

Appendix 3. Data Tables.

Appendix Table 2-1. List of mammal species, excluding bats, commonly seen along the Sittee River.

Virginia opossum
Gray four eyed opossum
Central American wooly opossum
Mouse opossum
Northern tamandua
Anteater
Armadillo
Yucatan squirrel
Central American agouti (Dasyprocta)
Paca (gibnut)
Gray fox
Jaguarundi
Margay
Ocelot
Jaguar
Striped hog nose skunk
Tayra
Neotropical otter
Kinkajou
White nosed coati
Collared peccary
White-lipped peccary
Red brocket deer
Baird's tapir
West Indian manatee

Appendix Table 4-1. Absolute values of litter mass and crab hole density.

Date/Location	Litter Mass (g dry wt./m ²)	Crab Hole Density (#/25 m ²)
8/05		
Possum Point hardwoods	165.9	15.8
Possum Point bamboo	1037.4	0
3/06		
Possum Point hardwoods	180.1	12.2
Possum Point bamboo	878.9	0.6
3/07		
Downstream from Bocatura Bank:		
By river	102.5	38.5
Away from river	264.0	6.0
Kaway swamp	1720.0	0

Appendix Table 4-2. List of fish species collected in the lower Sittee River, classified as peripheral species or marine invaders by Miller (1966).

Family	Species	Common Name
Tetraodontidae	Sphoeroides sp.	puffer
Gerreidae	Gerres cinereus	stone bass
	Eucinostomus melanopterus	
	unknown	shad
Belonidae	Strongylura marina	needlefish
Carangidae	Caranx latus	jack
	Oligoplites saurus	leatherjacket
	Trachurus lathami	
Sciaenidae	unknown	drummer
	Bairdiella sp.	
Centropomidae	Centropomus ensiferus	snook
Soleidae	Achirus maculatus	flatfish
Eleotridae	Eleotris amblyopsis	mudfish
	Dormitator maculatus	mudfish
Gobiidae	Gobionellus sp.	goby
Engraulidae	Anchoviella sp. 1	anchovy
	Anchoviella sp. 2	anchovy
Ariidae	unknown	catfish
Megalopidae	Megalops atlanticus	tarpon

Appendix Table 4-2. Peripheral species continued.

Family	Species	Common Name
Mugilidae	<i>Agonostomus monticola</i>	mullet
Polynemidae	<i>Polydactylus</i> sp.	
Serranidae	<i>Centropristis ocyurus</i>	
Blenniidae	<i>Lupinoblennius dispar</i>	
Lobotidae	<i>Lobotes surinamenis</i>	
Haemulidae	<i>Pomadasys crocro</i>	
Lutjanidae	<i>Lutjanus griseus</i>	snapper
Albulidae	<i>Albula vulpes</i>	bonefish
Sphyraenidae	<i>Sphyraena barracuda</i>	barracuda

Appendix Table 4-3. List of fish species collected in the lower Sittoung River, classified as primary or secondary species by Miller (1966).

Family	Species	Common Name
PRIMARY		
Characidae	Astyana fasciatus	billum
	Brycon guatemalensis	machaka
SECONDARY		
Synbranchidae	Synbranchus marmoratus	mud eel
Poeciliidae	Belonesox belizanus	alligator fish
	Gambusia sp.	pupsy
	Heterandria bimaculata	
	Xiphophorus sp.	swordtail
	Unknown sp. 1	
	Unknown sp. 2	
Cichlidae	Cichlisoma sp.	tuba
	Petenia splendida	bay snook

Appendix Table 4-4. Analysis of stomach contents of fishes from the lower Sittee River.

Species	Total fish	No. with empty stomachs	Algae	Plant material	Seed	Annelid	Mollusc	Decapod	Isopod	Amphipod	Insect larvae	Fish
<i>Albula vulpes</i>	51	6	0	0	0	1	3	39	0	4	0	1
<i>Cichlisoma</i> sp.	32	0	21	16	2	0	0	0	0	0	0	0
<i>Centropomus ensiferus</i>	63	32	1	6	0	0	0	14	0	0	0	15
<i>Gerres cinereus</i>	16	4	9	4	0	0	0	3	0	0	0	0
<i>Megalops atlanticus</i>	12	3	1	2	0	0	1	3	0	1	0	6
<i>Brycon guatemalensis</i>	46	2	0	44	19	0	0	0	0	0	1	0
<i>Caranx latus</i>	11	4	0	2	0	0	0	1	0	0	0	4
<i>Diapterus plumieri</i>	3	2	0	0	0	1	0	0	0	0	0	1
Unknown Ariidae4	1	0	0	0	0	0	1	0	0	0	2	
<i>Lutjanus griseus</i>	13	4	0	1	0	0	0	5	1	0	0	2
<i>Sphyrna barracuda</i>	6	2	0	0	0	0	0	0	0	0	0	4
<i>Agonostomus monticola</i>	8	5	0	2	0	1	0	0	0	0	0	0
<i>Micropogon undulates</i>	9	6	0	0	0	0	0	3	0	0	0	0
<i>Strongylura marina</i>	2	0	0	0	0	0	0	1	0	0	0	1

Appendix Table 4-4. Continued

Species	Total fish	No. with empty stomachs	Algae	Plant material	Seed	Annelid	Mollusc	Decapod	Isopod	Amphipod	Insect larvae	Fish
<i>Eleotris ambliopsis</i>	2	0	0	0	0	0	0	1	0	1	0	0
<i>Epinephalus itajara</i>	1	1	0	0	0	0	0	0	0	0	0	0
Bay snook	2	2	0	0	0	0	0	0	0	0	0	0
Grunt	1	0	0	0	0	0	0	1	0	0	0	0

Predator

Prey

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y
a	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0
c	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
d	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	1	1	1	1	0
g	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	0
h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	0
i	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	0
j	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	0
k	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	0
l	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
n	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
o	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
p	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
u	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
v	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
w	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a. detritus

b. fruit

c. algae

d. deadwood

e. shipworms

f. crabs

g. Palaemonid shrimp

h. small tuba

i. Atyid shrimp

j. mudfish

k. Gambusia

l. large tuba

m. bonefish

n. shad

o. snapper

p. snook

q. tarpon

r. kingfisher

s. great blue heron

t. little blue heron

u. night heron

v. tiger heron

w. egret

x. turtles

y. crocodiles

Appendix Table 4-5. Adjacency matrix for the brackish water food web.

Appendix Table 4-6. Calculations for energy flow of top predators in the brackish zone of the Sittee River.

Crocodile average body mass = 30 kg/individual (assumed, based on Spector (1956))

Turtle average body mass = 5 kg/individual (assumed, based on Spector (1956))

Density of crocodiles from rivermouth to Flap Doodle Farm, 11 individuals

Density of turtles from rivermouth to Flap Doodle Farm, 9 individuals

Reptile metabolic equation: $SMR = 0.086 (x)^{0.728}$ (Peters 1986)

Where, SMR = standard metabolic rate, watts and x = body mass, kg

Crocodile SMR = $0.086(30 \text{ kg/individual})^{0.728}$

= 1.0 watts/individual

Total crocodile energy flow = (1.0 watts/individual)(11 individuals) = 11 watts

Turtle SMR = $0.086(5 \text{ kg/individual})^{0.728}$

= 0.3 watts/individual

Total turtle energy flow = (0.3 watts/individual)(9 individuals) = 2.7 watts

Total reptile energy flow = 2.7 watts + 11 watts = 13.7 watts

Aquatic bird average body mass = 2 kg/individual (assumed, based on (Spector 1956))

Density of aquatic birds from rivermouth to Flap Doodle Farm, 10 individuals

Bird metabolic equation: $SMR = 3.35(x)^{0.64}$ (Peters 1986)

Where, SMR = standard metabolic rate, watts/individual and x = body mass, kg

Aquatic bird SMR = $3.35(2 \text{ kg/individual})^{0.64}$

= 5.2 watts/individual

Aquatic bird energy flow = (5.2 watts/individual)(10 individuals) = 52 watts

Appendix Table 4-7. Fanny Young macroinvertebrates, 7/29/91, 6/20/92, 8/12/92, 3/20/06. The relative abundance classes are: abundant, common, uncommon and rare.

Taxa	Relative Abundance
INSECTA	
Hemiptera	
Notonectidae	abundant
Gerridae	uncommon
Nepidae	rare
Odonata	
Coenagrionidae	uncommon
Libellulidae	uncommon
Diptera	
Chironomidae	uncommon
POLYCHAETA - Oligochaeta	rare

Appendix Table 4-8. Boom Creek macroinvertebrates, 6/21/91, 7/26/91, 7/26/91, 6/22/92, 8/11/92, 3/21/06. The relative abundance classes are: abundant, common, uncommon and rare.

Taxa	Relative Abundance
INSECTA	
Hemiptera	
Gerridae	uncommon
Notonectidae	uncommon
Belostomatidae	rare
Nepidae	rare
Diptera	
Chironomidae	rare
CRUSTACEA - Decapoda	
Palaemonidae	abundant
Grapsidae	rare
Ocypodidae	rare
MOLLUSCA - Bivalvia	
Teredinidae	uncommon
Mytilidae	uncommon

Appendix Table 4-9. Fishes caught in Fanny Young by seining, 7/21/91, 6/20/92, 8/13/92, 3/24/97.

Species	numbers (percentage)	frequency
<i>Astyana fasciatus</i>	93 (44.7)	2/4
<i>Hyphessobrycon milleri</i>	47 (22.6)	1/4
<i>Cichlisoma</i> sp.	25 (12.0)	4/4
<i>Dormitator maculatus</i>	21 (10.1)	3/4
<i>Gambusia</i> sp.	5 (2.4)	2/4
<i>Heterandria bimaculata</i>	5 (2.4)	2/4
<i>Eleotris ambliopsis</i>	5 (2.4)	2/4
<i>Belonesox belizanus</i>	4 (1.9)	2/4
<i>Synbranchus marmoratus</i>	1 (0.5)	1/4
<i>Xiphophorus</i> sp.	1 (0.5)	1/4
Unknown Poeciliidae	1 (0.5)	1/4
TOTAL	208	

Appendix Table 4-10. Fishes caught in Boom Creek by seining, 6/21/91, 7/26/91, 6/22/92, 8/11/92, 3/26/97.

Species	numbers (percentage)	frequency
Gambusia sp.	61 (61.0)	5/5
Cichlisoma sp.	11 (11.0)	2/5
Astyana fasciatus	6 (6.0)	1/5
Heterandria bimaculata	5 (5.0)	1/5
Oostetus maculatus	3 (3.0)	2/5
Centropomus ensiferus	3 (3.0)	2/5
Belonesox belizanus	3 (3.0)	2/5
Dormitator maculatus	3 (3.0)	2/5
Eleotis ambliopsis	3 (3.0)	1/5
Unknown Poeciliidae sp. 1	1 (1.0)	1/5
Unknown Poeciliidae sp. 2	1 (1.0)	1/5
TOTAL	100	

Appendix 5-1. Footnotes to Table 5-2. All data are from farmer interviews.

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- 1 (cost of labor, 1\$/box of oranges)(100 trees/acre)(3 boxes harvested/tree/yr.)
 - 2 (application rate, 8 lbs/tree/yr.)(price, 0.27\$/lb)(100 trees/acre)
 - 3 (cleaning rate, 4 times/yr.)(1 hour/acre for cleaning)(rental price, 25\$/hour)
 - 4 (application rate, 4 lbs/tree/yr.)(100 trees/acre)(price, 0.08\$/lb)
 - 5 (application rate, 4 times/yr.)(1 backpack sprayer/20 trees)(3 gal of water/backpack sprayer)(4 oz of herbicide/3 gal of water)(1 gal/128 oz)(price, 47.00\$/gal of herbicide)(100 trees/acre)
 - 6 (yield, 3 boxes of oranges harvested/tree/yr.)(100 trees/acre)(price, 3.00\$/box)
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Appendix Table 5-2. Procedures for coconut oil production in Sittie River.

Step	Procedure
1	purchase or collect coconuts
2	husk outer shell
3	cut away inner shell of nut
4	collect meat from inner shell and grind it
5	mix ground meat with water and squeeze out liquid
6	let material settle overnight, then skim off oil
7	boil oil for approximately 1 1/2 hours
8	strain oil for impurities; pour in to bottles or buckets for transport to market

Appendix Table 5-3. Life stage distributions for coconut palms along the Sittee River. 1,103 individuals were counted in 1993 and 618 individuals were counted in 1997. See text for definitions of life stages.

	1993	1997
seedlings	50 %	48 %
juveniles	17 %	15 %
subadults	10 %	11 %
adults	23 %	26 %

Appendix Table 6-1. Survey of large mahogany trees along the lower Sittee River.

Location	diameter at breast height (cm)	height (ft.)
Clifford's old house	78.6	82
Big George's yard	73.3	70
	43.7	50
	83.0	72
	61.5	66
	65.5	78
	90.4	72
	83.8	66
Downstream from Bocatura Bank	109.0	76
	49.5	81
	85.0	110
	43.5	71
Possum Point trail – on river	67.5	78
Possum Point trail – inside forest	68.5	72
Gaskin property	99.1*	60
American guy along river	88.5	75
Marie Mead's property	67.3	62
	80.3	70
	85.2	72

Appendix Table 6-2. Wind speed attenuation over time at Wee Wee Caye on November 17, 2002. Data are average wind velocities in miles/hour with gust velocities in parentheses. The transect locations range from the protected, inner clearing at 0 meters to the exposed end of the dock at 60 meters.

Transect location, Meters	9:00AM	10:00AM	11:00AM	2:30PM
0	5 (8)	4 (6)	< 2 (3.5)	<2 (3.5)
18	4 (6)	3.5 (4.5)	2 (3)	<2 (3.5)
26	2 (3)	2 (3)	<2 (2)	<2 (<2)
30	5 (12)	2.5 (4)	2 (4)	<2 (5)
34	20 (24)	14 (20)	11 (14)	8 (10)
40	20 (26)	14 (21)	12 (17)	8 (10)
48	20 (24)	14 (16)	12 (18)	8 (10)
53	20 (30)	14 (16)	11 (14)	8 (10)
60	20 (26)	14 (18)	11 (16)	8 (10)

Appendix Table 6-3. List of resident and migratory birds from the Possum Point Biological Station.

Residents

green heron	little blue heron
great (American) heron	great blue heron
snowy egret	cattle egret
yellow crowned night heron	roadside hawk
common black hawk	turkey vulture
black vulture	king vulture
Montezuma oropendola	chestnut headed oropendola
bat falcon	plain chachalaca
great tinamou	slaty breasted tinamou
great kiskadee	boat billed flycatcher
yellow olive flycatcher	Wied's crested flycatcher
social flycatcher	tropical kingbird
white throated spadebill	northern beardless tyrannulet
northern bentbill	gold fronted woodpecker
lineated woodpecker	ivory billed woodcreeper
tawny winged woodcreeper	masked tityra
red capped manakin	citreoline trogon
collared aracari	keel billed toucan
brown jay	Yucatan jay
great tailed grackle	melodius blackbird
red crowned ant tanager	black headed slatator
white collared seedeater	clay colored robin
groove billed ani	squirrel cuckoo
ringed kingfisher	Amazon kingfisher
pygmy kingfisher	sun grebe
Aztec parakeet	yellow headed parrot
ruddy ground dove	white tipped dove
mangrove swallow	rough winged swallow
spot breasted wren	long tailed hermit
little hermit	rufous-tailed hummingbird
neotropic cormorant	mangrove warbler
orange oriole	red crowned parrot
bare-throated tiger heron	white crowned parrot
tropical mockingbird	solitary eagle
gray headed kite	boat billed heron
green kingfisher	black cowled oriole
yellow billed cacique	common tudy flycatcher
anhingha	yellow winged tanager
black throated shrike tanager	grayish saltator

Appendix Table 6-3. Continued.

white collared swift	streak headed woodcreeper
olivaceous woodcreeper	least grebe
mangrove cuckoo	blue gray tanager
white necked Jacobin	white collared manakin
swallow tailed kite	blue ground dove
gray necked woodrail	jabiru
hooded oriole	smoky-brown woodpecker
blue honey creeper	red lored (yellow cheeked) parrot
gray headed tanager	yellow throated euphonia
vermiculated screech owl	common parauque
dusky capped flycatcher	magnificent frigate bird
southern house wren	black bellied whistling duck
pale vented pigeon	blue crowned motmot
mottled (wood) owl	golden olive woodpecker
gray hawk	tri-colored heron
yellow bellied tyrannulet	yellow tailed oriole
red-legged honey creeper	osprey
collared forest falcon	crested guan
red throated ant tanager	strong-billed woodpecker
mealy (blue-crowned) parrot	muscovy duck
plumbeous kite	white-tailed hawk
black hawk eagle	gray breasted martin
limpkin	gray chested dove
violet sabrewing	laughing falcon
white-chinned swift	Uxmal woodpecker
blue-hooded euphonia	chestnut-colored woodpecker
bright-rumped atilla	white necked puffbird
cinnamon hummingbird	Yucatan vireo
masked tanager	forked-tailed flycatcher
migrants	
red-eyed vireo	orchard oriole
spotted sandpiper	hooded warbler
black & white warbler	magnolia warbler
Kentucky warbler	worm-eating warbler
American redstart	oven bird
northern waterthrush	yellow throated vireo
wood thrush	gray catbird
yellow throated warbler	yellow bellied sapsucker
summer tanager	northern oriole
prothonotary warbler	cedar waxwing

Appendix Table 6-3. Continued.

parula warbler	yellow throat
Vaux's swift	Lousiana waterthrush
white-eyed vireo	belted kingfisher
barn swallow	indigo bunting
blue winged warbler	Canada warbler
palm warbler	wood ibis (stork)
scissor tailed flycatcher	American coot
yellow-breasted chat	rose-breasted grosbeak
golden-winged warbler	Blackburnian warbler
yellow warbler	

$$\begin{aligned}\frac{dN}{dt} &= k_1 RN - k_2 N - k_3 IN - k_{11} \left(\frac{TIN}{P_o} \right) N \\ \frac{dI}{dt} &= k_5 GL - k_4 I \\ \frac{dO}{dt} &= -k_8 OG \\ J_D &= k_{10} \frac{TIN}{P_o} P_T \\ J_T &= k_9 \frac{TIN}{P_o} \\ R &= \frac{J}{k_o N + 1}\end{aligned}$$

NOTE Calibrated Storages and Flows

1	J=	4.60E+10 m ³ /yr	Rainfall energy
2	R=	9.30E+09 m ³ /yr	Estimated remainder after ET
3	N=	1.35E+06 ha	Current area of rainforest
Prehistorical numbers for rainforest			
4	N=	2.11E+06 ha	Historical area of rainforest
5	R=	6.40E+09 m ³ /yr	Historical remainder after ET.
6	J1=	2323 ha/yr	Natural expansion rate of rainforest (estimate).
7	J2=	2323 ha/yr	Natural loss rate of rainforest (estimate).
Current (2000) numbers for all others			
8	N=	1.35E+06 ha	Total rainforest remaining (2000)
9	R=	2.24E+10 m ³ /yr	ET potential remaining (scaled to N for 2000)
10	I=	4450 rooms	Estimate of rooms in 2000
11	Po=	25 \$/bbl	Annual average of oil prices (2000)
12	J1=k1RN=	5.19E+03 ha/yr	Estimate of natural gain of N (2000)
13	J2=k2N=	1.48E+03 ha/yr	Estimate of natural losses of N (2000)
14	J3=	8.95E+03 ha/yr	Estimate of N losses from tourism construction (2000)
15	J11=	8.95E+03 ha/yr	Estimate of N losses from tourist impact (2000)
16	G=	2.16E+06 \$/yr	Estimate of global \$ input to I (2000)
17	J6=	1.15E+08 man-hr/yr	Estimate of local labor input to I (2000)
18	JT =	1.95E+05 tourists/yr	Annual flow of tourists (2000)
19	T0=	1.00E+06 tourists/yr	Total supply flow of tourists (estimate)
20	T=	8.05E+05	
21	J4=	2.10E+02 rooms/yr	Assumed number of rooms lost (2000)
22	J5=	2.10E+02 rooms/r	Assumed number of rooms built (2000)
23	L0=	2.40E+08 man-hr/yr	Total labor pool (2003)
24	L=	1.25E+08 man-hr/yr	Remainder of labor pool (2003)
25	PL=	1.13E+00 \$/man-hr	labor rate (2000)
26	Joil=	2.40E+10 bbl/yr	Oil production rate for 1997
27	Goil=	1.00E+06	Assumed
28	O=	5.00E+12 bbl	Estimated oil reserves.
29	Poil=	2.50E+01 \$/bbl	Oil price for 2000
30	J\$=	1.80E+13 \$/yr	Estimate of world GNP for 1997

Total labor...

Appendix Table 8-1 CONTINUED

Note	Comment
1	Rainfall energy calculated as the average annual rainfall of 2.00 m/yr (NASA LARC, 2005) multiplied by the total land area of $2.30 \times 10^6 \text{ m}^2$ (World Bank, 1984).
2	R determined by the estimated evapotranspiration rate. Total forested land area (in year 2000) is $1.348 \times 10^6 \text{ ha}$ (World Resources Institute, 2003). Estimated ET rate of 1.75 m yr^{-1} yields a total ET of $2.359 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$. This is subtracted from the total rainfall of $4.60 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$ to yield $2.24 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$.
3	Estimated area of rainforest in FY2000, as reported by World Resources Institute (2003).
4	Original, prehistoric area of rainforest, reported by World Resources Institute (2003) as 92% of total land area of Belize.
5	Historical R determined by the estimated evapotranspiration rate. Total historical forested land area is reported as 92% of land area, thus $2.112 \times 10^6 \text{ ha}$ (World Resources Institute, 2003). Estimated ET rate of 1.75 m yr^{-1} yields a total ET of $3.96 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$. This is subtracted from the total rainfall of $4.60 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$ to yield $0.64 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$.
6	Natural expansion rate of rainforest. Estimated by multiplying rainforest primary productivity by total prehistorical rainforest area and dividing by average biomass density of rainforest, and assuming that 1% of productivity is available for spatial expansion. Tropical rainforest mean net primary productivity estimated as 22 t/ha/yr by Holdgate (1996). Average biomass density of rainforest was estimated at 351 t/ha for Colombia (Overman et al. 1994) and 149 t/ha for Brazil (Santos et al. 2002), thus an estimate of 200 t/ha is used here for Belize. Thus, $(0.01)(22 \text{ t/ha/yr})(2.112 \times 10^6 \text{ ha}) / (200 \text{ t/ha}) = 2323 \text{ ha/yr}$.
7	Assumed equal to natural expansion rate at prehistoric steady state.
8	Total area of remaining rainforest in FY 2000, as reported by World Resources Institute (2003).
9	See Note 2.
10	Estimated total number of hotel rooms in Belize in 2000. Sluder (1995) reported 3,400 guest rooms in some 300 hotels for year 1995. Estimation from current hotel listings (Belize Tourism Board, 2005) yields 5500 guest rooms in some 523 hotels for year 2005. Interpolation yields 4450 rooms for year 2000.
11	Annual average of oil prices for FY2000, estimated from WTRG (2002).
12	Estimate of the natural growth rate of N at the value of N for FY2000, and calculated by $k_1 \cdot R \cdot N$.
13	Estimate of the natural loss rate of N at the value of N for FY2000, and calculated by $k_2 \cdot N$.
14	Estimate of annual losses of N due to construction of tourist infrastructure. Total forest lost from 1990 to 2000 reported to be $358,000 \text{ ha}$ (World Resources Institute, 2003). Thus annual average forest lost was $35,800 \text{ ha/yr}$. Assumed that 50% (thus, $17,900 \text{ ha/yr}$) of this lost was for all tourism activities, and 50% of this (thus, $8,950 \text{ ha/yr}$) was due to impact from tourism infrastructure.
15	Estimate of annual losses of N due to impact from tourists themselves. Assumed equivalent to J3 (see note 14).

APPENDIX TABLE 8-1 CONTINUED

- 16 Estimate of annual outside foreign investment in tourism infrastructure. U.S. Embassy Belize (2002) reports two major investors in Belize tourism: Caye Chapel Ventures, investing \$10E6 from 1996 to 2002, yielding an average of \$1.667E6/yr, and Ramon's Village, investing \$5E6 from 1981 to 2002, yielding an average of \$250,000/yr. Total annual investment of \$1.917E6/yr is rounded up to \$2E6/yr. In addition, two oil companies invested in Belize: Esso, investing \$9.6E6 from 1954 to 2002, yielding an average of \$2.0E5/yr, and Texaco, investing \$4.5E6 from 1964 to 2002, yielding an average of \$1.2E5/yr. Thus total oil investments is \$3.2E5/yr, of which 50% is assumed to support tourism, yielding a total foreign tourism investment of \$2.16E6/yr.
- 17 Estimate of local labor input to tourist infrastructure and services. Calculated from total work force of 90,000 persons (U.S. Embassy Belize, 2002; CIA, 2005). Assuming an 8-hour day and a 5-day work week yields 1.8E8 man-hr/yr. CIA (2005) reports that 55% (thus, 9.9E7 man-hr/yr) occupied in services, and 18% (thus, 3.24E7 man-hr/yr) occupied in industry. Assuming all the service and half of industrial labor supports the tourism industry yields a resulting 11.5E8 man-hr/yr.
- 18 Annual flow of tourists in 2002, as reported by U.S. Department of State (2004).
- 19 Arbitrary estimate of total number of possible international tourists.
- 20 Remainder of tourists, equal to total possible (note 19) minus the annual flow to Belize (note 18).
- 21 Number of hotel rooms in Belize increased from 3400 (Sluder, 1995) to 5500 (Belize Tourism Board, 2005) in 10 years, thus averaging an increase of 210 rooms per year. This is assumed to be the number of rooms lost as steady-state.
- 22 Using the calculation for note 21, this is assumed to be the number of rooms built per year at steady state.
- 23 Total labor pool in man-hours. Population of Belize in 1999 approximately 240,000 (CSO Belize, 2003). Assumed that 1/2 of population (thus 120,000 people) is employable. This is multiplied by the number of man-hours per year (assumed to be 8 hours per day, 5 days per week, 50 weeks per year) to yield 2.40E8 man-hours.
- 24 Remainder of labor available, calculated by subtracting the labor input to tourism (in man-hours per year; see note 17) from the total labor (see note 23).
- 25 National minimum wage for Belize is set at US \$1.13 (US Embassy Belize, 2002).
- 26 Annual average world crude oil production rate calculated from daily average for 1997, reported by DOE (2002)
- 27 Assumed for arbitrary constant.
- 28 Probable oil reserves remaining, as reported by Odell and Rosing (1983)
- 29 Estimated annual average for price of oil for 1997 as reported by WTRG (2003)
- 30 Estimate of world GNP for 1997, as reported by Costanza, et al. (1997)