downstream side slope : n = 0.80

(b) Study of Dam Stability in Case of After Completion

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	By (tm)
① Hydrostatic P.		1,824.08		20.13		36,725
② Sediment P.		508.48		14.33		7,288
③ Seismic L.		638.09		20.80		13,272
④ Hydrodynamic P.		319.21		24.16		7,712
⑤ Water W. on Dam	273.61		3.02		826	
⑥ Seiment W. on Dam	152.54		2.15		328	
⑦ Dam body	4,253.93		22.88		97,330	
⑧ Uplift	-716.10		19.76		-14,150	
Total	3,963.98	3,289.86			84,334	64,997

$$\Sigma M = \Sigma Vx + \Sigma By = 149.33 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 37.67 \text{ m}$$

$$b = h * (m+n) = 59.28 \text{ m}$$

$$e = x_0 - b / 2 = 8.03 \text{ m} < b/3 = 19.76 \text{ m, O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 4.57 > F_d = 4 \text{ O.K}$$

Theres, f : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma Y / b) * (1 + 6 * e / b) = 121.23 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma Y / b) * (1 - 6 * e / b) = 12.51 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ ✓}$$

Check-1.2 : Middle Height Section

Hf = EL

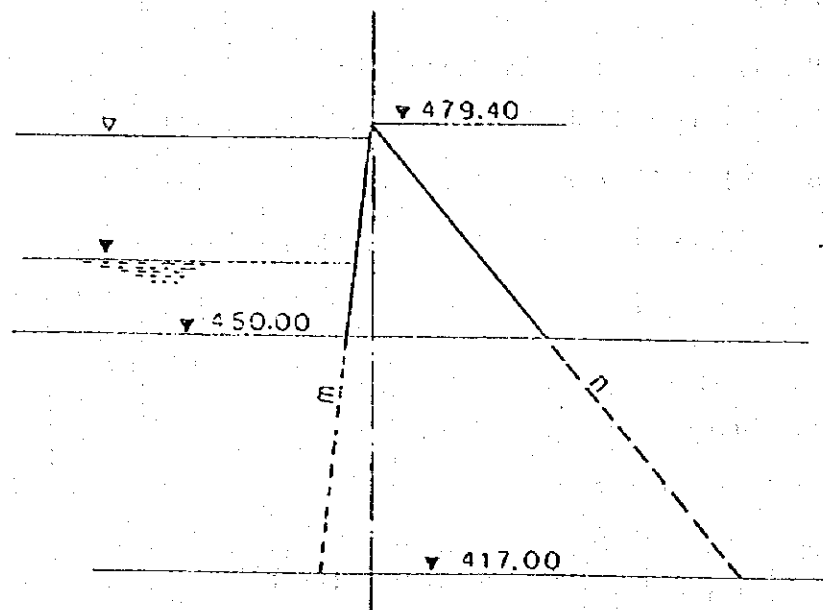
450.00 (without Fillet)

$\alpha$  : 0.15

$\eta$  : 0.80

Weight and Height

Vc : Unit weight of concrete (t/m <sup>3</sup> )	2.30
Vw : Unit weight of water (t/m <sup>3</sup> )	1.00
Vs : Unit weight of sedi. in water (t/m <sup>3</sup> )	1.10
hw : Water depth (hw=W.L-Hf) (m)	27.40
hs : Height of sedimentation (m)	10.00
h : Dam height (Hd-Hf) (m)	29.40
K : Seismic coefficient	0.15
Up : Coefficient uplift	0.40



1) Calculation of Loads

Load	Pressure/force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		375.38		9.13		3.428
② Sediment P.		27.50		3.33		92
③ Seismic L.		638.09		9.80		6.253
④ Hydrodynamic P.		65.69		10.96		720
⑤ Water W. on Dam	0.00		0.00		0	
⑥ Seiment W. on Dam	0.00		0.00		0	
⑦ Dam body	944.31		10.78		10.180	
⑧ Uplift	-153.06		9.31		-1.425	
Total	791.26	1.106.66			8.755	10.493

$$\Sigma M = \Sigma Vx + \Sigma Hy = 19.25 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 24.33 \text{ m}$$

$$b = h * (\mu + n) = 59.28 \text{ m}$$

$$e = x_0 - b / 2 = -5.31 \text{ m} < b/3 = 19.76 \text{ m. 0.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 11.29 > F_d = 4 \text{ 0.K}$$

Wheres,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + 6 * e / b) = 6.17 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ 0.K}$$

$$q_2 = (\Sigma V / b) * (1 - 6 * e / b) = 20.53 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ 0.K}$$

(c) Study of Dam Stability in Case of Before Completion (without Fillet)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.						
② Sediment P.						
③ Seismic L. -1		-638.09		20.80		-13,272
④ Hydrodynamic P.						
⑤ Water W. on Dam						
⑥ Sedi. W. on Dam						
⑦ Dam body-l	4,253.93		22.88		97,330	
⑧ Uplift						
Total	4,253.93	-638.09			97,330	-13,272

$$\Sigma M = \Sigma Vx + \Sigma Hy = 84.06 * 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 19.76 \text{ m}$$

$$b = h * (m+n) = 59.28 \text{ m}$$

$$e = x_0 - b / 2 = -9.88 \text{ m} < b / 3 = 19.76 \text{ m, O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 23.91 > F_d = 4 \text{ O.K}$$

Whereas,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + 6 * e / b) = 0.00 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 143.52 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

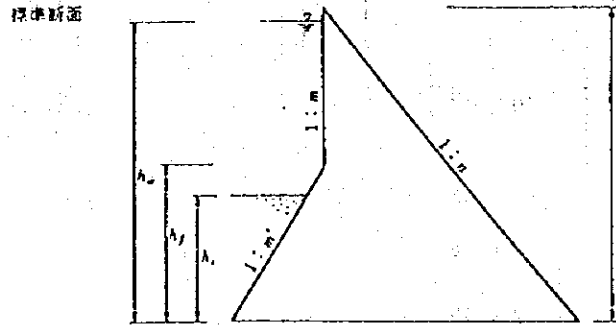


Case-2 : Dam with Fillet

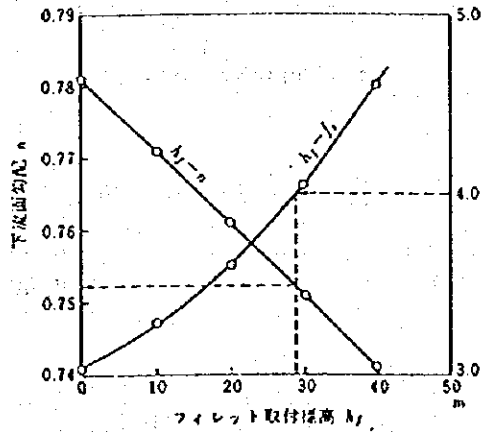
Case-2.1

(a) Study of Dam Cross Section

Upstream side slope :  $m = 0.00$   
 Fillet slope :  $m' = 0.60$   
 Downstream side slope :  $n = 0.80$   
 Beginning of fillet (EL) = 450.00 m  
 Height of fillet :  $h_f = 33.00$  m

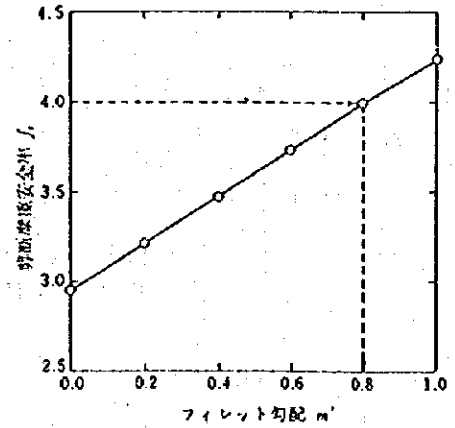


(1) 下流面勾配とフィレット取付高さの決定



$\lambda = 100$  m  $W_u = 2.3$  t/m<sup>3</sup>  $k = 0.06$   
 $\lambda_u = 98$  m  $W_u = 1.0$  t/m<sup>3</sup>  $U_s = 1/3$   
 $\lambda_s = 50$  m  $W_s = 1.0$  t/m<sup>3</sup>  $C_s = 0.6$   
 $m = 0$

(2) フィレット勾配の決定



$\lambda = 100$  m  $W_u = 2.3$  t/m<sup>3</sup>  $k = 0.06$   
 $\lambda_f = 30$  m  $W_u = 1.0$  t/m<sup>3</sup>  $U_s = 1/3$   
 $\lambda_s = 98$  m  $W_s = 1.0$  t/m<sup>3</sup>  $C_s = 0.6$   
 $\lambda_u = 50$  m  
 $m = 0$   
 $n = 0.76$

(b) Study of Dam Stability in Case of After Completion with Fillet EL450 m

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		1.824.08		20.13		36.725
② Sediment P.		508.48		14.33		7.288
③ Seismic L. -1		537.34		20.80		11.177
Fillet		112.71		11.00		1.240
④ Hydrodinamic P.		319.21		24.16		7.712
⑤ Water weight on the dam slope	548.46		13.72		7.527.17	
⑥ Sediment weight on the dam slope	577.17		7.85		4.528.06	
⑦ Dam body-l	3.582.26		36.44		130.538	
Fillet	751.41		13.20		9.919	
⑧ Uplift	-842.22		23.24		-19.573	
Total	4.617.08	3.301.82			132.938	64.142

$$\Sigma M = \Sigma Vx + \Sigma Hy = 197.08 * 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 42.68 \text{ m}$$

$$b = h * (m+n) = 49.92 \text{ m}$$

$$b' = h * (m+n) + hf * m' = 69.72 \text{ m}$$

$$e = x_0 - b' / 2 = 7.82 \text{ m} < b' / 3 = 23.24 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

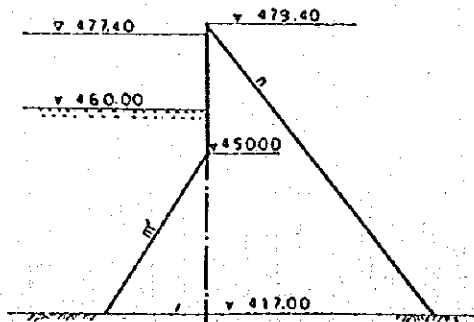
$$F = (f * \Sigma v + \tau * b') / \Sigma H = 5.34 > F_d = 4 \text{ O.K}$$

Whereas,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b') * (1 + 6 * e / b') = 110.82 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 21.63 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

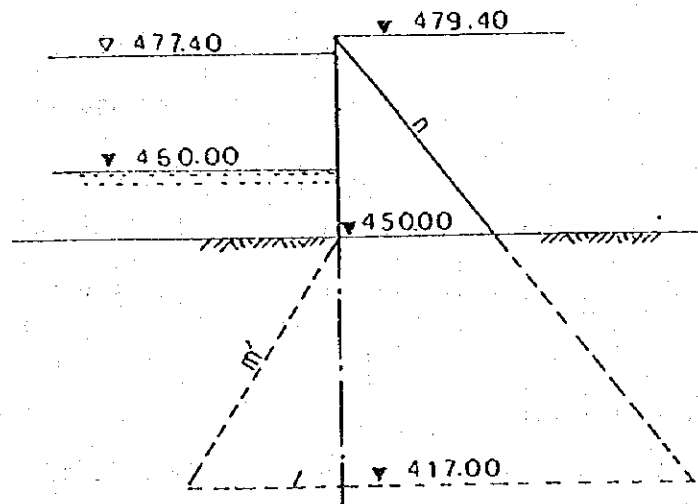


Check-1 : In Case of Half Section EL 450.00 m. with Fillet EL 450 m  
 Weight and Height

$\gamma_c$ : Unit weight of concrete (t/m <sup>3</sup> )	2.30
$\gamma_w$ : Unit weight of water (t/m <sup>3</sup> )	1.00
$\gamma_s$ : Unit weight of sedi. in water (t/m <sup>3</sup> )	1.10
$h_w$ : Water depth ( $h_w = W.L - Bf$ ) (m)	27.40
$h_s$ : Height of sedimentation (m)	10.00
$h$ : Dam height ( $H_d - Bf$ ) (m)	29.40
$K$ : Seismic coefficient	0.15
$U_p$ : Coefficient uplift	0.40

Upstream side slope :  $m = 0.00$

Downstream side slope :  $n = 0.80$



## Study of Dam Stability in Case of After Completion

### 1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Yx (tm)	Hy (tm)
① Hydrostatic P.		375.38		9.13		3.428
② Sediment P.		27.50		3.33		92
③ Seismic L.		119.28		9.80		1,169
④ Hydrodynamic P.		65.69		10.96		720
⑤ Water W. on Dam	0.00		0.00		0	
⑥ Seiment W. on Dam	0.00		0.00		0	
⑦ Dam body	795.21		7.84		6.234	
⑧ Uplift	-128.89		7.84		-1.010	
Total	666.32	587.85			5.224	5.409

$$\Sigma M = \Sigma Yx + \Sigma Hy = 10.63 * 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma Y = 15.96 \text{ m}$$

$$b = h * (m+n) = 23.52 \text{ m}$$

$$e = x_0 - b / 2 = 4.20 \text{ m} < b/3 = 7.84 \text{ m. O.K}$$

(Earthquake condition)

Safty factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 3.91 > F_d = 4 \text{ O.K}$$

Wheres,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma Y / b) * (1 + 6 * e / b) = 58.67 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma Y / b) * (1 - 6 * e / b) = -2.01 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2$$

(c) Study of Dam Stability in Case of Before Completion (Fillet EL 450 m)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.						
② Sediment P.						
③ Seismic L. -1 Fillet		-537.34 -112.71		20.80 11.00		-11.177 -1.240
④ Hydrodynamic P.						
⑤ Water weight on the dam slope						
⑥ Sediment weight on the dam slope						
⑦ Dam body-1 Fillet	3,582.26 751.41		36.44 13.20		130.538 9.919	
⑧ Uplift						
Total	4,333.67	-650.05			140.456	-12.416

$$\Sigma M = \Sigma Vx + \Sigma Hy = 128.04 * 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 29.55 \text{ m}$$

$$b = h * (m+n) = 49.92 \text{ m}$$

$$b' = h * (m+n) + hf * m' = 69.72 \text{ m}$$

$$e = x_0 - b' / 2 = -5.31 \text{ m} < b' / 3 = 23.24 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma V + \tau * b') / \Sigma H = 26.78 > F_d = 4 \text{ O.K}$$

Wheres,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

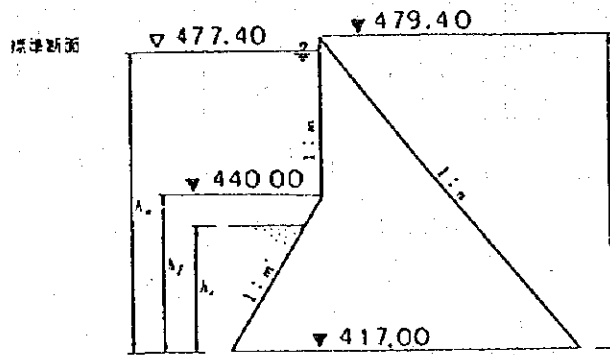
$$q_1 = (\Sigma V / b') * (1 + 6 * e / b') = 33.73 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 90.59 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

Case-2.1

(a) Study of Dam Cross Section

Upstream side slope :  $m = 0.00$   
Fillet slope :  $m' = 0.60$   
Downstream side slope :  $n = 0.80$   
Beginning of fillet (EL) = 440.00 m  
Height of fillet :  $h_f = 23.00$  m



(b) Study of Dam Stability in Case of After Completion (Fillet EL 440 m)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		1,824.08		20.13		36,725
② Sediment P.		508.48		14.33		7,288
③ Seismic L. -1		537.34		20.80		11,177
Fillet		54.75		7.67		420
④ Hydrodynamic P.		319.21		24.16		7,712
⑤ Water weight on the dam slope	520.26		8.25		4,291.25	
⑥ Sediment weight on the dam slope	473.17		5.02		2,400.80	
⑦ Dam body-1	3,582.26		30.44		109,044	
Fillet	365.01		9.20		3,358	
⑧ Uplift	-769.74		23.24		-17,889	
Total	4,175.96	3,243.86			101,205	63,322

$$\Sigma M = \Sigma Vx + \Sigma Hy = 164.53 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 39.40 \text{ m}$$

$$b = h * (m+n) = 49.92 \text{ m}$$

$$b' = h * (m+n) + hf * m' = 63.72 \text{ m}$$

$$e = x_0 - b' / 2 = 7.54 \text{ m} < b'/3 = 21.24 \text{ m, O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b') / \Sigma H = 4.96 > F_d = 4 \text{ O.K}$$

Wheres,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b') * (1 + 6 * e / b') = 112.06 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 19.02 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

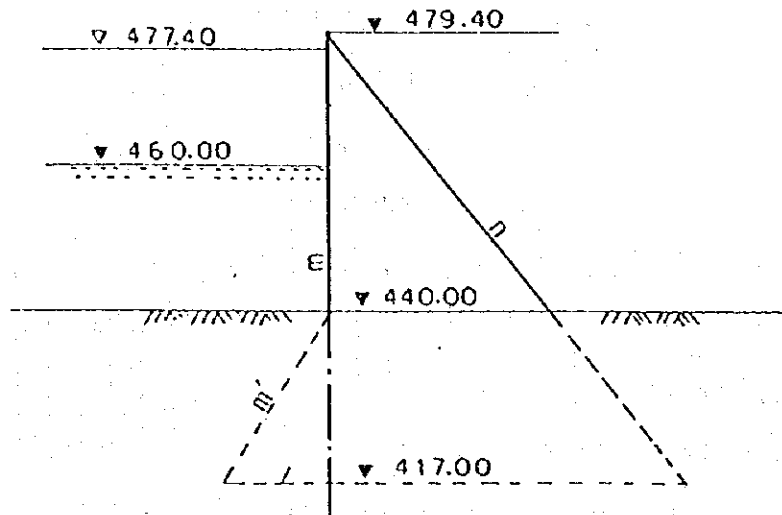
Check-2.2 : In case of Half Section, EL 440.00 m. (Fillet EL440 m)

Weight and Height

$\gamma_c$ : Unit weight of concrete (t/m <sup>3</sup> )	2.30	9
$\gamma_w$ : Unit weight of water (t/m <sup>3</sup> )	1.00	27
$\gamma_s$ : Unit weight of sedi. in water (t/m <sup>3</sup> )	1.10	28
$h_w$ : Water depth ( $h_w = V.L - R_f$ ) (m)	37.40	49
$h_s$ : Height of sedimentation (m)	20.00	50
$h$ : Dam height ( $H_d - R_f$ ) (m)	39.40	51
$K$ : Seismic coefficient	0.15	52
$U_p$ : Coefficient uplift	0.40	53

Upstream side slope :  $n = 0.00$   $E 50\%$

Downstream side slope :  $n = 0.80$   $E 50\%$





(b) Study of Dam Stability in Case of After Completion (Fillet EL 440 m)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.		699.38		12.47		8.719
② Sediment P.		110.00		6.67		733
③ Seismic L.		214.23		13.13		2.813
④ Hydrodynamic P.		122.39		14.96		1.831
⑤ Water W. on Dam	0.00		0.00		0	
⑥ Seiment W. on Dam	0.00		0.00		0	
⑦ Dam body	1.428.17		10.51		15.005	
⑧ Uplift	-235.77		10.51		-2.477	
Total	1.192.40	1.146.00			12.528	14.097

$$\Sigma M = \Sigma Vx + \Sigma Hy = 26.62 \times 10^3 \text{ tm}$$

$$x_0 = \Sigma M / \Sigma V = 22.33 \text{ m}$$

$$b = h * (m+n) = 31.52 \text{ m}$$

$$e = x_0 - b / 2 = 6.57 \text{ m} < b/3 = 10.51 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b) / \Sigma H = 6.33 > F_d = 4 \text{ O.K}$$

Wheres,  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b) * (1 + 6 * e / b) = 85.13 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b) * (1 - 6 * e / b) = -9.47 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2$$

(c) Study of Dam Stability in Case of Before Completion (Fillet EL. 440 m)

1) Calculation of Loads

Load	Pressure/Force		Action Point		Moment	
	Vertical (t)	Horizontal (t)	x (m)	y (m)	Vx (tm)	Hy (tm)
① Hydrostatic P.						
② Sediment P.						
③ Seismic L. -1 Fillet		-537.34 -54.75		20.80 7.67		-11.177 -420
④ Hydrodynamic P.						
⑤ Water weight on the dam slope						
⑥ Sediment weight on the dam slope						
⑦ Dam body -1 Fillet	3.532.26 365.01		30.44 9.20		109.044 3.358	
⑧ Uplift						
Total	3.947.27	-592.09			112.402	-11.596

$$\Sigma V = \Sigma V_x + \Sigma H_y = 100.81 \times 10^3 \text{ t}$$

$$x_0 = \Sigma V / \Sigma V = 25.54 \text{ m}$$

$$b = h * (m+n) = 49.92 \text{ m}$$

$$b' = h * (m+n) + hf * n' = 63.72 \text{ m}$$

$$e = x_0 - b' / 2 = -6.32 \text{ m} < b' / 3 = 21.24 \text{ m. O.K}$$

(Earthquake condition)

Safety factor

$$F = (f * \Sigma v + \tau * b') / \Sigma H = 26.86 > F_d = 4 \text{ O.K}$$

Thereas.  $f$  : Coefficient of internal friction = 0.80  
 $\tau$  : Shear strength (t/m<sup>2</sup>) = 200.00

Stress of foundation

$$q_1 = (\Sigma V / b') * (1 + 6 * e / b') = 25.07 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

$$q_2 = (\Sigma V / b') * (1 - 6 * e / b') = 98.82 \text{ t/m}^2 < \tau = 200 \text{ t/m}^2 \text{ O.K}$$

## A-11-2-2 Calculation of Penstock Steel Liner Thickness

### 1) Design Conditions

#### a) Hydraulic Pressure

The hydraulic water pressure is to be consisted of hydraulic pressure, surging and pressure rise due to water hammer.

The values of the each pressures are as blow;

Maximum hydrostatic pressure ( $H_0$ )

$$\begin{aligned} H_0 &= 477.40 \text{ m of H. W. L} - 79.50 \text{ m of Turbine center} \\ &= 397.90 \text{ m} \end{aligned}$$

$$\text{Surging } (H_s) = 492.08 \text{ of U. S. W. L} - 477.40 \text{ m of H. W. L}$$

$$= 14.68 \text{ m}$$

Water hammer pressure ( $H_p$ ) =

$$= \text{Max. hydrostatic pressure} + 25 \%$$

The hydraulic pressure on the each points are assumed attached sketch.

#### b) External Pressure

The external pressure is considered 4.0 Kg/cm<sup>2</sup> due to seepage water pressure from around rock.

#### c) Material

In the calculation, the material for the penstock steel liner is to be applied SM570 (SM58Q) standardised by JIS.

The allowable tensile strength of SM570 is 2,400 Kg/cm<sup>2</sup>.

## 2) Calculation of Penstock steel Liner Thickness

The thickness can be calculated as following formula:

Embedded steel liner

$$\sigma = P \cdot D \cdot (1 - \lambda) / (2 \cdot (t - \epsilon) \cdot \delta)$$

$$t = P \cdot D \cdot (1 - \lambda) / (2 \cdot \sigma \cdot \delta) + \epsilon$$

Exposed steel liner

$$\sigma = P \cdot D / (2 \cdot (t - \epsilon) \cdot \delta)$$

$$t = P \cdot D / (2 \cdot \sigma \cdot \delta) + \epsilon$$

Where,

$\sigma$	: Circumferential stress	(Kg/cm <sup>2</sup> )
P	: Hydraulic water pressure	(Kg/cm <sup>2</sup> )
D	: Inner diameter	(m)
$\lambda$	: Ratio of sharing of internal pressure by surrounding rock	
t	: Thickness of steel liner	(cm)
$\epsilon$	: Allowable corrosion and abrasion	(=0.15 cm)
$\delta$	: Efficiency of longitudinal joint	(=0.95)
$\sigma_a$	: Allowable stress (SM570)	(=2,400Kg/cm <sup>2</sup> )

The minimum thickness can be calculated as below formula:

$$t = (D \cdot 800) / 400 \quad (\text{mm})$$

## 3) Results of Calculation

The results of calculation such as design hydraulic water pressure and thickness of pipe at each points are as shown in Table and

Fig. A-11-2-2.

#### 4) Study of Against External Pressure

Critical buckling pressure due to the external pressure is

stimated by Amstuz's formula and below Figure:

Point	Diameter (cm)	r=D/2 (cm)	t (cm)	r / t	Pk
Surge T.	310	155.00	0.60	258.33	
1	310	155.00	0.60	258.33	
2	300	150.00	0.60	250.00	
VIP3 BC	280	140.00	1.10	127.27	7.00
VIP3 EC	280	140.00	1.10	127.27	7.00
VIP4 BC	280	140.00	1.10	127.27	7.00
VIP4 EC	260	130.00	1.10	118.18	8.00
VIP5 BC	260	130.00	1.50	86.67	15.00
VIP5 EC	240	120.00	1.50	80.00	16.00
VIP6 BC	240	120.00	1.50	80.00	16.00
VIP6 EC	220	110.00	1.50	73.33	19.00
Branch	220	110.00	1.60	68.75	22.00

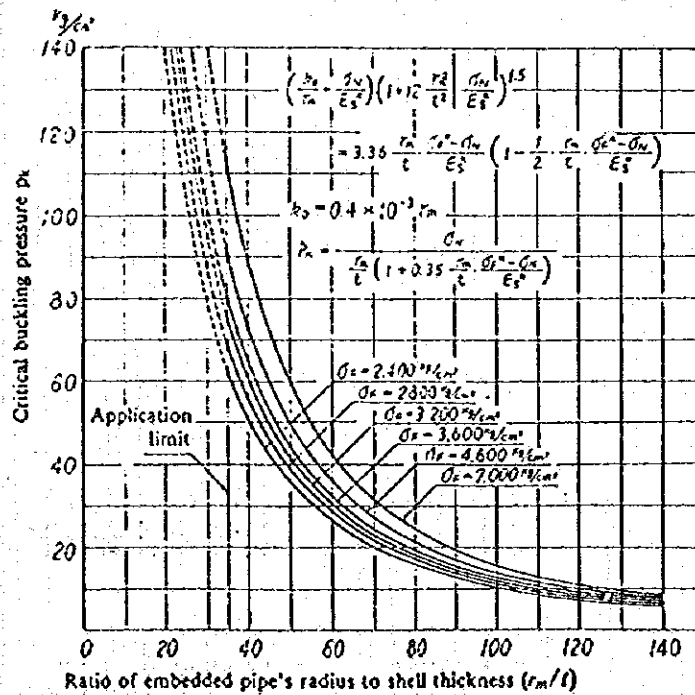


Fig. 1.16-5 Critical Buckling Pressures of Embedded Pipes without Stiffeners (by E. Amstuz's formula).



Minimum Thickness

$$t = (D + 800) / 400$$

Point	Diameter (cm)	Minimum Thickness		t (cm)	Design Thickness
		(mm)	(cm)		
0	310	9.75	0.98	0.29	
1	310	9.75	0.98	0.29	
2	300	9.50	0.95	0.29	
(VIP-3) 3	280	9.00	0.90	0.31	
4	280	9.00	0.90	0.33	
(VIP-4) 5	280	9.00	0.90	0.96	
6	260	8.50	0.85	0.92	
(VIP-5) 7	260	8.50	0.85	1.00	
8	240	8.00	0.80	0.95	
(VIP-6) 9	240	8.00	0.80	1.48	
10	220	7.50	0.75	1.39	
(Branch) 11	220	7.50	0.75	1.46	

### Calculation of Sharing Ratio

$$\lambda = \frac{(1 - E_s/P + \alpha_s + \Delta T + (2+t/D))}{(1 + (1 + \beta_c) * E_s/E_c + (2+t/D) + \log_e(D_r/D) + (1 + \beta_g) * E_s/E_g + (mg + l/mg) * 2 * t/D)}$$

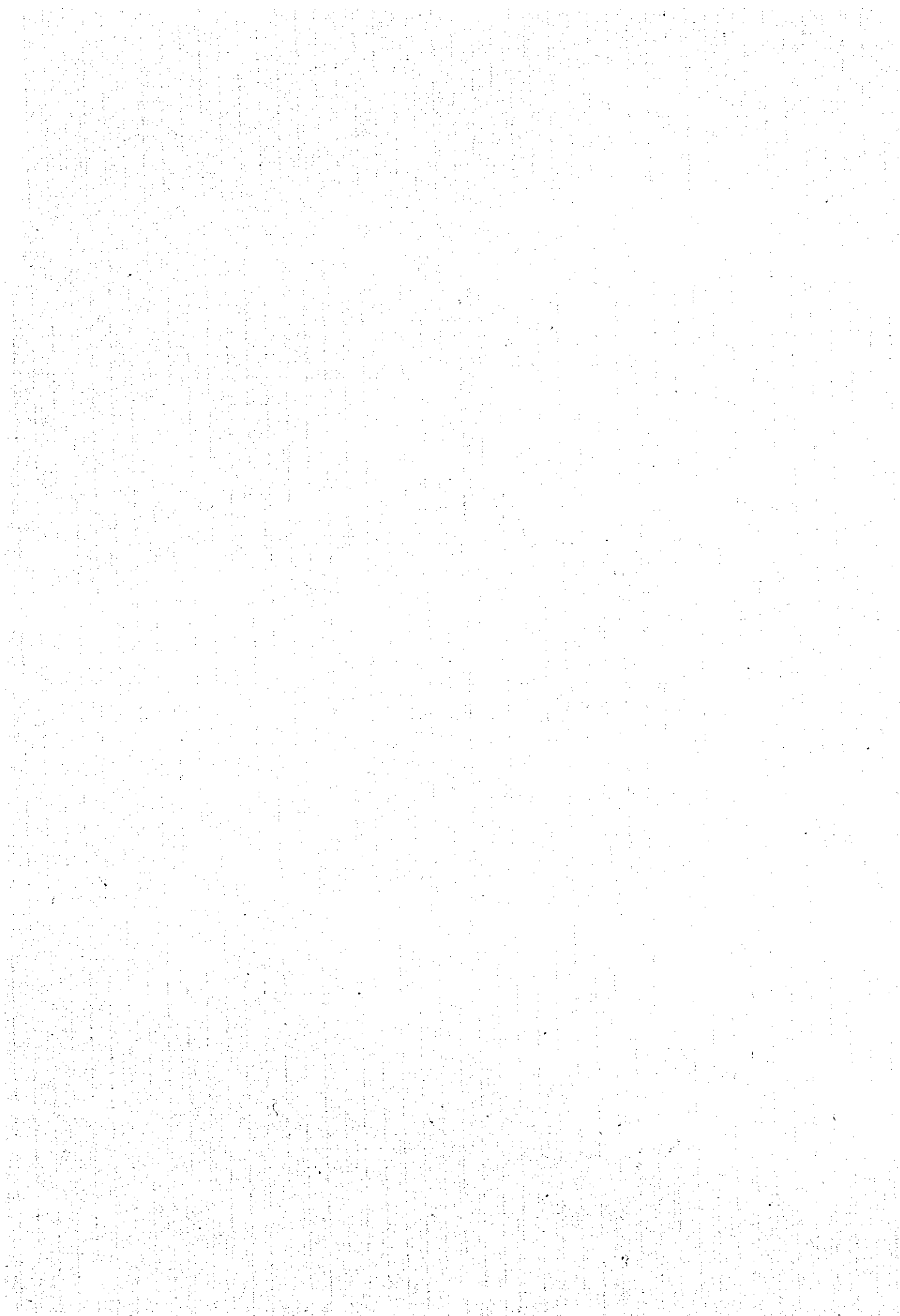
$E_s =$	2.100.000 Kg/cm <sup>2</sup>	$D =$	260.00 cm
$\alpha_s =$	0.000012 /C°	$D_r =$	380.00 cm
$\Delta T =$	5.00 C°	$t =$	1.00 cm
$\beta_c =$	0.00	$P =$	27.72 Kg/cm
$E_c =$	210.000 Kg/cm <sup>2</sup>		
$\beta_g =$	0.50 (0.3~0.6)		
$E_g =$	30.000 Kg/cm <sup>2</sup>		
$mg =$	5.00		

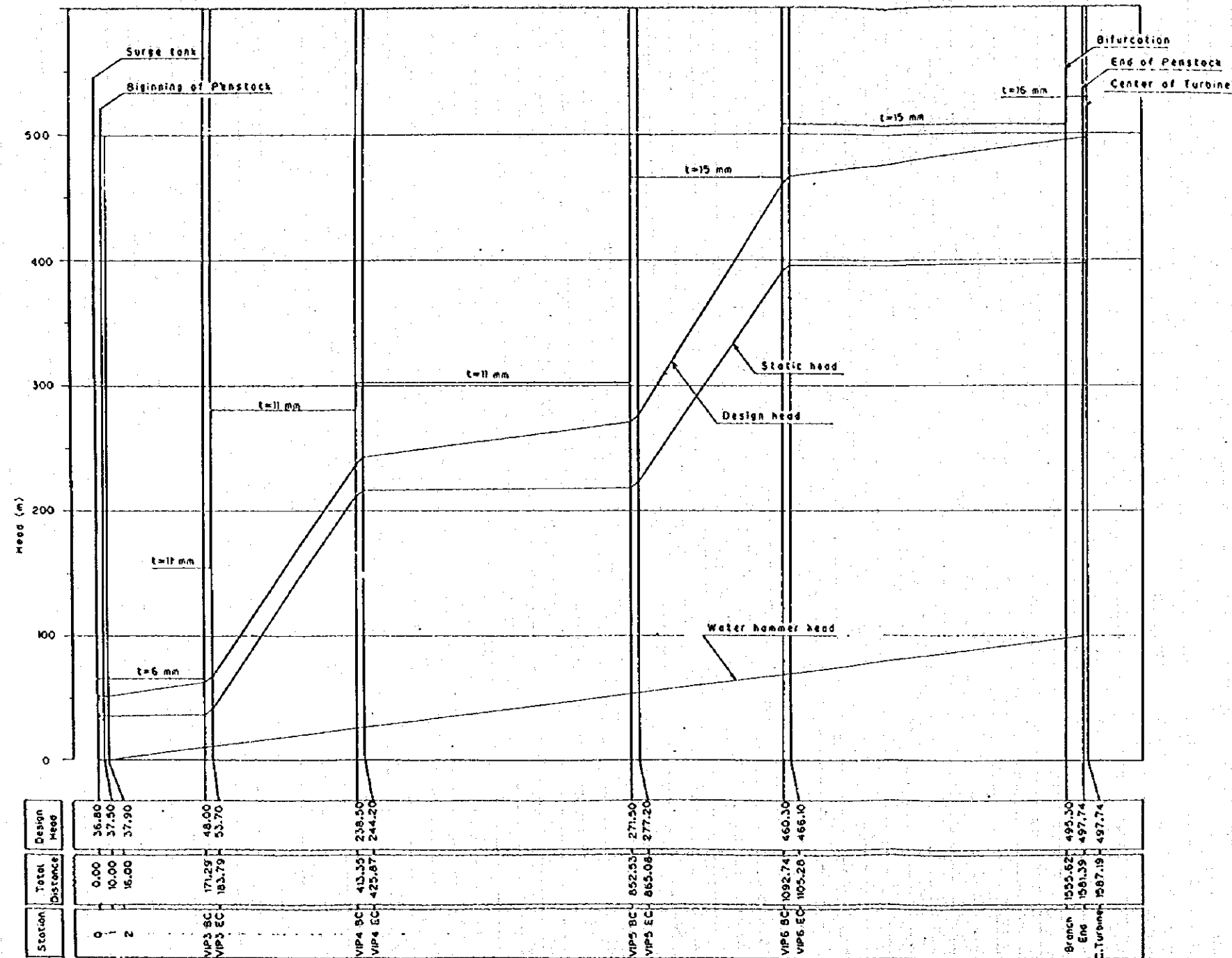
$$\lambda = 0.9636 / 1.6107 = 0.483 = 45\%$$

$$\text{分子} = 0.9650 \quad \text{分母} = 1.9984$$

In case of 50.000 Kg/cm<sup>2</sup> Of  $E_g$ ,  $\lambda$  becomes 60 %.







Specification

Maximum discharge	27.00 m <sup>3</sup> /sec
Maximum static head	397.90 m
Water hammer (at Turbine)	99.50 m
Closing time	12.00 sec
Material	
Allowable tensile stress	2.400 Kg/cm <sup>2</sup>
Welding efficiency	95 %
Corrosion allowance	1.50 mm

Fig. 11-6 Penstock Steel Liner Design Diagram

ENVIRONMENT

(環境)

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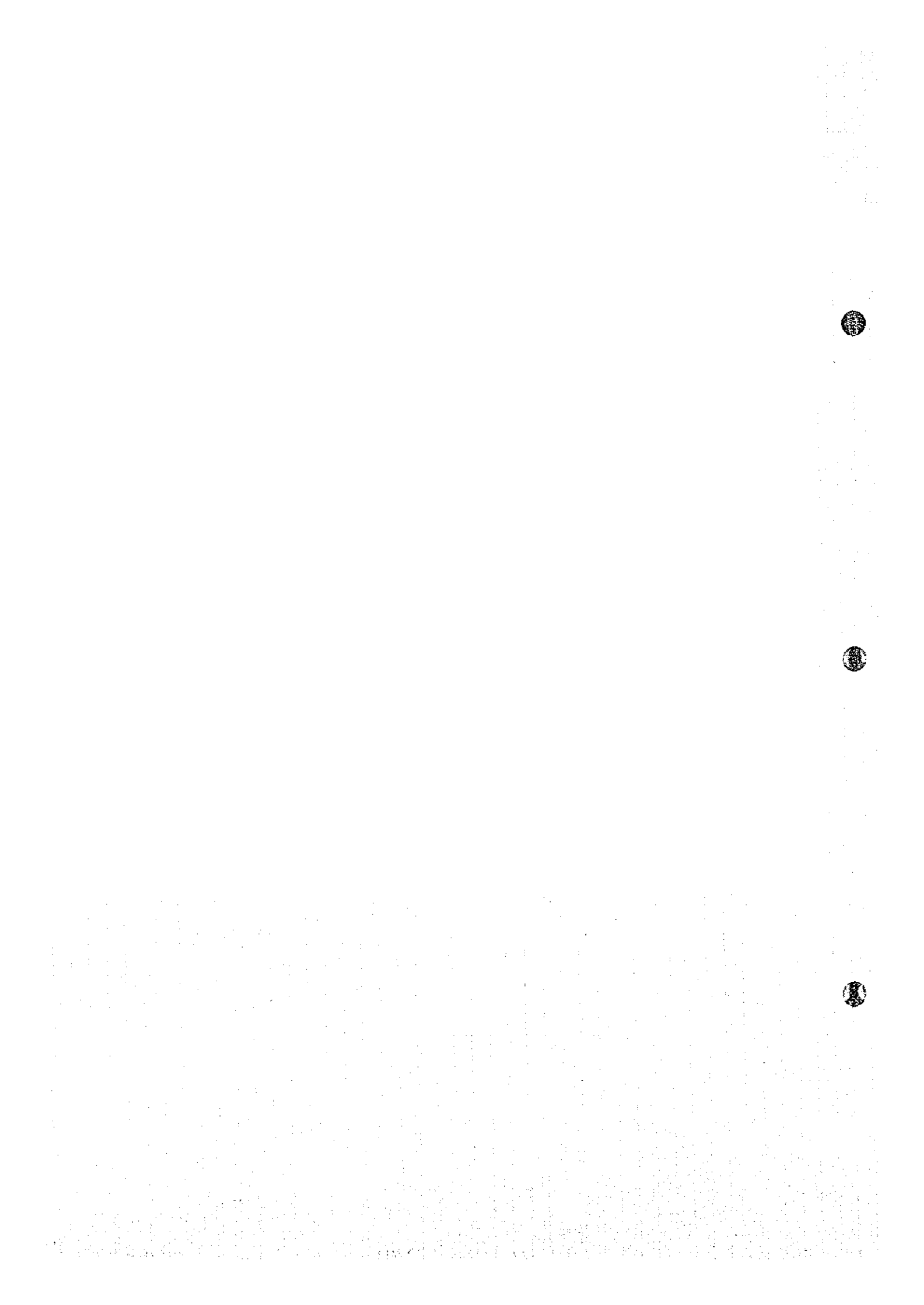
ENVIRONMENT

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## Appendix List

- Appendix 1 Type of Organisms Living in river Mouth
- Appendix 2 Type of Organisms Living in Sea at Manuel Antonio National Park
- Appendix 3 Living Organisms in Shallow Sea at Manuel Antonio National Park
- Appendix 4 Type of Organisms Living in Coastal Area at Manuel Antonio National Park
- Appendix 5 Living Organisms in Beach at Manuel Antonio National Park
- Appendix 6 Type of Sea Fish in Manuel Antonio National Park
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- Appendix 9 Living Organisms in Estuary at Manuel Antonio National Park
- Appendix 10 Species of Marine Migratory Animals
- Appendix 11(a) Salinity in Estero Negro
- Appendix 11(b) Salinity in Estero Negro
- Appendix 11(c) Salinity in Estero Negro
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- Appendix 12 General Composition of Vegetation in Manuel Antonio National Park
- Appendix 13 Endangered Species List and Actual Status
- Appendix 14 Species Found at the Mouth and Basins of Naranjo and Paquita Rivers
- Appendix 15 Endangered Species at the Mouth and the Basins of Naranjo and Paquita Rivers
- Appendix 16 Protected and Endangered Species of Paquita and Naranjo Mouth after the Wildlife Division



Appendix 1 Type of Organisms Living In river Mouth

Family	Species	Spanish name
		PECES
Engraulidae	<u>Anchoa lucida</u> *	"anchoa"
"	<u>Anchoa starksi</u>	"
Aihevinidae		"gruñon"
Clupeidae	<u>Neopisthopterus tropicus</u>	"sardina"
"	<u>Opisthorema libertate</u>	"Sardina gallera"
Exocoetidae	<u>Hyporhamphus unifasciata</u>	"picuda"
Soleidae	<u>Achirus nazatlanus</u>	
Haemulidae	<u>Pomadasys macracanthus</u>	"chinita"
Lutjanidae	<u>Lutjanus novemfasciatus</u>	"pargo roqueo ro"
"	<u>Lutjanus evatus</u>	"pargo"
"	<u>Lutjanus argentiventris</u>	"pargo amarillo"
Mugilidae	<u>Mugil curema</u> *	"lisa"
Carangidae	<u>Trachinotus culvevi</u> *	"la palometa"
"	<u>Trachirotus kennedyi</u>	"pompano"
"	<u>Oligoplites saurus</u> *	"sardina gallera"
"	<u>Selene oerstedii</u>	"palometa con cabeza curva"
"	<u>Caranx hippos</u>	"jurel"
Gerreidae	<u>Eucinostomus</u> sp.	"parguito blanco"
Poeciliidae	<u>Poeciliopsis turbarensis</u> *	"alunina"
"	<u>Poecilia gilli</u>	
Polynemidae	<u>Polydactylus approxinans</u>	"bobo"
Eleotridae	<u>Gobionorus</u> sp.	
Centropomidae	<u>Centropomus</u> sp.	"robato"
Cyprinodontidae	<u>Oxzygonectus dovii</u>	"ojo blanco"
Coenobitidae	<u>Coenobita complessus</u> (Milne - Edwards)	"hermitanio"

(Continue)

Diogenidae	<u>Clibarius panamensis</u> Stimpson	"
Ocypodidae	<u>Uca stenodactylus</u>	"el surdo"
Portunidae	<u>Callinectes arcuatus</u> Ordway	"jaiba del estero"
	<u>Portunus xantusi affinis</u> Faxon	
Palaemonidae	<u>Macrobrachium tenellum</u> Smith	"langostino"
Ostreidae	<u>Ostrea palmula</u> Carpenter	
Arcidae	<u>Anadara tuberculosa</u>	"piangua"
"	<u>Anadara grandis</u>	"chucheca"



Appendix 2 Type of Organisms Living In Sea at Manuel Antornio National Park

Family	Species	Spanish name
		PECES
Tetraodontidae	<u>Sphoeroides annulatus</u>	"tinboril"
Sciarnidae	<u>Uabrina xanti</u>	
"	<u>Neuticirrhus panamensis</u>	"corvina"
"	<u>Ophloseion sp.</u>	
"	<u>Polydaetylos sp.</u>	"bobo"
Batrachoididae	<u>Batrachoides boulangeri</u>	"perro"
Triglidae	<u>Prionatus rosearius</u>	"lapon"
Sphyrnidae	<u>Sphyrna lewini</u>	"martillo"
Carangidae	<u>Selene peruana</u>	
Stromateidae	<u>Peprilus sp.</u>	
Carangidae	<u>Oligoplites refulgens</u>	"pompano"
Grammistidae	<u>Rypticus nigriponnis</u>	"jaboncillo"
Torpedinidae	<u>Narcine entenador</u>	
Urolophidae	<u>Urotygon aspidurus</u>	
Soleidae	<u>Achirus seutum</u>	
"	<u>Achirus fimbriatus</u>	
"	<u>Achirus sp.</u>	
Bothidae	<u>Cyclopsetta querna</u>	
Ephippidae	<u>Chaetodipterus zonatus</u>	
Congridae	<u>Ariosoma prorigera</u>	
Xenichthyidae	<u>Xenichthys xanti</u>	
Clupeidae	<u>Opisthopterus dovii</u>	"sardina"
"	<u>Neopisthopterus tropicus</u>	"sardina"
"	<u>Harengula thrissina</u>	"sardina"
"	<u>Harengula peruana</u>	"sardina"
	<u>Opisthonema libertate</u>	"gallera"
Congridae	<u>Ariosoma prorigera</u>	
Engraulidae	<u>Anchovia macrolepidota</u>	"anchoa"
Atherinidae		
Lutjanidae	<u>Lutjanus aratus</u>	"pargo"

(Continua)

		CRUSTACEOS
	<u>Panotirus</u> sp.	"langosta"
Penaeidae	<u>Penaeus stylirostris</u> Stimpson	"canaron blanco"
"	<u>Penaeus brevirostris</u> Kingsley	"canaron rosado"
"	<u>Sicyonia affinis</u> Burkenroad	
"	<u>Sicyonia disdorsalis</u> Burkenroad	
"	<u>Solenocera</u> sp.	"fidel"
"	<u>Trachyponeus byrdi</u> Burkenroad	"cebra"
Penaeidae	<u>Xiphopenacus riveti</u> Bouvier	"titi"
"	<u>Trachypenacus fuseina</u> Perez - Fafante	
Leucosiidae	<u>Persephone edwardsi</u>	
Majidae	<u>Nodoclea boneti buitendijk</u> Holthuis	
"	<u>Stenorhyncus debilis</u> Salth	
Diogenidae	<u>Dardanus sinistripes</u> Stimpson	"Hermitanio"
Dromiidae	<u>Platypodia</u> sp.	
Portunidae ( 寄居蟹 )	<u>Callinectes arcuatus</u> Ordway	"jaiba del mar"
	<u>Euphylax vobustus</u> A. Milne Edwards	"jaiba del mar"
"	<u>Portunus xantusi affinis</u> Faxon	"jaiba del es tero"
Squillidae	<u>Squilla nantoidea</u> Bigelow	"alacran del mar"
Lepididae	<u>Lepas (anatifera)</u>	

Appendix 3 Living Organisms in Shallow Sea at Manuel Antonio National Park

Family	Species	Spanish name
Pomacentridae	<u>Abudefduf concolor</u> <u>Abudefduf troschelii</u>	PECES Sacapilla
Labrisomidae	<u>Malacoctenus zonifer</u>	
Gobiidae	<u>Evorthodus breviceps</u>	Saltador
Gobiesocidae	<u>Gobiesox</u> sp.	
Scorpaenidae	<u>Scorpaena</u> sp.	
Holocentridae	<u>Adioryx suborbitalis</u>	
Ophichthidae	<u>Apterichthys</u> sp.	Aguila
Aplysiidae	<u>Dolabrifera dolabrifera</u> Rang	MOLUSCOS
Chitonidae	<u>Chiton stokesii</u> Broderip	
Neritidae	<u>Nerita scabricosta</u> Lamarck <u>Nerita funiculata</u> Menke	
Thaididae	<u>Acanthina brevidentata</u> Wood <u>Thais speciosa</u> Valenciennes	
Aiptasiidae	<u>Zooanthus</u> sp.	ANEMONAS
Diogenidae	<u>Calcinus obscurus</u> Stimpson <u>Clibanarius albidigitus</u> Nobili	CRUSTACEOS Hermitaño Hermitaño
Echinometridae	<u>Echinometra vanbranti</u>	EQUINODERMO Erizo negro
Diadematidae	<u>Diadema mexicanum</u>	Erizo

(Continue)

Family	Species	Spanish name
Heritidae	<u>Herita scabricosta</u> Lamarck <u>Herita funiculata</u> Menke	MOLUSCOS Burgado Burgado
Siphonariidae	<u>Sinophonaria palmata</u> Carpenter <u>S. naura</u> Sowerby <u>S. gigas</u> Sowerby	Casco de burro Casco de burro Casco de burro
Acmaeidae	<u>Collisella pediculus</u> (Philippi) <u>Scurria nesoleuca</u> Menke <u>S. stipulata</u> Reeve	
Fissurellidae	<u>Fissurella microtremis</u> sowerby <u>Fissurella virescens</u> sowerby <u>Littorina modesta</u> Philippi	Casco de burro con huecos
Littorinidae	<u>Tequta pellisserpentis</u> Wood	
Trochidae	<u>Thais biserialis</u> Blainville <u>Thais speciosa</u> Valenciennes	
Thaididae	<u>Thais melones</u> Duclos <u>Purpura pansa</u> Gould <u>Purpura collumeralis</u> Lamarck <u>Acanthina brevidentata</u> Wood <u>Brachydontes senitaevis</u> Menke	
Mytilidae	<u>Chiton stokesii</u> Broderip	
Chitonidae	<u>Chama echinata</u> Broderip	
Chamidae	<u>Ostrea palmula</u> Carpenter	
Ostreidae	<u>Cantharus ringens</u> Keve <u>Cantharus elegans</u> Griffith Pidgeon <u>C. saquinolentus</u> Duclos	
Buccinidae	<u>Crucibulum scutellatum</u> Wood <u>Crucibulum umbrella</u> Deshayes	
Calyptraeidae	<u>Cerithium maculosum</u> Kiener	
Cerithiidae		
Cypraeidae	<u>Cypraea annettae</u> Dall	
Ovulidae	<u>Janneria pustulata</u> Lightfoot	
Conidae	<u>Conus diadema</u> sowerby <u>C. arcuatus</u> Broderip & Sowerby	

(Continue)

Family	Species	Spanish name
Columbellidae	<u>Columbella paytonensis</u> Lesson <u>Columbella strombiformis</u> Lamarck <u>Anachis nigricans</u> Sowerby <u>Anachis bolvini</u> Lkiener	
Planaxidae	<u>Planaxis planicostatus</u> Sowerby	
		CRUSTACEOS
Balanidae	<u>Balanus</u> sp.	
Cuthonellidae	<u>Cuthonellus fissus</u> Darwin <u>C. panamensis</u>	
Tetraclitidae	<u>Tetraclita stalactifera</u> Darwin	
Alpheidae	<u>Alpheus</u> sp.	
Grapsidae	<u>Grapsus grapsus</u> Linnaeus <u>Geograpsus lividus</u> Milne-Edwards <u>Cyclograpsus escondidensis</u> Rstbun <u>Pachygrapsus transversus</u> Gibbers	
Porcellanidae	<u>Pachycheles stimanus</u> Lockington <u>Clastocheilus diffractus</u>	
Xanthidae	<u>Ata</u> <u>dovii</u> Stimpson <u>Eriphia squamata</u> Stimpson <u>Eriphiades hispida</u> Stimpson <u>Eurytium affine</u> Streets & Kingsley	
Ligiidae	<u>Ligia</u> sp.	Isopodo
		POLIQUETOS
Sabellaariidae	<u>Phragmatopoma attenuata</u> Hartman <u>Idanthyrus</u> sp.	
Glyceridae	<u>Henipodus roseus</u> Quatrefages	
Amphinomidae	<u>Eurythoe complanata</u> Pallas	
Nereidae	<u>Pseudonereis variegata</u> Grube	
Porcellanidae	<u>Petrolisthes edwardsii</u> Saussure <u>P. lewisi austrinus</u> Haig	
Porcellinidae	<u>Neopisona mexicanum</u> Streets	
Eunicidae	<u>Palolasicyliensis</u> Grube <u>Eunica reducta</u> Fauchald	
Onuphidae	<u>Diopatra</u> sp.	



(Continue)

Family	Species	Spanish name
	<u>Gelidium pusillum</u> <u>Gracilaria sp.</u> <u>Galaxaura filamentosa</u> <u>Catenella impudica</u> <u>Laurencia sp.</u> <u>Hypnea panosa</u> <u>Bostrychia radicans</u> <u>Bostrychia sp.</u> <u>Ceramium gracillium</u> <u>Ceramium clarionense</u> <u>Ceramium sinicola</u> <u>Asparagopsis taxiformis</u> <u>Heterosiphonia sp.</u> <u>Herposiphonia sp.</u> <u>Polysiphonia sp.</u> <u>Arcthamnion antillarum</u> <u>Friffithsia tenuis</u> <u>Callithamnion rupicolum</u> <u>Spyridia filamentosa</u>	

Appendix 4 Type of Organisms Living In Coastal Area at Manuel Antonio National Park

Family	Species	Spanish name
Pomacentridae	<u>Abudefduf concolor</u>	PECES
	<u>Abudefduf troschelli</u>	"Sacapilla"
Labrisomidae	<u>Malacoctenus zonifer</u>	
Gobiidae	<u>Evorthodus breviceps</u>	
Gobiesocidae	<u>Gobiesox sp.</u>	"Saltador"
Scorpaenidae	<u>Scorpaena sp.</u>	
Holocentridae	<u>Adioryx suborbitalis</u>	
Ophichthyidae	<u>Apterichthus sp.</u>	"Anguila"
		MOLUSCOS
Aplysiidae	<u>Dolabrifera dolabrifera</u> Rang	
Chitonidae	<u>Chiton Stakesii</u> Broderip	
Neritidae	<u>Nerita scabricosta</u> Lamarck	
	<u>Nerita funiculata</u> Menke	
Thaididae	<u>Acanthina brevidentata</u> Wood	
	<u>Thais speciosa</u> Valenciennes	
		ACTINIAS
Aiptasiidae	<u>Zooanthus sp.</u>	
		CRUSTACEOS
Dioyenidae	<u>Calcinus obscurus</u> Stimpson	"Hermitanio"
	<u>Clibanarius albidigitus</u> Nobili	"Hermitanio"
Echinometridae	<u>Echinometra vanbranti</u>	"Erizo negro"
Diadematidae	<u>Diadema mexicanum</u>	"Erizo"



( Continue)

Family	Species	Spanish name
		MOLUSCOS
Neritidae	<u>Nerita scabricosta</u> Lamarck	"Burgado"
	<u>Nerita funiculata</u> Menke	"Burgado"
Siphonariidae	<u>Siphonaria palmata</u> Carpenter	"Casco de burro"
"	<u>S. naura</u> Sowerby	"
"	<u>S. gigas</u> Sowerby	"
Acmaeidae	<u>Collisella pediculus</u> (Philippi)	
	<u>Scurria mesoleuca</u> Menke	
	<u>S. stipulata</u> Reeve	
Fissurellidae	<u>Fissurella microtrema</u> Sowerby	"Casco de burro con hueco"
"	<u>Fissurella vivescens</u> Sowerby	"
Littorinidae	<u>Littorina modesta</u> Philippi	
"	<u>Littorina aspera</u> Philippi	
Trochidae	<u>Tegula pelliserpentis</u> Wood	
Thaididae	<u>Thais biserialis</u> Blainville	
"	<u>Thais speciosa</u> Valenciennes	
"	<u>Thais melones</u> Duclos	
"	<u>Purpura pansa</u> Gould	
"	<u>Purpura collumeralis</u> Lamarck	
"	<u>Acanthina brevidentata</u> Wood	
Nytilidae	<u>Brachy dentes semilaevis</u> Menke	
Chitonidae	<u>Chiton stokesii</u> Broderip	
Chamaidae	<u>Chama echinata</u> Broderip	
Ostreidae	<u>Ostrea palma</u> Carpenter	

(Continue)

Family	Species	Spanish name
Buccinidae	<u>Cantharus ringens</u> Keene	
"	<u>Cantharus elegans</u> Griffith Pidgen	
"	<u>C. sanguinolentus</u> Duclos	
Calyptraeidae	<u>Crucibulum sentellatum</u> Wood	
"	<u>Crucibulum umbrella</u> Deshayes	
Cerithiidae	<u>Cerithium maculosum</u> Kiener	
Cypracidae	<u>Cypraea annettae</u> Dall	
"	<u>Jenneria pustulara</u> Lightfoot	
Conidae	<u>Conus diadema</u> Sowerby	
"	<u>C. arcuatus</u> Broderip & So- werby	
Columbellidae	<u>Columbella paytensis</u> Lesson	
"	<u>Columbella strobiliformis</u> Lamarck	
"	<u>Anachis nigricans</u> Sowerby	
"	<u>Anachis boivini</u> Kiener	
"	<u>Planaxis planicostata</u> Sowerby	

(Continue)

Family	Species	Spanish name
		CRUSTACEOS
Balanidae	<u>Balanus</u> sp.	
Cuthanalidae	<u>Chthamalus fissus</u> Darwin	
"	<u>C. panamensis</u>	
Tetraclitidae	<u>Tetraclita stalactifera</u> Darwin	"Saca bocado"
Alpheidae	<u>Alpheus</u> sp.	
Grapsidae	<u>Grapsus grapsus</u> ' Linnaeus	"la marinera"
"	<u>Geograpsus lividus</u> Milne - Edwards	
"	<u>Cyclograpsus escondidensis</u> Rathbun	
"	<u>Pachygrapsus transversus</u> Gibbers	
Porcellanidae	<u>Pachycheles setimanus</u> Lockington	
"	<u>Glastotoechus diffractus</u>	
Xanthidae	<u>Actae dovii</u> Stimpson	
"	<u>Eriphia squamata</u> Stimpson	
"	<u>Eriphides hispida</u> Stimpson	
"	<u>Eurytium affine</u> Streets & Kingsley	
Ligiidae	<u>Ligia</u> sp.	"la cucaracha"
		POLYCHAETES
Sabellariidae	<u>Phragmatopoma attenuata</u> Hartman	
"	<u>Idanthesis</u> sp.	
Glyceridae	<u>Henipodus roseus</u> Quatre- fages	
Amphinomidae	<u>Eurythoe complanata</u> Pallas	
Nereidae	<u>Pseudonereis vavilata</u> Grube	

(Continue)

Family	Species	Spanish name
Porcellanidae	<u>Petrolisthes edwardsii</u> Saussure	
"	<u>P. lewisi austrinus</u> Haig	
	<u>Neopisona mexicanum</u> Stree Streets	
Eunicidae	<u>Palolasiciliensis</u> Gruba	
"	<u>Eunice reducta</u> Fauchald	
Onuphidae	<u>Diopatra</u> sp.	
Holothuriidae	<u>Selenkothuria</u> sp.	"pepino"
( 海胆科 )	<u>Holothuria lubrica</u>	"pepino"
Echinometridae	<u>Echinometra vanbrunti</u>	"herizo ne- gro"
Diadematidae	<u>Diadema mexicanum</u>	"herizo"
	<u>Bostrychia binderi</u> Harvey	
	<u>Cladophora (prolifera)</u> Kutzing	
	<u>Antithamnion dumontii</u>	
	<u>Polysiphonia ferulacea</u> Suhr	
	<u>Amphiroa</u> sp.	
	"Coralline red alga"††	
	<u>Bryopsis pennata</u> Lamouroux	

(Continue)

Family	Species	Spanish name
Rhizophoraceae	<u>Rhizophora mangle</u> Linnaeus	Mangle colorado
Avicenniaceae	<u>Avicennia germinans</u> L.	Mangle salado
Combretaceae	<u>Laguncularia racemosa</u> L.	Mangle blanco mariquita
Theaceae	<u>Pelliciera rhizophorae</u> Plan. & Thiana	Mangle pinuela
	<u>Acrosticum aureum</u>	
	<u>Boottlopsis verticillata</u> Dawson	
Guapsidae	<u>Aratus pisonii</u> Milne- Edwards	
"	<u>Goniopsis pulchra</u> Lockington	
"	<u>Tetragrapsus jouyi</u> Rathbun	
"	<u>Sesarma</u> sp.	
Gecarcinidae	<u>Gecarcinus (planatus)</u>	
Ocypodidae	<u>Uca musica</u> Rathbun	"El surdo"
"	<u>Uca galapagensis</u> Milne- Edwards & Lucas	"
Diogenidae	<u>Clibanarius panamensis</u> Stimpson	"Hermitanio"
Balanidae	<u>Balanus</u> sp.	
Potamididae	<u>Cerithidea mazatlanica</u> Car- penter	
"	<u>Cerithidea nantagnei</u> Orbigny	
Cerithiidae	<u>Cerithium maculosum</u> Kiener	
Neritidae	<u>Theodoxus luteofasciatus</u> Miller	

Appendix 5 Living Organisms in Beach at Manuel Antonio National Park

Family	Species	Spanish name
Scaridae	<u>Scarus compressus</u>	"loro"
"	<u>S. perico</u>	"guacamaya - perico"
"	<u>S. rubroviolacens</u>	"perico"
Cirrihitidae	<u>Cirrhitis rivulatus</u>	
Scorpaenidae	<u>Scorpaena mystes</u>	"el cullero"
Dalistidae	<u>Pseudobalistes naufragium</u>	"chancho"
"	<u>Balistes polylepis</u>	"
Tetraodontidae	<u>Spheroides annulatus</u>	"tinboril"
Diodontidae	<u>Diodon holocentrus</u>	"pez erizo"
Acanthuridae	<u>Prionurus punctatus</u>	"pez cirujano"
"	<u>Acanthurus yanthopterus</u>	
"	<u>A. glaucopareius</u>	
Pomacentridae	<u>Enpomacentrus rectifraenum</u>	"mojarra del mar"
"	<u>Microspathodon dorsalis</u>	"
"	<u>Chromis atrilobata</u>	"castaneta"
"	<u>Abudefduf troschelii</u>	"chopa"
"	<u>Eupomacentrus flavilatus</u>	
"	<u>Nexilarius concolor</u>	
Lutjanidae	<u>Lutjanus argentiventris</u> Peters	"pargo amarillo"
"	<u>L. novemfascianus</u> Gill	"pargo roquero"
"	<u>Lutjanus viridis</u> Valenciennes	
Ostraciontidae	<u>Ostra melagris</u> Shaw	
Labridae	<u>Thalassoma lucasanum</u> Gill	"arco iris"
"	<u>Pseudojulis notospilus</u> Günther	"cocinero"
"	<u>Thalassoma lutescens</u> Layard Pennett	
"	<u>Bodianus diplotaenia</u> Gill	"vleja"

(Continuo)

Family	Species	Spanish name
Chaetodontidae	<u>Chaetodon humeralis</u> Gunther	"muñeca"
"	<u>Heniochus nigrirostris</u> Gill	"barbero"
"	<u>Chaetodon falcifer</u> Hubbs & Rehnitz	
"	<u>Forcipiger flavissimus</u> Jordan & Mc Gregor	
Pomacanthidae	<u>Pomacanthus zonipectus</u> Gill	"angel"
"	<u>Holocanthus passer</u> Valenciennes	"angel real"
Kyphosidae	<u>Kyphosus elegans</u> Peters	"vieja"
Mullidae	<u>Mulloidichthys dentatus</u> Gill	
Sparidae	<u>Calamus brachysomus</u> Lockington	
Haemulidae	<u>Haemulon sexfasciatum</u> Gill	"chinita"
"	<u>H. flavigattatum</u> Gill	"
"	<u>A. taeniatus</u> Gill	"
"	<u>Anisotrenus interruptus</u> Gill	"
Serranidae	<u>Epinophelus analogus</u> Gill	"venado"
"	<u>Paralabrax maculatofasciatus</u> Steindachner	"cabrilla de roca"
Muraenidae	<u>Gymnothorax castaneus</u> Jordan & Gilbert	"morena verde"
	<u>Muraena lentiginosa</u> Jenyns	"morena pinta"
Grammistidae	<u>Rypticus</u> sp.	"pez jabon"
Carangidae	<u>Caranx hippos</u> Linnacus	"jurel"
Trypterygiidae	<u>Ixocinus carinalis</u>	
Holocentridae	<u>Myripristes priognathus</u> Valenciennes	"soldado"
"	<u>Adioryx suborbitalis</u> Gill	"ardilla"
Acanthuridae	<u>Zonclus canexens</u> Lln.	"idolo negro"

(Continue)

Family	Species	Spanish name
	<u>Phopaldea birkelandi</u> Tokioka	"TUNICATO"
	<u>Pyura sp. aff vittata</u> Stimpson	
	<u>Pyura sp. 1</u>	
	<u>Pyura (chilensis)</u>	
	(unidentified)	
Palinuridae	<u>Panuliris sp.</u>	"langosta"
Diagenidae	<u>Clibanarius diguet</u> Bouvier	"hermitanio"
"	<u>Clibanarius sp. 1</u>	"
"	<u>Aniculus elegans</u> Stimpson	"
"	<u>Trizopagarus magnificus</u> Bouvier	"
	<u>Lysmata sp.</u>	
Gonodactylidae	<u>Gonodactylus zachae</u> Manning	"alacran"
Squillidae	<u>Neiosquilla oculinova</u> Glas- ssel	
Maiidae	<u>Stenorhynchus debilis</u> Smith	
Alpheidae	<u>Alpheus websteri</u> Kingsley	
Palaemonidae	<u>Pontonia margarita</u> Smith	
Nithrodiidae	<u>Nidorellia armata</u> Gray	"estrella"
Ophidiasteridae	<u>Pharia pyramidata</u> Gray	
"	<u>Phataria unifascialis</u> Gray	
"	<u>Oreaster occidentalis</u> Verrill	
Cidaridae	<u>Eucidaris thouarsii</u> Valencienns	"erizo sin espinas"
Echinometridae	<u>Echinometra vanbrunti</u> Agassiz	"erizo negro"
Diadematidae	<u>Diadema mexicanum</u> Agassiz	"erizo"
Ophioconidae	<u>Ophiocona aethiops</u> Lutken	"estrella - quebradiza"



(Continue)

Family	Species	Spanish name
Stichopodidae	<u>Isostichopus fuscus</u> Ludwig	"papino del mar"
	<u>Cucumaria californica</u>	"
	<u>Ophocheila mirabilis</u>	"estrella quebradiza"
	<u>Ophiactis simplex</u>	"
	<u>Ophiactis savignyi</u>	"
	<u>Ophiatrix spiculata</u>	"
		ALRAS
	<u>Cladophoropsis</u> sp.	
	<u>Hypnea pannosa</u> J. Agardh	
	<u>Padina crispata</u> Thivy	
	<u>Dictyota Stolonifera</u>	
	<u>Asparagopsis taxiformis</u> Trevisan (Falkenbergia phase)	
	<u>Bryopsis pennata</u> Lamouroux	
	<u>Ceramium hematispinum</u> Dawson	
	<u>C. Flaccidum</u> (Kutzing) Ardissone	
	<u>Centroceras claunatum</u> (Agardh)	
	<u>Herposiphonia tenella</u> (Agardh) Schmit	
	<u>Tachiona nanum</u> Papenfuss	
	<u>Antithanion</u> sp.	
	<u>Antithanion breviramosus</u> Dawson	
<u>Callithanion</u> sp.		
<u>Anphiroa</u> sp.		
<u>Halimeda discoidea</u> Decaisne		
<u>Scinaia setchellii</u> Taylor		
		CORALES
Gorgoniidae	<u>Lophogorgia alba</u> Duch & Mich	

(Continue)

Family	Species	Spanish name
Gorgoniidae	<u>Pacifigorgia ivens</u> <sup>4</sup> Bayer	"Abanico"
"	<u>Pacifigorgia cribrum</u> Valenciennes	"
"	<u>Pacifigorgia</u> sp. 1	"
"	<u>Lophogorgia</u> sp. 1	"
"	<u>Eugorgia multifida</u> Verrill	"Abanico"
"	<u>Muricea californica</u> <sup>4</sup>	"
"	<u>M. fructicosa</u> Verrill	"
"	<u>M. retusa</u> <sup>4</sup>	"
"	<u>Muricea (purpurea)</u>	"
"	<u>M. echinata</u> Valenciennes	"
"	<u>Muricea</u> sp.	"
"	<u>Muricela</u> sp.	"
"	Hard corals (Scleractinian corals)	"
Agariciidae	<u>Pavona varians</u> Verrill	"coral duro"
"	<u>Pavona gigantea</u> Verrill	"
"	<u>Pavona</u> sp. 1	"
Poritidae	<u>Porites</u> sp. 1	"
Thamneriidae	<u>Stephanaria stellata</u> Verrill	"
Pocilloporidae	<u>Pocillopora danicornis</u> Lin	"
Dendrophylliidae	<u>Tubastrea tennilamellosa</u> <sup>4</sup>	"
Caryophylliidae	"	"
		Moluscos
Conidae	<u>Conus gladiator</u> Broderip	"
"	<u>Conus diadema</u> Sowerby	"
Cypraeidae	<u>Cypraea annettae</u> Dall	"
Conidae	<u>Conus arenatus</u> Broderip & Sowerby	"
"	<u>Conus princeps lineolatus</u> Valenciennes	"

(Continue)

Family	Species	Spanish name
Fasciolaridae	<u>Opeatostoma pseudodon</u> Burrow	
Muricidae	<u>Muricanthus vadix</u> Gmelin	
"	<u>Muricanthus princeps</u> Broderip	
"	<u>Hexaplex regius</u> Swainson	
Olividae	<u>Oliva splendidula</u> Sowerby	
Ovulidae	<u>Sinnia rufa</u> Sowerby	
Strombidae	<u>Strombus galeatus</u> Swainson	"cambute"
"	<u>Strombus gracilior</u> Sowerby	
Vasidae	<u>Vasum caestus</u> Broderip	
Turnidae	<u>Crassispira xanti</u> Hartlein & Strong	
"	<u>Doxospira hartleini</u> Shasky	
Thaididae	<u>Thais kiosquiferans</u> Duclos	
		<u>SPONGES</u>
Dendroceratidae	<u>Dendrilla verongiformes</u>	
Axionellidae	<u>Axionella</u> sp.	
Microcionidae	<u>Microciona</u> ' sp.	
Dysidiidae	<u>Dysidea</u> sp.	
Axionellidae	<u>Pseudaxinella</u> sp.	
Aplysinidae	<u>Saenospongia</u> sp.	
Aplysillidae	<u>Aplysilla</u> sp. <u>Chelonaplysilla</u> sp.	
Euryponidae	<u>Eurypon</u> sp.	
Hymenocidonidae	<u>Ulosa</u> sp.	
Polynoidae	<u>Halosyana jahnsoni</u> Darboux	
Amphinonidae	<u>Eurythoe complanata</u> Pallas	
Eunicidae	<u>Eunice antennata</u> Savigny	
Glyceridae	<u>Glycera</u> sp.	
Pluxulariidae	<u>Aglaophenia</u> sp.	"hilo de oro"
Campanulariidae		

## Appendix 6

## Type of Sea Fish In Manuel Antonio National Park

Family	Species	Spanish name
Scaridae	<u>Scarus compressus</u> <u>S. perrico</u> <u>S. rubroviolacens</u>	Loro Guacamaya-perico Perico
Cirrihitidae	<u>Cirrhites rivulatus</u>	
Scorpaenidae	<u>Scorpaena mystes</u>	El cullero Chancho
Balistidae	<u>Pseudobalistes naufragium</u> <u>Balistes polytepis</u>	Tiaboril
Tetraodontidae	<u>Sphoeroides annulatus</u>	Pez erizo
Diodontidae	<u>Diodon holocanthus</u>	Pez cirujano
Acanthuridae	<u>Prionurus punctatus</u> <u>Acanthurus xanthopterus</u> <u>A. glaucopareus</u>	Mojarra de mar
Pomacentridae	<u>Eupomacentrus rectifraenum</u> <u>Microspathodon dorsalis</u>	Castanera
Pomacentridae	<u>Chronis atrilobata</u> <u>Abudefduf troschelli</u> <u>Eupomacentrus flavilatus</u> <u>Abudefduf concolor</u>	Chopa
Lutjanidae	<u>Lutjanus argentiventris</u> Peters <u>L. novemfasciatus</u> Gill <u>Lutjanus viridis</u>	Pargo amarillo Pargo roquero
Ostraciontidae	<u>Ostracion meleagris</u> Shaw	
Labridae	<u>Thalassoma lucasanum</u> Gill <u>Pseudojulis notospilus</u> Gunther <u>Thalassoma lutescens</u> Layard Pannett <u>Bodianus diplotaenia</u> Gill	
Labridae		

(Continue)

Family	Species	Spanish name
Chaetodontidae	<u>Chaetodon humeralis</u> Gunther	Muñeca
	<u>Heniochs nigrirostris</u> Gill	Barbero
	<u>Chaetodon falclfer</u> Hubbs & Rehnitzer	
	<u>Forcipiger flavissimus</u> Jordan & MC Gregor	
Pomacanthidae	<u>Pomacanthus zonipectus</u> Gill	Angel
	<u>Holocanthus passer</u> Valenciennes	Angel real
Kyphosidae	<u>Kyphosus elegans</u> Peters	
Nullidae	<u>Mulloidichthys dentatus</u> Gill	Vieja
Sparidae	<u>Calamus brachysonus</u> Lockington	
Haemulidae	<u>Haemulon sexfasciatum</u> Gill	
	<u>H. flaviquittatum</u> Gill	Chinita
	<u>Anisostromus interruptus</u> Gill	"
	<u>A. taeniatus</u> Gill	"
Serranidae	<u>Epinephelus analogus</u> Gill	
	<u>Paralabrax maculofasciatus</u> Steindachner	Venado
		Cabrita de roca
Muraenidae	<u>Gymnothorax castaneus</u> Jordan & Gilbert	Morena verde
Muraenidae	<u>Muraena lentiginosa</u> Jenyns	Morena pinta
Grammistidae	<u>Rypticus</u> sp.	Pez jabon
Carangidae	<u>Caranx hippos</u> Linnaeus	Jurel
Tripterygiidae	<u>Txocinus carminalis</u>	
Holocentridae	<u>Myripristis leioqmathos</u> Valenciennes	
Holocentridae	<u>Adioryx suborditalis</u> Gill	Soldado
Acanthuridae	<u>Zanclus canescens</u> L.	Ardilla
		Idolo moro

Appendix 7 Living Organisms In Sand Beach at Manuel Antonio National Park

Family	Species	Spanish name
		<b>MOLUSCOS</b>
Veneridae	<u>Chione californiansis</u> Broderip	"Mejillon"
Ficidae	<u>Ficus ventricosa</u> Sowerby	
Muricidae	<u>Muricanthus vadix</u> Gmelin	
Turritellidae	<u>Turritella leucostoma</u>	
Luidiidae	<u>Luidia columbia</u> Gray <u>Renilla amethystina</u>	"estrella"
Chaetopteridae	<u>Spirochaetopterus</u> sp.	
		<b>CRUSTACEOS</b>
Albuneidae	<u>Lepidopa</u> (mexicana)	"cuzucu"
Hippidae	<u>Enerita</u> sp.	"armadillo de mar"
Coenobitidae	<u>Coenobita compressus</u> Milne-Edwards	"hermitanio"
Ocypodidae	<u>Ocypode occidentalis</u> Stimpson	"el caballero"
Portunidae	<u>Portunus tuberculatus</u> Stimpson	"jaiba de playa"
"	<u>Aranaeus mexicanus</u>	"
Gecarcinidae	<u>Gecarcinus</u> (planatus)	"tijuacal"
Sautellidae	<u>Mellita longifissa</u> Michelin	"galleta"
"	<u>Encope grandis</u> Agassiz	"
Olividae	<u>Olivella senistriata</u> Gray	
"	<u>Agaronia testacea</u> Lamarck	
	<u>Exosphaerma linnatum</u>	
Cirolanidae	<u>Exeiolana braziliensis</u>	

(Continue)

Family	Species	Spanish name
Hippidae	<u>Enerita rathubunae</u> Shmitt	
Porcellanidae	<u>Orthocheta pumila</u> Glassel	
Pisionidae	<u>Pisionidens indica</u> * Aiyar & Alikunhi	
Orbinidae	<u>Scoloplos</u> sp.	
Glyceridae	<u>Hemipodus roseus</u> Quatrefages	
Olividae	<u>Olivella semistriata</u> Gray	
Donacidae	<u>Donay</u> sp.	

Appendix 8 Type of Invertebrate in Manuel Antonio National Park

Family	Species	Spanish name
<u>Clase Gastropoda</u>	<i>Cionella</i> sp.	Caracol
<u>Orden Araneae</u>		
Thomisidae	<i>Synema</i> sp. <i>Oxyptila</i> sp. <i>Misumenoides</i> sp.	Aranas Cangrejo
Salticidae	<i>Plexippus paykullii</i> <i>Menemerus bivittatus</i> <i>Cobanus extensus</i> <i>Cobanus</i> sp. <i>Thiodina</i> sp. <i>Thiodina</i> (prob. <i>sylvana</i> ) <i>Metaphidippus</i> sp.	Aranas
Araneidae	<i>Cyclosa</i> sp. <i>Leucauge</i> (prob. <i>venusta</i> ) <i>Microthema</i> (prob. <i>sagittata</i> ) <i>Eriophora</i> sp. <i>Drezilia</i> sp. <i>Gasteracantha cancriformis</i> <i>Verrucosa</i> sp. <i>Acacecia</i> sp. <i>Araeus</i> spp.	Aranas
Tetragnathidae	<i>Tetragnatha</i> sp. <i>Tetragnatha</i> (prob. <i>pullescens</i> )	Aranas
Dinopidae	<i>Dinopsis</i> sp.	Aranas
Selenopidae	<i>Selenops</i> sp. (prob. <i>mexicanus</i> )	" "
<u>Orden Scorpiones</u>		
Buthidae	<i>Centruroides</i> sp.	Escorpiones
<u>Orden Decapoda</u>		
<u>Palaemonidae</u>	<i>Macrobrachium</i> spp. <i>Macrobrachium tenellum</i> <i>Palaemon pandaliformis</i>	Cangrejos y Cangrones
Penaeidae	<i>Penaeus</i> (prob. <i>vanamei</i> )	
Grapsidae	<i>Sesarma</i> sp.	
Potamonidae	<i>Potamon carcinus</i>	



(Continue)

Family	Species	Spanish Name
Orden Odonata		Libelulas
Aeshnidae	Gynacantha mexicana Gynacantha nervosa Triacanthagyna (prob septima)	" "
Gomphidae	Aphylla caraiba	
Libellulidae	Erythrodiplax spp. Perithemis sp. Tholymis citrina Planiplex spp. Orthemis ferruginea Orthemis levis  Orthemis sp. Leptemis veiculosa Cannaphila angustipennis Micrathyria spp. Nephepeltia sp.	" " " "
Calopterygidae	Hetaerina sp.	"Gallegos"
Coenagrionidae	Ischnura spp.  Enallagma  Argia spp.	" " "
Pseudostigmatidae	Necistogaster ornata	
Orden Hemiptera		Chinches
Notonectidae	Buena spp.	Chinches acuaticos
Reduviidae	Apionerus sp.  Rasahus sp. Rasahus nanatus  Atrachus sp.	Chinches
Pyrrhocoridae	Hypselonotus (prob. atratus)	" "

(Continue)

Family	Species	Spanish Name
Coreidae	Leptoscelis tricolor	
	Hyalinenus sp.	
	Jadera sp.	
Pentatomidae	Edessa sp.	
	Edessa rufomarginata	
<u>Orden Homoptera</u>		Chicharras, chicharritas y afidos
Cicadidae	Fidicina pronoe	
	Fidicina sp. (prob. mannifera)	
	Quesada gigas	
	Proana spp.	
	Pacarina spp.	
Fulgoridae	Dychyophora spp.	
	Pherodes sp.	
<u>Orden Coleoptera</u>		Escarabajos
Cicindelidae	Cicindela sp.	" "
Carabidae	Calosphaena bicincta	" "
Staphylinidae	Schizochilus versicolor	" "
	Osorius sp.	" "
Passalidae	Passalus spp.	" "
	Aponelidas spp.	" "
Scarabacidae	Strategus julianus	" "
	Cyclocephala nigerrima	
	Cyclocephala sp.	
	Anomala spp.	
	Macraspis lucida	
Buprestidae		" "
Elateridae	Pyrophorus spp.	" "
Lampyridae	Photurus sp.	Candelillas
	Photinus sp.	Candelillas
Lycidae	Calopteron bifasciatum	
Languriidae	Calopteron sp.	
Erotylidae	Dasydactylus sp.	
	Aegithus spp.	Escarabajos
	Prepophorus xanthoaelas	" "

(Continue)

Family	Species	Spanish Name
Cerambycidae	Callipogon barbatum	Escarabajos
Chrysomelidae	Callichroma cosmicum	-
	Homophoea aequinoctialis	"
	Diabrotica adonis	-
		Mariposas
<b>ORDEN LEPIDOPTERA</b>		
Castnidae	Castnia sp.	-
Noctuidae	Ascalapha odorata	Mariposas nocturnas
Lycaenidae	Arawacus actolus	Mariposas
	Thecia coronata	-
Riodinidae	Mesosemia telegona	"
	Eurybia lycisca	-
Peridae	Phoebis philea	"
	Phoebis sennae	"
	Ascia monuste	-
	Eurena proterpia	-
	Eurena दौरा	-
	Eurena nice	-
	Eurena albula	-
Papilionidae	Papilio thoas	
	Parides Lycimenes	
	Parides childrenae	
	Parides iphidaunas	
	Battus polydamas	Mariposas
	Battus belus	-
Satyridae	Pierella luna	-
	Euptychia hernes	-
	Euptychia hesione	-
	Euptychia labe	-
	Taygetis androneda	-
Heliconiidae	Heliconius charitonius	-
	Heliconius erato	-
	Heliconius hecale	-
	Heliconius pacheus	-
	Heliconius hewitsoni	"
	Dryas julia	-
	Philaetria dido	-
	Dione juno	-
	Oryadula phaetusa	-
	Eueides olympia	-
	Dione moneta	-

(Continue)

Family	Species	Spanish Name
Ithoniidae	<i>Mechanitis isthmia</i>	"espejitos"
	<i>Tithorea tarracina</i>	--
	<i>Ithonia patilla</i>	--
	<i>Melinaea illus</i>	--
Nymphidae	<i>Myscelia ethusa</i>	Mariposas
	<i>Nymphidium ascolia</i>	--
	<i>Pseudonica flavilla</i>	--
	<i>Siprosta stelenes</i>	--
	<i>Physiodes liriopis</i>	--
	<i>Adelpha celerio</i>	--
	<i>Adelpha cocala</i>	--
	<i>Catonphele nyctinus</i>	--
	<i>Marpesia berania</i>	--
	<i>Colebura dirce</i>	--
	<i>Anartia fatina</i>	--
	<i>Anartia jatropha</i>	--
	<i>Chlosyne janais</i>	--
	<i>Chlosyne hyperia</i>	--
	<i>Junonia evarate</i>	--
	<i>Dynamine salpensa</i>	--
<i>Dynamine mylitta</i>	--	
Brassolidae	<i>Caligo memnon</i>	--
Morphidae	<i>Morpho peleides</i>	Morfos
<u>ORDEN DIPTERA</u>		Moscas y zancudos
Culicidae	<i>Toxorhynchytes</i> sp.	Zancudo
Stratiomyidae	<i>Hermetia illuscens</i>	Moscas
Tabanidae	<i>Tabanus</i> spp.	Tabanos
	<i>Chrysops</i> spp.	--
	<i>Esenbeckia</i> sp.	--
	<i>Dichelacera</i> sp.	--
Asilidae	<i>Panemasiulus</i> sp.	Moscas
	<i>Laphria</i> sp.	--
	<i>Pilica</i> sp.	--
	<i>Holococéphala</i>	--
Dolichopodidae	<i>Condylostylus</i> spp.	Moscas

(Continue)

Family	Species	Spanish Name
Syrphidae	<i>Volucella</i> spp.	Mascas
	<i>Ornidia obesa</i>	--
	<i>Ornidia</i> sp.	--
	<i>Eristalis agrorum</i>	--
	<i>Eristalis scutellaris</i>	--
Micropezidae	<i>Metopobranhia</i> spp.	Moscas
	<i>Micropeza</i> spp.	Moscas
Caliphoridae	<i>Lucilia</i> sp.	Moscas metaticas
	<i>Phaenicia</i> sp.	--
	<i>Callitroga macellaria</i>	--
	<i>Haemulucilia flavifacies</i>	--
<u>Orden Hymenoptera</u>		Avispas, abejas y
		Hornigas
Formicidae	<i>Ectatona tuberculatum</i>	Hornigas
	<i>Camponotus sericeiventris</i>	--
	<i>Camponotus</i> sp.	--
	<i>Pachycondyla impressa</i>	--
	<i>Pachycondyla villosa</i>	--
	<i>Gnaptogenys</i> sp.	--
	<i>Eciton burchelli</i>	--
	<i>Ecton anatum</i>	--
	<i>Atta cephalotes</i>	--
Vespidae	<i>Stelopolibia</i> sp.	Avispas
	<i>Trypoxylon</i>	--
	<i>Synoeca septentrionalis</i>	--
Sphecidae	<i>Sphex</i> spp.	--
Beabidae	<i>Beabix</i> sp.	--
Anthophoridae	<i>Centris</i> spp.	Abejorros
Apidae	<i>Eulaema meriana</i>	Abejas y abejorros
	<i>Eulaema cingulata</i>	Abejorros
	<i>Boabus pullatus</i>	"
	<i>Euglossa</i> sp.	Abejas
	<i>Trigona</i> spp.	Abejas

Appendix 9 Living Organisms In Estuary at Manuel Antonio National Park

Family	Species	Spanish name
Engraulidae ( かつお科 )	<u>Anchoa lucida</u> <u>Anchoa starksi</u>	PECES Anchoa Anchoa
Atherinidae	<u>Neopisthopterus tropicus</u>	Gruñon
Clupeidae	<u>Opisthonema libertate</u>	Sardina
Hemiramphidae	<u>Hyporhamphus unifasciata</u> <u>Hyporhamphus unifasciata</u>	Sardina galtera Picuda
Soleidae	<u>Achirus mazatlanus</u>	Lenguado
Haemulidae	<u>Pomadasys macracanthus</u>	Chinita
Lutjanidae	<u>Lutjanus novemfasciatus</u> <u>Lutjanus aratus</u> <u>Lutjanus argentiventris</u>	Pargo roqueoro Pargo Pargo amarillo
Mugilidae	<u>Mugil curema</u>	Lisa
Carangidae	<u>Trachinotus culveri</u> <u>Oligoplites saurus</u> <u>Selene oerstedii</u> <u>Caranx hippos</u>	La palometa Pompano Sardina gallera Palometa con cabeza curva
Gerreidae	<u>Eucinostomus sp.</u>	
Poeciliidae	<u>Poeciliopsis turrubaresis</u> <u>Poecilia gilli</u>	Parguito blanco Alumina
Eleotridae	<u>Gobionorus sp.</u>	Bobo
Centropomidae	<u>Centropomus sp.</u>	Robalo
Cyprinodontidae	<u>Oxyzygonectes dovii</u>	Ojo blanco

## Appendix 10 Species of Marine Migratory Animals

Species of marine migratory animal animals and the corresponding visiting period to the area from Naranjo river mouth to Paqueta river mouth (This list did not include bird species that have resident populations or are winter residents. Not all bird species included are pelagic but migrate on open ocean, some of them well off Pacific coast.)

Species	English name	Visiting
<b>AVES</b>		
<b>PROCELARIIFORMES</b>		
<b>PROCELARIIDAE</b>		
<i>Procellaria parkinsoni</i>	(Parkinson's petrel)	Mar-Apr R
<i>Puffinus griseus</i>	(Sooty shearwater)	May-Oct Co
<b>HYDROBATIDAE</b>		
<i>Oceanites oceanites</i>	(Wilson's storm petrel)	Apr-Aug RV
<i>Oceanodroma microsoma</i>	(Leach's storm petrel)	Sep-Oct Un M
		Apr-Jun Co M
<i>Oceanodroma tethys</i>	(Wedge-rumped storm petrel)	Jul-Nov RV
<i>Oceanodroma leucorhoa</i>	(Leach's storm petrel)	May-Aug Co
<i>Oceanodroma melania</i>	(Black storm-petrel)	Oct-Apr Co M
<b>PELECANIFORMES</b>		
<b>PHAETHONTIDAE</b>		
<i>Phaeton aethereus</i>	(Red-billed tropicbird)	Year-round RV
<b>SULIDAE</b>		
<i>Sula nebouxii</i>	(Blue-footed booby)	Any time of year IV
<i>Sula dactylatra</i>	(Masked booby)	Year-round UV
<b>CHARADRIIFORMES</b>		
<b>CHARADRIIDAE</b>		
<i>Charadrius alexandrinus</i>	(Snowy plover)	Mar, Sep-Nov R
<b>SCOLOPACIDAE</b>		
<i>Linosa haemastica</i>	(Hudsonian Godwit)	Spring Un M
<i>Heteroscolus incanus</i>	(Wandering tattler)	Fall, Spring Un M
<i>Aphriza virgata</i>	(Surfbird)	Fall Co M
<i>Calidris fuscicollis</i>	(White-rumped sandpiper)	Spring R
<i>Calidris bairdii</i>	(Baird's sandpiper)	Fall, Spring Un M
		and Apr-Jun
<i>Calidris melanotos</i>	(Pectoral sandpiper)	Sep-Nov Co M
		and Apr-May
<b>PHALAROPODIDAE</b>		
<i>Phalaropus fulicarius</i>	(Red phalarope)	Fall, Spring Un M
<i>Phalaropus lobatus</i>	(Red-necked phalarope)	Aug-Nov Co M
<b>STERCORARIIDAE</b>		
<i>Catharacta maccornicki</i>	(South polar skua)	Southern hemisphere IV
<i>Stercorarius pomarinus</i>	(Pomarine jaeger)	Winter (Dec-Feb) UV
<i>Stercorarius parasiticus</i>	(Parasitic jaeger)	Aug-Oct
		Mar-Apr UV
<b>LARIDAE</b>		
<i>Anous stolidus</i>	(Brown noddy)	Spring Co M
<i>Larus philadelphia</i>	(Bonaparte's gull)	UV
<i>Xema sabini</i>	(Sabine's gull)	Spring Un M
<i>Sterna fuscata</i>	(Sooty tern)	UV
<i>Larus atricilla</i>		
<i>Larus pipixcan</i>		
<b>MAMMALIA</b>		
<b>CETACEA</b>		
<b>DELPHINIDAE</b>		
<i>Stenella attenuata</i>	(Spotted dolphin)	
Occasionally		
<i>Stenella longirostris</i>	(Spinner dolphin)	

(Continue)

Occasionally	<i>Stenella coeruleoalba</i>	(Striped dolphin)	
Occasionally	<i>Delphinus delphis</i>	(Common dolphin)	
Occasionally	<i>Peponocephala electra</i>	(Melon-headed whale)	Occasionally
	<i>Orcinus orca</i>	(Killer whale)	Rare possib
	<i>Grampus griseus</i>	(Risso's dolphin)	
Occasionally	PHYSETERIDAE		
	<i>Physeter catodon</i>	(Sperm whale)	
Occasionally	ZIPHIIDAE		
	<i>Mesoplodon carlhubbsi</i>	(Hubb's beaked whale)	Rare possib
	BALAENOPTERIDAE		
	<i>Megaptera novaengliae</i>	(Humpback whale)	
Occasionally	<i>Balaenoptera borealis</i>	(Sei whale)	Rare possib
	<i>Balaenoptera musculus</i>	(Blue whale)	Rare possib
	BALAENIDAE		
	<i>Eubalaena glacialis</i>	(Right whale)	Rare possib
REPTILIA			
TESTUDINATA			
CHELONIIDAE			
	<i>Eretmochelys imbricata</i>	(Hawksbill turtle)	June- Rec* R
	<i>Lepidochelys olivacea</i>	(Pacific ridley sea turtle)	June- Rec Ab
	<i>Chelonia agassizii</i>	(Pacific Green)	R
	DERMOCHELYIDAE		
	<i>Dermochelys coriacea</i>	(Leatherback turtle)	June- Rec Co
SQUAMATA			
HYDROPHIDAE			
	<i>Pelamis platurus</i>	(Pelagic sea snake)	Year-round R

R = Rare; Co = Common; Co M = Common migrant; Un M = Uncommon migrant; RV = Regular visitor  
irregular visitor; UV = Uncommon visitor; \* Approximated nesting period.



Appendix 11(a) Salinity in Estero Negro

Low Water		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Station																	
Date	1995.02.27																
Time	8:20		8:58		9:08		9:32		9:53		10:05		10:17		10:33		
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
0m	29.7	2.5	29.8	2.8	29.7	3.0	29.0	8.5	29.4	27.5	29.9	13.7	27.3	2.2	29.1	16.2	
0.5m	29.7	2.3	29.7	2.8	29.7	3.1	29.0	8.7	29.9	29.5	30.0	32.4	29.7	26.7	29.6	24.2	
1.0m									29.9	31.2			29.7	29.7	29.8	27.9	
2.0m																	
Depth(m)	1.0	1.2			0.7		1.0		1.1		0.8		1.3				1.3
High Water		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Date	1995.02.28																
Time	12:38		12:45		12:55		13:04		13:10		13:15		13:20		13:30		
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
0m	30.3	30.2	30.3	32.7	30.2	33.0	30.0	33.0	30.1	32.9	30.3	20.5	32.3	2.7	30.0	33.0	
0.5m	30.3	32.2	30.2	32.8	30.3	32.9	30.0	33.0	30.0	32.9	30.3	32.5	30.3	32.2	30.0	33.0	
1.0m	30.3	32.3	30.3	32.8	30.2	32.9	30.0	33.0	30.0	32.9	30.3	32.8	30.2	32.8	29.9	33.0	
2.0m	30.3	32.6	30.2	32.9	30.2	32.9	30.0	33.0	30.1	32.9			30.1	33.0			
Depth(m)	2.0	2.2			0.5		2.5		2.9		1.9		2.6				1.9

Rising Tide		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Station																	
Date	1995.02.28																
Time	11:20		11:27		11:30		11:45		11:54		11:59		12:02		12:11		
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
0m	30.7	0.0	31.4	5.8	31.5	7.4	32.1	30.2	31.9	30.8	32.2	30.5	32.1	29.8	32.0	30.5	
0.5m	30.7	3.7	31.4	6.2	31.2	7.3	32.1	30.5	31.8	30.8	32.2	30.6	32.1	30.6	32.0	30.5	
1.0m			31.4	6.5	31.2	7.3	32.0	30.5	31.8	30.9	32.2	30.8	32.0	30.7	32.0	30.5	
2.0m									31.8	31.0			32.1	30.8			
Depth(m)	0.9	1.2			1.5		1.0		2.2		1.2		2.4				1.8
High Water		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Date	1995.02.28																
Time	13:53		14:00		14:08		14:18		14:30		15:00		15:05		14:43		
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
0m	32.3	31.2	32	29.8	32.2	32.05	32.2	31.8	32.6	16.7	31.7	15.3	32.2	2.1	32	32.73	
0.5m	32.2	31.0	32.3	31.1	32.2	31.8	32.0	32.6	32.2	31.7	32.3	31.7	32.0	28.4	32.0	32.7	
1.0m	32.3	31.0	32.3	31.5	32.2	31.8	32.0	32.6	32.2	32.0	32.0	32.4	32.1	31.7	31.9	32.7	
2.0m	32.2	31.2	32.3	31.6	32.2	31.8	32.1	32.7	32.1	32.5							
3.0m									32.1	32.6							
Depth(m)	2.5	2.2			2.8		2.1		3.3		1.9		2.0				2.3

Appendix 11(b) Salinity in Estero Negro

Edd Tide		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Station		T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
Date		1995.07.28															
Time	16:47	16:37															
Item		T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m		32.2	27.3			32.2	31.3										
0.5m		32.0	27.5			32.1	31.4										
1.0m		32.1	27.5			32.0	31.3										
2.0m																	
Depth(m)	1.9	1.8															

Low Water		N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Station		T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
Date		1995.03.01															
Time	9:03	9:08		9:11		9:28		9:53		10:07		10:19		9:38			
Item		T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m		29.7	3.3	29.7	4.5	29.8	5.2	30.3	8.1	30.8	11.7	30.0	2.0	29.5	0.9	39.9	17.6
0.5m		29.7	4.0	29.8	4.5			30.2	8.2					29.5	0.9		
1.0m		29.7	4.1											29.5	0.9		
2.0m																	
Depth(m)	1.2	1.0		0.8		0.7		0.7		0.3		1.6		0.3			
Rising Tide		12:44		12:50		12:55		13:03		13:15		13:20		13:24		13:09	
Item		T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m		32.2	9.7	32.3	13.3	32.5	28.6	32.3	32.9	32.2	33.0	32.7	32.4	32.5	33.0	32.3	32.9
0.5m		32.2	9.8	32.3	13.2	32.6	31.2	32.5	32.9	32.2	33.0	32.6	32.5	32.6	32.8	32.3	32.9
1.0m		32.2	9.8	32.4	13.7	32.5	31.3	32.4	32.9	32.2	32.9	32.6	32.6	32.5	32.8	32.4	32.9
2.0m								32.4	32.9	32.2	33.0			32.5	32.8	32.4	32.9
Depth(m)	2.1	1.9		1.7		2.5		2.9		1.7		2.3		2.1			

Appendix 11(c) Salinity in Estero Negro

Tide	N-1		N-2		N-3		N-4		N-5		N-6		N-7		N-8	
Station	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
Date	1995.4.26															
Time	11:12		11:05		11:00		10:43		10:30		10:04		9:53			
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m	29.0	1.6	29.2	2.5	29.0	2.5	26.0	0.3	29.5	2.0	26.5	0.0	27.0	0.0	26.5	0.0
0.5m	29.0	2.0	29.2	2.4	28.7	2.5	26.0	0.0	29.5	2.0	26.5	0.0	27.3	0.0	27.0	0.0
1.0m	29.0	2.0	29.3	2.5	29.0	2.8	26.0	0.0	29.5	2.2	26.0	0.7			27.0	0.0
2.0m	29.0	2.1			29.0	3.0					26.0	4.8				
Depth(m)	2.1		1.8		2.2		1.8		1.6		2.0		0.9		1.9	
High Water																
Time	13:15		13:19		13:32		13:41		13:56		14:01		14:06			
Item	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m	26.8	1.2	27.5	5.0	28.0	11.0	28.1	8.5	28.0	4.5	27.7	1.0	27.5	0.7	28.0	9.0
0.5m	27.2	4.3	27.5	7.3	28.0	11.1	28.1	10.5	28.0	4.8	27.7	3.7	27.5	1.2	28.1	9.8
1.0m	27.3	4.5	27.6	8.5	28.0	11.6	28.2	12.5	28.0	6.7	28.1	10.0	27.6	1.2	28.3	14.7
2.0m	27.3	5.1	27.6	9.1	28.0	11.9	29.9	21.4	29.0	25.8	28.7	20.0	29.1	28.5	29.0	25.3
Depth(m)	2.5		2.8				2.2		2.8		3.0		2.7		2.7	

Appendix 12 General Composition of Vegetation in Manuel Antonio National Park

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Criptogamas vasculares (Helechos; Ferns)

Adiantaceae

- Acrostichum aureum L.
- Adiantum conccinun Willd.
- \*A. deflectens Maxon
- A. latifolium Lam.
- A. obliquum Willd.
- A. pulverulentum L.
- \*Gymnopteris rufa (L.) Bernh.
- Notholaena brachypus (Kze.) J. Sm.
- Pityrogramma calomelanos (L.) Link
- P. dealabata (Presl) Tryon

Aspleniaceae

- Asplenium abscissum Willd.
- A. auriculatum Sw.
- A. auritum Sw.
- A. cuspidatum Lam. var. foeniculaceum (HBK) Wirt. & Lellinger
- A. praemorsum Sw.
- A. radicans L. var. cirrhatum (L.C. Rich.) Rosentock
- Diplazium bradeorum Rosenstock
- D. grandifolium Sw.
- D. urticifolium Christ

Blechnaceae

- Blechnum fraxineum Willd.
- B. occidentale L.
- B. plypodioides (Sw.) Kuhn
- Salpichlaena volubilis (Kaulf.) J. Smith

Cyatheaceae [Tree Ferns]

- \*Cnemidaria choricarpa (Maxon) Tryon
- \*Cyathea multiflora J. Sm.
- \*Nephelea mexicana (Schlecht. & Chan.) Tryon
- \*Metaxya rostrata J. Sm.
- \*Trichipteris stipularis (Christ) Tryon

Davalliaceae

- Nepthroopsis biserrata (Sw.) Schott
- N. rivularis (Vahl) Mett. ex Krup

Dennstaedtiaceae

- Dennstaedtia obtusifolia (Willd.) Moore
- \*D. spinulosa Mickel

Equisetaceae [Horsetails]

- Equisetum bogotense H.B.K.

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\*Species in danger on the extinction.

Gleicheniaceae

- Dicranopteris flexuosa (Schrad.) und.
- D. pectinata (Willd.) Und.
- Gleichenia bifida Willd.

Hymenophyllaceae

- Hymenophyllum polyanthos Sw.
- Didymoglossum angustifrons (Fee) W. Boer
- D. punctatum (Kze.) W. Boer
- Trichomanes elegans L. C. Rich
- T. collariatum v. d. Bosch

Lomariopsidaceae

- Bolbitis portoricensis (Sw.) Hennip.
- Elaphoglossum apodum (Kaulf.) Schott
- E. erinaceum (Fee) Moore
- E. laminarioides Bory
- Polybotrya cervina (L.) Kaulf.
- P. caudata Kze.

Lycopodiaceae

- Lycopodium cominum L.
- L. clavatum L. var. trichiatum (Bory) Baker
- L. linifolium L.

Marattiaceae

- Danaea nodosa (L.) J. E. Sm.

Parkeriaceae

- Ceratopteris pteridoides (Hooker) Hieron

Polypodiaceae

- Campyloneuron angustifolium Fee
- C. phyllitides Presl
- Microgramma lycopodioides (L.) Copel.
- Phlebodium aureum J. Sm.
- Pleopeltis astrolepis Fournier
- Polypodium chnoodes Spreng
- P. dispersum Evans
- P. fallax Schlecht. & Cham.
- P. plumula H.B. ex Willd.
- P. polypodioides (L.) Hitch.

Pteridaceae (Bracken Fern)

- Lindsaea stricta (Sw.) Dryander
- Pteridium aquilinum (L.) Kuhn
- Pteris grandifolia L.
- P. quadrifurcata Retz

Schizaceae

- Anemia hirsuta (L.) Sw.
- A. phyllitidis (L.) Sw.
- Lygodium radiatum Presl
- L. venustum Sw.
- \*Schizaea elegans (Vahl) Swartz

(Continue)

Selaginellaceae

- Selaginella anceps Presl
- S. arthritica Alston
- S. cladorhizans A. Br.
- S. flagellata Spring
- S. pallescens (Presl) Spring

Tectariaceae

- Ctenistis hemsleyana (Baker ex Hemsl.) Copel
- C. ampla (H.B. ex Willd.) Ching
- Didymochlaena truncatula (Sw.) J. Sm.
- Druopteris patula (Sw.) Kunze
- Tectaria incisa Cav.
- T. plantaginea (Jacq.) Maxon
- T. antioquiensis (Baker) C. Chr.

Thelypteridaceae

- Thelypteris asterothrix (Fee) Proctor
- T. balbisii (Spreng.) Ching
- T. cumingiana (Kze.) Morton
- T. dentata (Forsk) E. St. John
- T. patens (Sw.) Small
- T. tetragona (Sw.) Small
- T. serrata (Cav.) Alston
- T. tristis (Kze.) Morton

Vittariaceae

- Vittaria lineata (L.) J. Sm.
- V. stipitata Kunze

Angiospermas:

Monocotyledoneae

Cyperaceae [Navajuela; Sedges]

- Cyperus diffusus Vahl
- C. surinamensis Roob.
- Fimbristylis spathacea (L.) Roth.
- Mariscus tenuis (Sw.) C.B. Cl.
- Rhynchospora cephalotes (L.) Vahl
- R. micrantha Vahl
- R. radicans (Schlesht. & Cham.) Pfeiffer
- Scleria pterota Presl.

Graminae [Zacates; Grasses]

*Anthephora hermaphrodita* J. P. Reede  
*Axonopus compressus* (Sw.) Beauv.  
*Bouteloua* sp.  
*Cenchrus echinatus* L.  
*Coelorachis aurita* (Steud.) A. Canus  
*Chloris radiata* (L.) Sw.  
*Cynodon dactylon* (L.) Pers.  
*Dactyloctenium aegyptium* (L.) Beauv.  
*Digitaria decumbens* Steud.  
*D. horizontalis* Willd.  
*Echinochloa colonum* (L.) Link  
*Eragrostis ciliaris* (L.) R. Br.  
*Gynnerium sagittatum* (Aubl.) Beauv.  
*Haeckelochloa granularis* (L.) Kunze  
*Hymenachne amplexicaulis* (Rudge) Nees  
*Hyparrhenia rufa* (Nees) Stapf.  
*Ichnanthus* sp.  
*Jouvea pilosa* (Presl) Scribn.  
*Lasiacis procerrima* (Haek.) Hitch  
*Lasiacis* sp. (aff. *nigra*)  
*Leptochloa* sp.  
*Olyra* sp.  
 \**Panicum* spp.  
 \**Paspalum* spp.  
*Sorghum halepense* (L.) Pers.

Bromeliaceae

*Bromelia penguin* L.  
*Catopsis apicroides* (Sch. & Ch.) Baker  
*Tillandsia ionantha* Roxb.  
*Tillandsia* sp.

Orchidaceae

*Aspasia epidendroides* Lindl. in Hooker  
*Blettia purpurea* (Lam.) DC  
*Brassia caudata* (L.) Lindl.  
*Brassavola nodosa* (L.) Lindl.  
*Canpyloneuron micranthum* (Lindl.) Rolfe  
*Catasetum* sp. aff. *bicolor* Klotzsch  
*Cyrtopodium punctatum* (L.) Lindl.  
*Chysis aurea* Lindley  
*Diacrium bilamellatum* (L.) Ames  
*Dichaea panamensis* Lindley  
*Epidendrum atropurpureum* Willd.  
*E. ionophlebium* Reichb. f.  
*E. isomerum* Schltr.  
*Epidendrum* sp.  
*Laelia rubescens* Lindl.

Orchidaceae

*Lockhartia acuta* (Lindl.) Reich. fl.  
*L. pittieri* Schltr.  
*Maxillaria alba* (HBK.) Lindl.  
*M. planicola* C. Schweinf.  
*M. uncata* Lindl.  
*M. variabilis* Bates. ex Lindl.  
*Nornodes igneum* Lindl. ex Paxt.  
*Notylia barkeri* Lindl.  
*Oncidium ampliatum* Lindl.  
*O. cabagrae* Schltr.  
*O. pusillum* (L.) Reichb. f.  
*Oncidium* sp.  
*Pleurothallis* sp.  
*Stanhopea pulla* Reichb. f.  
*Stellis* spp.  
*Trichopilia maculata* Reichb. f.  
*Schomburgkia tibicinis* auct.  
*Vanilla pompona* Scheide

Palmae

*Asterogyne martiana* Wendl.  
*Astrocarym standleyanum* L. H. Bailey  
*Cocos nucifera* L.  
*Corozo oleifera* (HBK) Bailye  
*Cryosophila guagara* Allen  
*Geonoma* sp.  
*Scheelea rostrata* (Oerst.) Burret  
*Socratea durissima* (Oerst.) Wendl.  
*Xelfia georgii* Wendl. ex Burret

Dicotyledoneae

Acanthaceae

*Aphelandra deppeana* Schl. & Cham.  
*Blechnum costarricense* Oerst.  
*Bravaisia integerrima* (Spreng.) Standl.  
*Ruellia tonduzii* Lindau

Anacardiaceae

*Anacardium excelsum* (Bert. & Bal.) Skeels  
*Astronium graveolens* Jacq.  
*Mangifera indica* L.  
*Spondias monbin* L.  
*S. purpurea* L.

Annonaceae

*Canga odorata* auct.  
*Rollinia microsepala* Standl.  
*Zylopia sericophylla* Standl. & Yas.

Apocynaceae

*Aspidosperma negalocarpon* Muller-Aargau  
*Lacnelloea panamensis* (Woodson) Monachino  
*Prestonia portobellensis* (Baueri) Woodson



Araliaceae

- Dendropanax arboreus* (L.) Descaine & Pl.
- D. praestans* Standley

Begoniaceae

- Begonia filipes* Bentham

Bignoniaceae

- Amphitena latifolia* (Miller) A. Gentry
- Tabebuia rosea* Bertol.
- T. ochracea* ssp. *noochrysantha* (A. Gentry) A. Gentry

Bombacaceae

- Bombacopsis sessile* (Benth.) Pittier
- Ceiba pentandra* (L.) Gaertn.
- Ochroma lagopus* Swartz
- Quararibea guatemalensis* (D.-Sm.) Standley

Boraginaceae

- Cordia alliodora* (Ruiz & Pavon) Cham.
- Tournefortia hirsutissima* L.

Burseraceae

- Bursera simarouba* (L.) Sargent
- Protium panamense* (Rose) Johnston

Cecropiaceae [cf. Moraceae otros autores]

- Cecropia insignis* Liebmann

Celastraceae

- Naytenus* sp.

Combretaceae

- Terminalia catapa* L.
- T. bucidoides* Standl. & Wms.
- T. chiriquiana* Pittier

Compositae

- Clibadium* sp.
- C. surinamense* L.
- Eupatorium sinclairii* Benth.
- Isocarpha atripleifolia* (L.) R. Br.
- Kikania tonduzii* Robinson
- Wedelia trilobata* (L.) Hitch.

Connaraceae

- Connarus panamensis* Griseb.

Convolvulaceae

- Ipomoea alba* L.
- Ipomoea* sp.

Crassulaceae

- Bryophllum pinnatum* (Lam.) Kurz

Cucurbitaceae

- Gurania nakoyana* (Lam.) Cogniaux
- Melothris pendula* L.

Dilleniaceae

- Davilla nitida* (Vahl) Kubitz.

( Continue)

Elaeocarpaceae

Muntingia calabura L.

Euphorbiaceae

Acalypha diversifolia Jacq.

Hipponeone mancinella L.

Hieronyma alchorneoides Allamo

H. tectissima Standl. & Wms.

Makea occidentalis Benth.

Phyllanthus acuminatus Vahl

P. urinaria L.

Poinsettia heterophylla (L.) Kl. & Gke.

Sapium jamaicense Sw.

Flacourtiaceae

Casearia argu HBK

Laetia procera (Poeppig) Eichler

Zuelania guidonis (Sw.) Britt. & Millsp.

Gentianaceae

Schultesia lisianthoides (Griseb.) Benth. & Hooker

Gesneriaceae

Codonanthe carassifolia (Focke) Morton

C. macradenia Donn-Smith

Kohleria spicata (Kunth) Oersted

Guttiferae

Clusia rosea L.

Galophyllum brasiliense Camb.

Rheedia edulis Tr. & Planch.

Vismia ferruginea HBK

Labiatae

Hybris capitata L.

Acymum micranthum Willd.

Scutellaria glabra Leonard

Lauraceae

Netandra salifolia (HBK) Nees

Licaria carvantesii (HBK) Kostermans

Leguminosae s. l.

Andira inermis (Wright) Urban

Cassia reticulata Willd.

Desmodium sp.

Cynometra hemimltophylla (D. -Sm.) Britt. & Rose

Copaifera aromatica Dyer

Gliricidia saccium (Jacq.) Steud.

Hymenaea courbaril L.

Lonchocarpus pentaphyllus (Poir.) DC

Inga edulis Mart.

I. densiflora Benth.

I. punctata Willd.

I. spectabilis (Vahl) Willd.

I. multijuga Benth.

Leguminosae s.l.

- Inga thibaudiana DC
- Mucuna holtonii (Kunze) Moldenke
- Machaerium sp.
- Pithecolobium saman Benth.
- P. arboreum (L.) Urban
- Phyllocarpus septentrionalis Donn. -Smith
- Pterocarpus officinalis Jacq.
- Swartzia simplex (Sw.) Spreng.
- S. panamensis Benth.
- Mora oleifera (Tr.) Ducke

Lobeliaceae

- Hippobroma longiflora (L.) G. Don

Loganiaceae

- Spigelia anthelmia L.

Lythraceae

- Cuphaea sp.

Malpighiaceae

- Bunchosia cornifolia HBK
- Byrsonina crassifolia (L.) HBK
- Spaethea elegans (G.F. Meyer) Jussieu

Malvaceae

- Hempea platanifolia Standley

Maranthaceae

- Caltha spp.
- Thalia geniculata auct.

Melastomataceae

- Niconia argentea (Sw.) DC

Neliaceae

- Carapa guianensis Aublet
- Trichilia cinerascens (C. DC) Pennington

Monimiaceae

- Siparuna sp.

Moraceae

- Brosimum costaricanum Liebmann
- B. utile (HBK) Pittier
- Chlorophora tinctoria (L.) Gaud.
- Ficus kullensei I. J. Johnston
- F. maxima Miller
- F. nymphaeifolia P. Miller
- F. goldmani Standley
- Poulsenia armata (Miquel) Standl.
- Pseudolacdia spuria (Sw.) Griseb.

Myristicaceae

- Dialyanthera otoba (H & B) Warb.
- Virola sebifera Aublet
- V. kschuy Warb.

(Continue)

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Myrtaceae

Eugenia sp.  
Myrciaria sp.  
Psidium guajava L.

Oleaceae

Haisteria cyanocarpa Poeppig  
Ximonia americana L.

Piperaceae

Peperomia rotundifolia (L.) HBK  
Piper guanacastense C. DC  
P. marginatum Jacq.  
P. reticulatum L.  
P. sancti-felicis Trelease  
P. villiraulum C. DC

Polygonaceae

Coccoloba sp.  
C. venosa L.

Rhizophoraceae

\*Rhizophora Mangle L.  
\*R. harrisii  
\*Cassipourea podantha Standl.

Rosaceae

Chrysobalanus icaco L.  
Hirtella racemosa Lam.  
Licania platypus (Hemsl) Fritsch

Rubiaceae

Anisomeris microloba (D. -Sm.) Standley  
Alibertia edulis (L. Rich.) A. Rich.  
Chinarris latifolia Standl.  
Geophyla repens (L.) Johnston  
Gonzalagunia panamensis (Cav.) Schum.  
Posoqueria latifolia (Rudge) Romer & Schultes  
Psychotria marginata Swartz

Sapindaceae

Dipterodendron costarricense Radlk.  
Paullinia clavigera Schlechtendal  
Talisia nervosa Radlk.

Sapotaceae

Lucuma lucentifolia Standley  
Peuteria sp.

Scrophulariaceae

Scoparia dulcis L.

Simaroubaceae

Picramnia latifolia Tul  
Quassia amara L.  
Simaba cedron L.

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(Continue)

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Sterculiaceae

- Byttneria aculeata Jacq.
- Guazuma ulmifolia Lam.
- Sterculia apetala (Jacq.) Karst.

Solanaceae

- Solanum lancifolium Jacq.
- S. nigrum L. vel aff.

Theaceae

- Pelliciera rhizophorae Tr. & Pl.

Tiliaceae

- Apoiba tibourbou Aubl.
- Goethalsia neiantha (D. Sm.) Burret
- Heliocarpus appendiculatus Turczaninov
- Luehea seemanii Tr. & Pl.

Ulmaceae

- Trema micrantha (L.) Blume

Urticaceae

- Boehmeria ramifera Jacq.
- Pilea microphylla (L.) Liebm.

Verbenaceae

- \*Avicennia uinda
- Callicarpa acuminata HBK
- \*Avicennia cacemosa

Vitaceae

- Vitis cooperi Standley
- V. tiliifolia H.B. ex R. & S.

Gymnospermae

Cycadaceae (Cycads)

- \*Zamia acuminata Oersted
  - \*Z. fairchildiana L. D. Gomez
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**Appendix 13    Endangered Species List and Actual Status**  
**Compiled by Dr. Gary Stiles (1981)**

Group and Species	Scientific Name	Actual Status
<b>BIRDS</b>		
Crested Eagle	<i>Morphnus guianensis</i>	No definite reports in 20 years; 2 recent sightings require confirmation.
Harpy Eagle	<i>Harpia harpyja</i>	Very small population on Osa Peninsula; probably also in Talamanca; extirpated elsewhere.
Solitary Eagle	<i>Harpophalietus solitarius</i>	Small population in mountainous regions of Cordillera Central, Osa Peninsula, probably Talamanca.
Black-and-White Hawk-Eagle	<i>Spizastur melanoleucus</i>	Rare, wet lowlands to middle elevation on both slopes, now mostly in Osa and Talamanca.
Ornate Hawk-Eagle	<i>Spizaetus ornatus</i>	Similar to preceding but perhaps less rare.
Black Hawk-Eagle	<i>Spizaetus tyrannus</i>	Uncommon but not rare; forested hilly to mountainous areas, wet lowlands to middle elevation on both slopes.
Orange-breasted Falcon	<i>Falco deiroleucus</i>	No reliable records in last 25 years.
Scarlet Macaw	<i>Aratinga macao</i>	Good, probably stable population on Osa Peninsula; a few in Guanacaste.
Great Curassow	<i>Crax rubra</i>	Widespread in forest regions; now rare generally except Osa Peninsula.
Jabiru	<i>Jabiru mycteria</i>	Population now down to ca. 30-35 birds and evidently still declining.
Quetzal	<i>Pharomachrus mocinno</i>	Large, stable populations in most high mountainous areas; not in immediate danger in CR. Adapts well to considerable deforestation.
<b>AMPHIBIANS</b>		
Golden Toad	<i>Bufo periglenes</i>	Very local but not rare; virtually entire population within protected area.
<b>MAMMALS</b>		
Giant Anteater	<i>Myrmecophaga tridactyla</i>	Extremely rare, even in extensively forested areas.
Margay	<i>Felis tigrina</i>	Rare, mountain areas, little known.
Margay	<i>Felis wiedii</i>	Very rare, fairly widespread in forest areas.
Mountain Lion	<i>Felis concolor</i>	Seldom seen; uncommon to fairly rare overall, more common on Osa Peninsula, Talamanca.
Ocelot	<i>Felis pardalis</i>	Now rare in most areas; less rare on Osa Peninsula, in forested mountains.
Jaguar	<i>Felis onca</i>	Now rare, limited to large forested areas; most numerous on Osa Peninsula.
Jaguarundi	<i>Felis yagouaroundi</i>	Uncommon but by no means rare; adapted to partly deforested areas.
Poás Squirrel	<i>Syntheosciurus poasensis</i>	Status unknown; population recently discovered in Talamanca.
Miravalles Squirrel	<i>Sciurus deppei</i>	Status unknown, probably rare.
Baird's Tapir	<i>Tapirus bairdii</i>	Common on Osa Peninsula and locally in Talamanca; elsewhere uncommon to rare, but by no means in serious danger.
Manatee	<i>Trichechus manatus</i>	At best very rare and local. Atlantic slope especially vicinity Tortuguero.
Howler Monkey	<i>Alouatta palliata</i>	Common and widespread, able to tolerate much deforestation; not threatened.
Spider Monkey	<i>Ateles geoffroyi</i>	Common in most forested areas, lowlands to mid-elevation, good populations in protected areas.
White-faced Monkey	<i>Cebus capucinus</i>	Common, widespread, tolerates considerable deforestation; not threatened.
Squirrel Monkey	<i>Saimiri oerstedii</i>	Locally common in Pacific SW; adapts well to second growth; not particularly threatened.
Tamarin	<i>Saguinus geoffroyi</i>	Has never been definitively recorded from C.R.
<b>REPTILES</b>		
Crocodile	<i>Crocodylus acutus</i>	Fairly sizeable populations on Osa Peninsula, Tempisque basin, Sixola region; rare or extirpated elsewhere.

Table IV-6. (Continued)

(Continued)

Group and Species	Scientific Name	Actual Status
Cayman Pacific Ridley Turtle	<i>Caiman crocodilus</i> <i>Lepidochelys olivacea</i>	Same as preceding, but more common and widespread. Abundant but under severe pressure at Ostional and elsewhere.
Leatherback Turtle Green Turtle	<i>Dermochelys coriacea</i> <i>Chelonia mydas</i>	Uncommon but not severely threatened. Total numbers small, but slowly increasing under protection.
Loggerhead Turtle Hawksbill Turtle	<i>Caretta caretta</i> <i>Eretmochelys imbricata</i>	Rare. Rare to very rare.

## SPECIES WITH REDUCED POPULATIONS

## BIRDS

All remaining diurnal  
birds of prey

Accipitridae, Falconidae

Some species declining or rare, others flourishing; probably none as severely endangered as larger eagles, though pesticides and hunting may be affecting Snail Kite, Bat Falcon in particular. Red-throated Caracara also very rare now, only found on Osa Peninsula.

Great Green Macaw

*Ara ambigua*

Has declined drastically on Atlantic slope, due mainly to forest fractionation; evidently must wander or migrate widely to survive, and critical seasonal resources being eliminated.

## MAMMALS

Aimadillo  
Grison  
Olingo  
Cacomistle  
2-toed Sloth  
1-toed Sloth  
\*Tepezcuintle*Cabassous centralis*  
*Gallictis allamandi*  
*Bassaricyon gabbii*  
*Bassariscus sumichrasti*  
*Choloepus hoffmanni*  
*Bradypus griseus*  
*Cuniculus paca*Only 1 record for CR; very rare at best. Little known, possibly relatively rare. Status uncertain.  
Status uncertain.  
Status uncertain; probably not excessively rare. Locally common; probably not threatened.  
Greatly reduced in many areas, but still good populations in some parks.  
Status uncertain but certainly rare.  
Increasing settlement along Atlantic slope rivers—hunting, fur; considerable reduction.\*Golden Anteater  
\*River Otter*Cyclopes didactylus*  
*Lutra annectens*

## REPTILES

Iguana

*Iguana iguana*

Locally reduced but still abundant in mangroves; not severely threatened.

## BIRDS

\*Spot-breasted Oriole  
\*Yellow-tailed Oriole  
\*Dark-backed Goldfinch  
\*Yellow-bellied Siskin  
\*Blue-hooded Euphonia  
\*Muscovy Duck*Icterus pectoralis*  
*Icterus mesomelas*  
*Spinus psaltria*  
*Spinus xanthogaster*  
*Euphonia elegantissima*  
*Cairina moschata*Greatly reduced due to cage bird trapping.  
Very severely reduced due to cage bird trapping.  
Considerably reduced due to cage bird trapping.  
Greatly reduced due to cage bird trapping.  
Greatly reduced due to cage bird trapping.  
Hunting pressure, deforestation — severe reductions.

\*Species with severely reduced populations but not on Endangered Species List.

Appendix 14 Species Found at the Mouth and Basins of Naranjo and Paqueta Rivers

Species	English name	Habitat
AVES		
PELECANIFORMES		
PELECANIDAE		
<i>Pelecanus occidentalis</i>	(Brown pelican)	Ma, Co
PHALACROCORACIDAE		
<i>Phalacrocorax olivaceus</i>	(Olivaceous cormorant)	Aq, Ma, Co
ANHINGIDAE		
<i>Anhinga anhinga</i>	(Anhinga)	Aq, Ma, Un
FREGATIDAE		
<i>Fregata magnificens</i>	(Magnificent frigatebird)	Ma, Co, MR
CICONIFORMES		
ARDEIDAE		
	( <i>Egretta thula</i> )	Snowy egret AqCo, MR
<i>Butorides virescens</i>	(Green-backed heron)	Aq, Co, MR
	( <i>Bubulcus ibis</i> )	Cattle egret OA, Ab
<i>Casmerodius albus</i>	(Great egret)	Aq, Co, MR
<i>Egretta caerulea</i>	(Little blue heron)	Aq, Ab, MR
	( <i>Tigrisoma mexicanum</i> )	Bare-throated tiger-heron Aq, Un
CICONIIDAE		
<i>Mycteria americana</i>	(Wood stork)	Aq, Co
THRESKIORNITHIDAE		
<i>Ajaia ajaja</i>	(Roseate spoonbill)	Aq, Co
<i>Eudocimus albus</i>	(White ibis)	Ma, Co
ANSERIFORMES		
ANATIDAE		
<i>Dendrocygna autumnalis</i>	(Black-bellied whistling-duck)	Aq-OA, Co
FALCONIFORMES		
CATHARTIDAE		
<i>Cathartes aura</i>	(Turkey vulture)	Ae, Ab
<i>Coragyps atratus</i>	(Black vulture)	Ae, Ab
ACCIPITRIDAE		
	( <i>Buteogallus anthracinus</i> )	Common black-hawk AqCo
	( <i>Buteo magirostris</i> )	Roadside hawk OA, SF, Co
<i>Elanus caeruleus</i>	(Black-shouldered kite)	OA, Co.
FALCONIDAE		
<i>Milvago chimachima</i>	(Yellow-headed caracara)	OA, Co
<i>Polyborus plancus</i>	(Crested caracara)	OA, Co
GRUIFORMES		
RALLIDAE		
<i>Araucides cajanea</i>	(Gray-necked wood-rail)	E-SF, un
<i>Laterallus albigularis</i>	(White-throated crane)	Aq, Co
<i>Porphyryla martinica</i>	(Purple gallinule)	Aq, Co
CHARADRIIFORMES		
JACANIDAE		
<i>Jacana spinosa</i>	(Northern jacana)	Aq, Ab
SCOLOPACIDAE		
	( <i>Numenius phaeopus</i> )	Aq, Co, MR
	( <i>Tringa flavipes</i> )	Lesser yellow legs AqUn
	( <i>Catoptrophorus semipalmatus</i> )	Willet AqAb MR
	( <i>Arenaria interpres</i> )	Ruddy turnstone AqCo MR
	( <i>Actitis macularia</i> )	Spotted sandpiper AqCo
	( <i>Charadrius wissonia</i> )	Wilson plover AqAb MR

† Habitat; OA=Open area, Ae=Aerial, Aq=Aquatic, T=Thickets, SF=Secondary forest, PF=Primary forest, A=All habitats, Ma=Marine, Coastal zone. Condition; R=Rare, Un=Uncommon, Co=Common, Ab=Abundant, M=Migratory, MR=Resident and migratory populations, NB=Winter breeder.  
 (1); Observed by R. Canpos (PROANBI-UCR) in a channels close to the african palm plantations in June 1994  
 (2); Observed by some fishermen at the mangrove close to the Naranjo river.



(Continued)

Species	English name	Habitat
COLUMBIFORMES		
COLUMBIDAE		
<i>Columbina talpacoti</i> <i>Leptotila verreauxi</i>	(Zenaida asiatica) (Ruddy ground-dove) (White-tipped dove) (Columbina inca) (Claravis pretiosa)	White-winged dove OACo OA, Ab SF, Ab Inca dove OACo Blue ground-dove OA TCo
CUCULIFORMES		
CUCULIDAE		
	( <i>Crotophaga sulcirostris</i> )	Groove-billed ani OAAb
CAPRIMULGIFORMES		
CAPRIMULGIDAE		
<i>Nyctidromus albicollis</i>	(Common nighthawk) ( <i>Chordeiles acutipennis</i> )	OA, T, SF, Co Lesser nighthawk OACo M
APODIFORMES		
APODIDAE		
	( <i>Chaetura spinicauda</i> )	Band-rumped swift AeCo
CORACIFORMES		
ALCEDINIDAE		
<i>Ceryle torquata</i> <i>Chloroceryle americana</i> <i>Chloroceryle amazona</i>	(Ringed kingfisher) (Green kingfisher) (Amazon kingfisher)	Aq, Co Aq, Co Aq, Un
PICIFORMES		
CAPITONIDAE		
	( <i>Eubucco bourcierii</i> )	Red-headed barbat PFVc
RAMPHASTIDAE		
<i>Ramphastos sulfuratus</i>	(Keel-billed toucan)	PF, SF Co
PICIDAE		
	( <i>Dryocopus lineatus</i> )	Lineated woodpecker OA SFCo
PASSERIFORMES		
TROGLODYTIDAE		
	( <i>Microthopias quixensis</i> )	Dotted-winged antwren PF E-SFCo
TYRANNIDAE		
<i>Megathynchus pitangus</i> <i>Pitangus sulphuratus</i> <i>Tyrannus melancholicus</i>	( <i>Elaenia flavogaster</i> ) (Boat-billed flycatcher) (Great kiskadee) (Tropical kingbird)	Yellow-bellied elania OA EFSCo OA, E-SF, Ab OA, T, Ab T, OA, Ab
HIRUNDINIDAE		
<i>Tachycineta albilinea</i>	( <i>Stelgidopteryx ruficollis</i> ) ( <i>Progne chalybea</i> ) (Mangrove swallow) ( <i>Hirundo rustica</i> )	Southern rough-winged swallow OACo Gray-breasted martin OACo OA, Aq, Co Barn swallow OA
Ab MR		
TROGLODYTIDAE		
<i>Thryothorus modestus</i> <i>Troglodytes aedon</i>	(Plain wren) (House wren)	OA, T, Co OA, T, Ab
TURDIDAE		
<i>Turdus grayi</i>	(Clay-colored robin)	OA, E-SF, Ab
COEREBIDAE		
	( <i>Coereba flaveola</i> )	Bananaquit OA, SF
Ab		
PARULIDAE		
	( <i>Mniotilta varia</i> )	Black-and-white warbler ACo

(Continue)

Species	English name	Habitat
<b>THRAUPIDAE</b>		
<i>Ramphocelus passerinii</i>	(Euphonia hirundinacea) (Scarlet-rumped tanager)	Yellow-throated euphonia AUn T, Ab
<i>Thraupis episcopus</i>	(Blue-gray tanager)	OA, Ab
<i>Thraupis palmarum</i>	(Palm tanager)	OA, Co
	(Tangara gyrola)	Bay-headed tanager PF Co
<b>ICTERIDAE</b>		
<i>Quiscalus mexicanus</i>	(Great-tailed grackle)	OA, Ab
<b>EMBERIZIDAE</b>		
	(Arremonops conirostris)	Black-striped sparrow OA SFCo
	(Oryzoborus funereus)	Thick-billed seed-finch OATCo
	(Sporophila aurita)	Variable seedeater OA Ab
	(Volatinia jacarina)	Blue-black grassquit OA Co
<b>MAMMALIA</b>		
<b>CARNIVORA</b>		
<b>MUSTELIDAE</b>		
<i>Lutra longicaudus</i> (1)	(River Otter)	Aq, R
<b>PRIMATES</b>		
<b>CEBIDAE</b>		
<i>Cebus capucinus</i> (2)	(White-faced capuchin)	PF, SF, Co
<b>AMPHIBIA</b>		
<b>ANURA</b>		
<b>BUFONIDAE</b>		
<i>Bufo marinus</i>	(Common toad)	OA, Ab
<b>LEPTODACTYLIDAE</b>		
<i>Leptodactylus pentadactylus</i>	(Bullfrog)	A, Co
<i>Physalemus pustulosus</i>	(Tungara frog)	A, Co
<b>REPTILIA</b>		
<b>SQUAMATA</b>		
<b>IGUANIDAE</b>		
	(Ctenosaura similis)	Black iguana AAb
	(Iguana iguana)	Green iguana PF SF Co
<b>TEIIDAE</b>		
<i>Anolis quadrilineata</i>	(Lizard)	A, Co
<b>CORYTOPHANIDAE</b>		
	(Basiliscus basiliscus)	Basilisk A Co

Abbreviations: Habitat= OA: Open areas, Aa: Aereal, Aq: Aquatic  
T: Thickets, SF: Secondary forest, PF: Primary forest, A: All habitats (Includes forested and open areas), Ma: Marine, coastal zones.

Condition= R: Rare, Un: Uncommon, Co: Common, Ab: Abundant,  
M: Migratory, MR: Resident and migratory populations, NB: Winter breeder.

(1) Observed by R. Campos (PROAMBI-UCR) in a channel close to the african palm plantations in june 1994.

(2) Observed by some fishermen at the mangrove close to the Naranjo river.

Appendix 15      Endangered Species at the Mouth and the Basins of Naranjo and Paqueta Rivers

Species	English name
AVES	
PELECANIFORMES	
PELECANIDAE	
<i>Pelecanus occidentalis</i>	(Brown pelican)
FALCONIFORMES	
ACCIPITRIDAE	
<i>Buteogallus anthracinus</i>	(Common black-hawk)
<i>Buteo magnirostris</i>	(Roadside hawk)
<i>Elanus caeruleus</i>	(Black-shouldered kite)
FALCONIDAE	
<i>Milvago chimachima</i>	(Yellow-headed caracara)
<i>Polyborus plancus</i>	(Crested caracara)
PICIFORMES	
RAMPHASTIDAE	
<i>Ramphastos sulfuratus</i>	(Keel-billed toucan)
PASSERIFORMES	
TURDIDAE	
<i>Turdus grayi</i>	(Clay-colored robin)
MAMMALIA	
PRIMATES	
CEBIDAE	
<i>Cebus capucinus</i>	(White-faced capuchin)
CARNIVORA	
MUSTELIDAE	
<i>Lutra longicaudus</i>	(Otter)
REPTILIA	
SQUAMATA	
IGUANIDAE	
<i>Iguana iguana</i>	(Green iguana)
<i>Bolborhynchus lineola</i>	(Barred parakeet)
<i>Pionopsitta haematotis</i>	(Brown-hooded parrot)
<i>Pionus senilis</i>	(White-crowned parrot)
<i>Pyrrhura hoffmanni</i>	(Sulfur-winged parakeet)
PICIFORMES	
RAMPHASTIDAE	
<i>Ramphastos swainsonii</i>	(Chestnut-mandibled toucan)
PASSERIFORMES	
TURDIDAE	
<i>Turdus assimilis</i>	(White-throated robin)
* <i>Turdus grayi</i>	(Clay-colored robin)
MAMMALIA	
PRIMATES	
CEBIDAE	
<i>Ateles geoffroyi</i>	(Spider monkey)
<i>Alouatta palliata</i>	(Howler monkey)
* <i>Cebus capucinus</i>	(White-faced capuchin)
<i>Saimiri oerstedii</i>	(Squirrel monkey)
EDENTATA	
MYRMECOPHAGIDAE	
<i>Cyclopes didactylus</i>	(Silky anteater)
<i>Tamandua mexicana</i>	(Lesser anteater)
BRADYPODIDAE	
<i>Bradypus variegatus</i>	(Three-toed sloth)
<i>Choloepus hoffmanni</i>	(Two-toed sloth)

\* Endangered species detected during the field study.

CARNIVORA		
MUSTELIDAE		
	<i>Gallicictis vittata</i>	(Grison)
	<i>Lutra longicaudus</i>	(River otter)
PROCYONIDAE		
	<i>Bassariscus sumichrasti</i>	(Coonisttle)
	<i>Potos flavus</i>	(Kinkajon)
FELIDAE		
	<i>Felis concolor</i>	(Cougar)
	<i>Felis pardalis</i>	(Ocelot)
	<i>Felis tigrina</i>	(Little spotted cat)
	<i>Felis neidii</i>	(Margay)
	<i>Felis yagouaroundi</i>	(Jaguaroundi)
	<i>Panthera onca</i>	(Jaguar)
PERYSSODACTYLA		
TAPIRIDAE		
	<i>Tapirus bairdii</i>	(Baird's tapir)
TRICHECHIDAE		
	<i>Trichechus manatus</i>	(Indian manatee)
TAYASSUIDAE		
	<i>Tayassu pecari</i>	(White-lipped pecari)
CHIROPTERA		
PHYLLOSTOMATIDAE		
	<i>Vampyrum spectrum</i>	(False vampire bat)
AMPHIBIA		
CAUDATA		
PLETHODONTIDAE		
	<i>Oedipina carablanca</i>	(Salamander)
ANURA		
LEPTODACTYLIDAE		
	<i>Eleutherodactylus</i>	(Mountain toad)
HYLIDAE		
	<i>Agalychnis callidryas</i>	(Gaudy leaf frog)
CENTROLENIDAE		
	<i>Centrolenella spinosa</i>	(Glass frog)
	<i>Centrolenella vireovittata</i>	(Glass frog)
BUFONIDAE		
	<i>Atelopus varius</i>	(Harlequin frog)
DENDROBATIDAE		
	<i>Dendrobates granuliferus</i>	(Poison dart frog)
	<i>Phyllobates vittatus</i>	(Poison dart frog)
REPTILIA		
SQUAMATA		
SAURIA		
POLYCHRIDAE		
	<i>Norops chocorus</i>	(Anole)
IGUANIDAE		
	<i>Iguana iguana</i>	(Green iguana)
OPHIDEA		
BOIDAE		
	<i>Corallus hortulanus</i>	(Rainbow boa)
	<i>Boa constrictor</i>	(Boa)
COLUBRIDAE		
	<i>Clelia clelia</i>	(Musarana)
	<i>Spilotes pullatus</i>	(Bicolored mico)
VIERIDAE		
	<i>Bothriechis schlegelii</i>	(Eyelash viper)
CROCODYLEA		
CROCODYLIDAE		
	<i>Caiman crocodilus</i>	(Cayman)
	<i>Crocodylus acutus</i>	(Crocodile)

Appendix 16 Protected and Endangered Species of Paqueta and Naranjo Mouth  
after the Wildlife Division

the wildlife division include some of the species that were originally found in the region, and may be still present there, and others that may be already extinct.

Species	English name
AVES	
TINAMIFORMES	
TINAMIDAE	
<i>Tinamus major</i>	(Great tinamou)
PELECANIFORMES	
PELECANIDAE	
* <i>Pelecanus occidentalis</i>	(Brown pelican)
ANSERIFORMES	
ANATIDAE	
<i>Cairina moschata</i>	(Muscovy duck)
<i>Oxyura dominica</i>	(Masked duck)
FALCONIFORMES	
ACCIPITRIDAE	
<i>Accipiter bicolor</i>	(Bicolored hawk)
<i>Buteo brachyurus</i>	(Short-tailed hawk)
* <i>Buteo magnirostris</i>	(Roadside hawk)
<i>Buteo nitidus</i>	(Gray hawk)
<i>Buteo platypterus</i>	(Broad-winged hawk)
<i>Buteo swainsoni</i>	(Swainson's hawk)
* <i>Buteogallus anthracinus</i>	(Common black hawk)
<i>Buteogallus urubitinga</i>	(Great black hawk)
<i>Circus cyaneus</i>	(Northern harrier)
<i>Elanoides forficatus</i>	(American swallow-tailed kite)
* <i>Elanus caeruleus</i>	(Black-shouldered kite)
<i>Geranoospiza caerulescens</i>	(Crane hawk)
<i>Harpagus bidentatus</i>	(Double-toothed kite)
<i>Ictinia plumbea</i>	(Plumbeous kite)
<i>Leptodon cayanensis</i>	(Gray-headed kite)
<i>Leucopternis albicollis</i>	(White hawk)
<i>Spizaetus tyrannus</i>	(Black hawk eagle)
PANDIONIDAE	
<i>Pandion haliaetus</i>	(Osprey)
FALCONIDAE	
<i>Daptus americanus</i>	(Red-throated caracara)
<i>Falco ruficularis</i>	(Bat falcon)
<i>Falco sparverius</i>	(American kestrel)
<i>Herpetotheres cachinnans</i>	(Laughing falcon)
* <i>Milvago chimachima</i>	(Yellow-headed caracara)
<i>Microrastur semitorquatus</i>	(Collared forest falcon)
<i>Microrastur ruficollis</i>	(Barred forest falcon)
* <i>Polyborus plancus</i>	(Crested caracara)
GALLIFORMES	
CRACIDAE	
<i>Chamaepetes unicolor</i>	(Black guan)
<i>Crax rubra</i>	(Great curassow)
<i>Penelope purpurascens</i>	(Crested guan)
PSITTACIFORMES	
PSITTACIDAE	
<i>Amazona autumnalis</i>	(Red-lobed parrot)
<i>Ara macao</i>	(Scarlet macaw)
<i>Aratinga finschi</i>	(Crimson-fronted parakeet)

**DATA/INFORMATION OBTAINED**

**( 入 手 資 料 )**

**A - 13**

DATA/INFORMATION OBTAINED

(入手資料)

A - 13

### Data/Information Collected

The following reports/documents/information have been collected.

- (1) INFORME DE FACTIBILIDAD  
DIRECCION DE PLANIFICACION ELECTRICA  
Agosto, 1994
- (2) PROYECCIONES DE DEMANDA DE ENERGIA ELECTRICA 1994-2015  
DEPARTAMENTO DE TARIFAS Y MERCADO ELECTRICO  
Mayo, 1994
- (3) HIDROLOGIA OFICINA DE ESTUDIOS HIDROLOGICOS  
INFORME HIDROLOGICO DEL PROYECTO HIDROELECTRICO LOS LLANOS  
OFICINA DE ESTUDIOS HIDROLOGICOS  
Octubre, 1993
- (4) EVALUACION PRELIMINAR DEL POTENCIAL HIDROELECTRICO  
APROVECHABLE DE COSTA RICA  
PLAN MAESTRO DE LA CUENCA HIDROGRAFICA RIO NARANJO  
OFICINA PROYECTOS HIDROELECTRICOS  
Setiembre, 1987
- (5) INFORME HIDROLOGICO DE RECONOCIMIENTO P.H. LOS LLANOS  
OFICINA DE HIDROLOGIA  
Junio, 1990
- (6) SOLICITUD DE COOPERACION TECNICA PARA LA FACTIBILIDAD  
DEL PROYECTO HIDROELECTRICO LOS LLANOS  
DEPARTAMENTO PROYECTOS DE GENERACION  
Enero, 1992
- (7) DESCRIPCION DEL PROYECTO HIDROELECTRICO LOS LLANOS  
Junio, 1991
- (8) INFORME DE LABORES P.H. LOS LLANOS  
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Enero, 1994
- (9) DIAGRAMA UNIFILAR S.E.N.  
AÑO 2015



- (10) ESTUDIO SISMOLOGICO ETAPA DE FACTIBILIDAD  
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Febrero, 1993
- (11) SEDIMENTO EN SUSPENSION  
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Diciembre 1993
- (12) SEDIMENTOLOGICAL STUDIES IN THE CACHI RESERVOIR  
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- (13) OBRAS DE TRANSMISION PROGRAMA DE DESARROLLO ELECTRICO III  
PERIODO 1994-1998 RESPALDO DE COSTOS A DICIEMBRE DE 1992  
Febrero 1993
- (14) INFORMACION SUMINISTRADA A PRIMERA MISION JICA  
OFICINA EVALUACION ECONOMICA  
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- (15) RESUMEN DE CARACTERISTICAS DE PROYECTOS DE GENERACION  
Setiembre 1994
- (16) PRECIOS UNITARIOS DE OBRAS PARA CONSTRATISTAS Y POR  
ADMINISTRACION  
Diciembre 1993
- (17) SISTEMA ELECTRICO NACIONAL AÑO 2010  
DEPT. PROGRAMAS DE TRANSMISION
- (18) PLANTAS HIDROELECTRICAS DEL ICE  
OFICINA DE PUBLICACIONES
- (19) DEMANDA DE ENERGIA (1987-1993)  
ESCENARIO DE DEMANDA BASE (ABRIL 1994)  
PARAMETROS BASICOS DE LOS ESCENARIOS DE DEMANDA
- (20) POBLACION Y P.I.B. (1980-2015)
- (21) INDICADORES ECONOMICOS  
1980-1992
- (22) PRECIOS UNITARIOS PARA LAMINOS

VALIDOS PARA SEPTIEMBRE 1994

- (23) MINIMUM WAGE (DIARIO OFICIAL 20 de Julio de 1994)
- (24) TARIFAS PARA SUMINISTRO DE ENERGIA ELECTRICA  
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- (25) INFORME PRELIMINAR, ASPECTOS AMBIENTALES P.H. LOS LLANOS  
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- (26) DESARROLLO SOCIOECONOMICO Y EL AMBIENTE NATURAL  
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- (27) COUNTRY ENVIRONMENTAL PROFILE  
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- (28) LA DEPRECIACION DE LOS RECURSOS NATURALES EN COSTA RICA Y SU  
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- (29) AVENTURA CON REMOS, DESCRIPCION DE LOS VIAJES  
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- (30) ZONAS DE VIDA DE COSTA RICA  
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- (31) CUESTIONARIO PARA DETERMINAR LOS REQUERIMIENTOS DE PRESENTACION  
DE ESTUDIOS DE IMPACTO AMBIENTAL
- (32) GUIA PARA LA ELABORACION DE ESTUDIOS DE IMPACTO AMBIENTAL PARA  
PROYESTOS DE ACUACULTURA EN REFUGIOS DE VIDA SILVESTRE Y  
HUMEDADES
- (33) GUIA PARA LA ELABORACION DE ESTUDIOS DE IMPACTO AMBIENTAL PARA  
PROYECTOS DE SALINAS EN APROVECHAMIENTO DE RECURSOS NATURALES  
RENOVABLES
- (34) ANIMALS EN PELIGRO DE EXTINCION DE COSTA RICA  
PUBLICACION FINANCIADA POR HOLANDA, CANADA, USA 1990
- (35) REGULACIONES PARA EL EJERCICIO DE LA CAZA Y LA PESCA

CONTINENTAL DURANTE EL AÑO 1990

- (36) HISTORIA NATURAL DE COSTA RICA
- (37) ALGUNAS ESPECIES EN PELIGRO DE EXTINCION PROTEGIDAS EN LOS PARQUES NACIONALES DE COSTA RICA
- (38) PROYECTO DE REGLAMENTACION DEL MANEJO DEL RECURSO AIRE
- (39) PROGRAMA DE CONTROL DE CONTAMINACION DEL AIRE EN COSTA RICA
- (40) REGULAMENTO PARA EL CONTROL DE RUIDOS Y VIBRACIONES
- (41) REGULATIONS; POTRONES OPS PARA AGUA POTABLE, CONTAMINACION POR LIQUIDOS, RESIDUOS SOLIDOS
- (42) OUTLINE OF FISHERY OPERATING IN THE SEA NEAR QUEPOS
- (43) PLAN DE DESARROLLO SOSTENIBLE Y AREA DE CONSERVACION QUEPOS AGUIRRE-PARRITA-ASERRI-TARRAZU-DOTA-PEREZ ZELEDON  
Julio 1994
- (44) CONVENTION ON WETLAND OF INTERNATIONAL IMPORTANCE ESPECIALLY AS WATERFALL HABITAT
- (45) MANUAL DESCRIPTIVO DE LA LEYENDA DEL MAPA DE ASOCIACIONES DE SUBGRUPOS DE SUELOS DE COSTA RICA  
MIDEPLAN 1991
- (46) SOME COMMENTS ON BEACHES  
KATO (JICA) 1987
- (47) DATA RELATING REGIONAL FISHERY  
ICE 1994
- (48) INFORME SOBRE FORMACIONES VEGETALES EN LAS OBRAS DEL PH. LOS LLANOS  
ICE 1995
- (49) NOTA INTERNA  
ICE 1995
- (50) INVENTARIO DE MEDERA COMERCIAL EN EL AREA DEL EMBALSE

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- (51) COMISION COODINADORA PARA LA REGENERACION, CONSERVACION Y MANEJO DE LOS RECURSOS
- (52) NATURALES EN AGUIRRE Y PARRITA (1994): PLAN DE DESARROLLO SOSTENIBLE Y AREA DE CONSERVACION QUEPOS
- (53) ECOLOGY OF MANGROVES  
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- (54) LOS MANGLARES DEL PACIFICO DE CENTROAMERICA  
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- (55) LOS LLANOS HYDROELECTRIC PROJECT: PRELIMINARY REPORT  
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- (56) INVENTARIO DE MEDERA COMERCIAL EN EL AREA DEL EMBALSE
- (57) POBLACION POR SEXO SEGUN CANTON Y DISTRITO ADMINISTRATIVO 1994
- (58) POBLACION URBANA Y GRADO DE URBANIZACION, CIUDADES Y VILLAS INVOLUCRADAS SEGUN CANTON, 1984
- (59) DATOS SOCIOGEOGRAFICOS SEGUN DISTRITO ADMINISTRATIVO
- (60) ALGUNOS INDICADORES DE EMPLEO SEGUN CANTON, 1973-1984
- (61) GRADO DE INDUSTRIALIZACION POR NUMERO DE ABONADOS
- (62) GRADO DE INDUSTRIALIZACION POR VENTAS DE ENERGIA
- (63) TASAS MIGRATORIAS NETAS POSITIVAS Y NEGATIVAS POR CANTONES 1973-1984
- (64) MAPA DE ACTIVIDAD ECONOMICA POR SECTOR ECONOMICO SEGUN CANTON
- (65) INFORME SOBRE FORMACIONES VEGETALES EN LAS OBRAS DEL P.H. LOS LLANOS
- (66) CONTIENDO QUIMICO MUESTRAS DE AGUA P.H. LOS LLANOS 28/6/95
- (67) DATA OF AIR TEMPERATURE AND HUMIDITY AT 3 LOCATIONS

(68) WATER FLOW RATE OF NARANJO RIVER IN SALINITY MEASUREMENT

(69) MANUAL DESCRIPTIVO DEL MAPA GEOMORFOLOGICO DE COSTA RICA

(70) AERIAL PHOTOGRAPH

1: 10,000 R.274 L-B 50008-50011

R.274 L-D 50026-50031

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1: 20,000 R.274 L-B 49978-49983

(71) AERIAL MAP

1: 2,000 No.3, No.4, No.5, No.6

1: 10,000 No.1, No.2

(72) INSTITUTO GEOGRAFICO NACIONAL

1: 200,000 CR2CM-5 SAN JOSE

CR2CM-7 QUEPOS

1: 50,000 3345 I ABRA

3345 II CARAIGRES

3344 I DOTA

3344 II QUEPOS