

# A SINGLE SPECIES ACTION PLAN FOR THE CONSERVATION OF THE YELLOW-BILLED COTINGA (*Carpodectes antoniae*)



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## **PREFACE**

This species conservation action plan outlines priority conservation and research actions which address the threats and other limiting factors which have resulted in the endangered global conservation status of the Yellow-billed Cotinga (*Carpodectes antoniae*), a Costa Rican resident and regional endemic species. While research into life history traits and species ecology are in its early stages, this plan is intended to be a preliminary road map guiding conservation, research and long term monitoring. This plan describes species behavioral characteristics, highlights threats to the population, and suggests activities needed to reach proposed conservation goals. All recommendations reflect current available knowledge and strategies proposed are meant to be adaptive as new information comes to light. This action plan's fundamental goal is to avert further population declines and seeks to prevent the extinction of this little known and highly endangered species.

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## **REVIEWS**

This International Single Species Action Plan should be reviewed and updated every five years (first review in 2016). An emergency review will be undertaken if there is a sudden major change liable to affect one of the populations.

## **RECOMMENDED CITATION:**

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**COVER PICTURE:** Adult Yellow-billed Cotinga (*Carpodectes antoniae*) © Christina Boldero

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*Immature Female Yellow-billed Cotinga (Carpodectes antoniae) captured and radio-tagged February 2011 at the Rincon River and mangrove estuary, Costa Rica. Copyright© Karen Leavelle*

## **I. EXECUTIVE SUMMARY**

### **Background**

The Yellow-billed Cotinga (*Carpodectes antoniae*) is a rare and range restricted passerine regionally endemic to southern Costa Rica and northern Panama's Pacific coast. This canopy dwelling species requires both mangroves and adjacent premontane wet tropical forest in both the reproductive and non-reproductive times of the year. This species requires close access to fruit from mature mixed rainforest tree species preferring a mixed diet of both fruit and insects. The Yellow-billed Cotinga appears to be a lekking species but has not been defined as such. Males gather in courtship display groups to attract females and radio-tagged males (Leavelle 2011) have not been observed attending any nest. Only one nest has been found to date in red mangrove (*Rhizophora mangle*) (Abraham Gallo, pers. com.) but has not been formally described. Females have been observed carrying nesting material from rainforest into mangroves. However, the reproductive ecology for this species is otherwise unknown.

### **Population Status**

The Yellow-billed Cotinga is considered a tropical resident of Costa Rica and Panama of high conservation concern and the International Union for the Conservation of Nature (IUCN) has classified this species as globally “endangered”. Its population is thought to be declining rapidly within its small geographic range occurring only within an estimated six disjunctive areas. Habitat loss has nearly caused its disappearance from Panama and its current stronghold appears to be the Osa Peninsula and the mangroves of the Térraba-Sierpe National Wetlands and Golfo Dulce river estuaries. It is estimated to have a range population between 298 – 794 individuals remaining (BirdLife International 2011). Leavelle (2011) provides an index of 0.422 birds/ha for a total of 130 birds for the Rincon River estuary. This is only meant to be an index for comparison to look for trends in the population until an intense area search for leks can be identified and a closed population model can be estimated.

### **Population Threats**

Anthropogenic and non-habitat threats have been identified as having known or potential negative impacts on the Yellow-billed Cotinga population.

- ❖ Habitat loss and degradation
- ❖ Climate change effects on habitat
- ❖ Specialized life history requirement of adjoining mangrove and rainforest habitats

Specific ecological and demographic characteristics (differentiated use of each habitat type, the fragmented nature of mangrove estuaries and small population size) may render the Yellow-billed Cotinga more vulnerable to human pressures and stochastic events.

### **Population Goals and Conservation Actions**

Population status and trends over the Yellow-billed Cotingas current range need to be determined and monitored over an established time period. The primary conservation goal should be to have no further loss in habitat and distribution and a potential increase in the population through habitat restoration. Addressing habitat loss and degradation at current sites should mitigate any further loss within isolated Yellow-billed Cotinga populations leading to positive effects in achieving overall conservation goals. Since the magnitude of effects of threats and limiting factors are not well understood, we begin to address specific conservation goals protecting, managing and restoring Yellow-billed Cotinga year-round habitat.

A specific population goal should be established by a recommended *Yellow-billed Cotinga Conservation Working Group* (YBCCWG), a broad based public and private partnership set up to define and refine conservation, research and population goals and to evaluate progress annually. The YBCCWG will refine methods and protocols for monitoring to determine the population size of the Yellow-billed Cotinga across its range which will be used as a baseline to

monitor population trends over time. The working group will then establish an agreed upon population goal to be achieved over a specified time period.

### **Research Actions**

Several actions are presented which address identified threats either by direct conservation or by scientific research, the results of which will take up and advise future directives for conservation. Conservation actions focus on mangrove and rainforest habitat protection and the required connection between the two, as well as protection of the biological corridors between mangrove wetlands and each associated Yellow-billed Cotinga population. Research actions address and reduce vital information gaps necessary for determining life history traits and understanding limiting factors needed to better inform and direct conservation strategies.

### **Evaluating Accomplishments**

Progress of the success of conservation and research actions will be assessed through a range-wide monitoring program. The recommended program *Osa Birdwatch* proposes to monitor and track abundance, occupancy and distribution of each Yellow-billed Cotinga population in known remaining population centers throughout Southern Costa Rica. Further *Osa Birdwatch* goals will be to monitor all other threatened associated species which overlap in habitat with the Yellow-billed Cotinga such as the Black-cheeked Ant-Tanager (*Habia atrimaxillaris*; EN), Mangrove Hummingbird (*Amazilia boucardi*; EN) (BirdLife International 2011) and the Prothonotary Warbler (*Protonotaria citrea*), a neotropical migratory species of conservation concern (Petit 1999). Monitoring of Panama populations is also recommended. *Osa Birdwatch* will provide refined global population estimates over the longer term allowing for a more defined and appropriate listing of threatened resident birds and provide information and facilitate conservation actions of Neotropical migrants while on their wintering grounds.

## II. BACKGROUND

### Introduction

The Yellow-billed Cotinga (Cotingidae: *Carpodectes antoniae*) (American Ornithological Union 1998) is a medium sized passerine (78 – 92 grams in weight [Leavelle & Vargas 2011]) regionally endemic to the mangroves of the southern pacific coastal slope of Costa Rica and the northern pacific coast of Panama. It is alternatively known as Antonia's Cotinga (Stiles and Skutch 1989) and locally known as the Cotinga Piquiamarillo. It is most closely related to the Snowy Cotinga (*Carpodectes nitidus*) common to the Central American Caribbean slope but does not overlap in range or habitat. The Yellow-billed Cotinga is one of Central America's most rare, and range restricted tropical resident species and listed as "endangered" by the International Union for the Conservation of Nature (IUCN).

### Distribution

The Yellow-billed Cotinga once ranged from the mangrove estuaries of the Río Tárcoles near Carara Biological Reserve on Costa Rica's Pacific coast, south along the coast to western Panama reaching down to the Burica Peninsula (Wege & Long 1995, Angehr 2000) (Fig. 1). Based on surveys conducted by Jones et al. (2009) the current range appears to be severely reduced with habitat loss nearly causing its disappearance from Panama. The current distribution (Jones et al. 2009) covers the Río Tárcoles, the Terraba-Sierpe National Wetlands including Boca Ganado north of Drake Bay all of which are located on the Costa Rican Pacific coast; the Río Rincón, Río Esquinas and Río Coto surrounding the Golfo Dulce along the Osa Peninsula and southern pacific mainland of Costa Rica; and Cerro Batipa near David, Panama. Certain historical locations such as the Río Palo Seco and Corcovado National Park need to be surveyed while the mangrove estuaries of Golfito that flow into the Golfo Dulce in Costa Rica, and Boca Bravo and Boca Chica in Panama require additional surveys (Jones *et al.* 2009) to ascertain total distribution. Additionally, the Gulf of Panama between La Parrita and San Miguel has historically the largest mangrove system in Panama and may also be an area of Yellow-billed Cotinga presence.

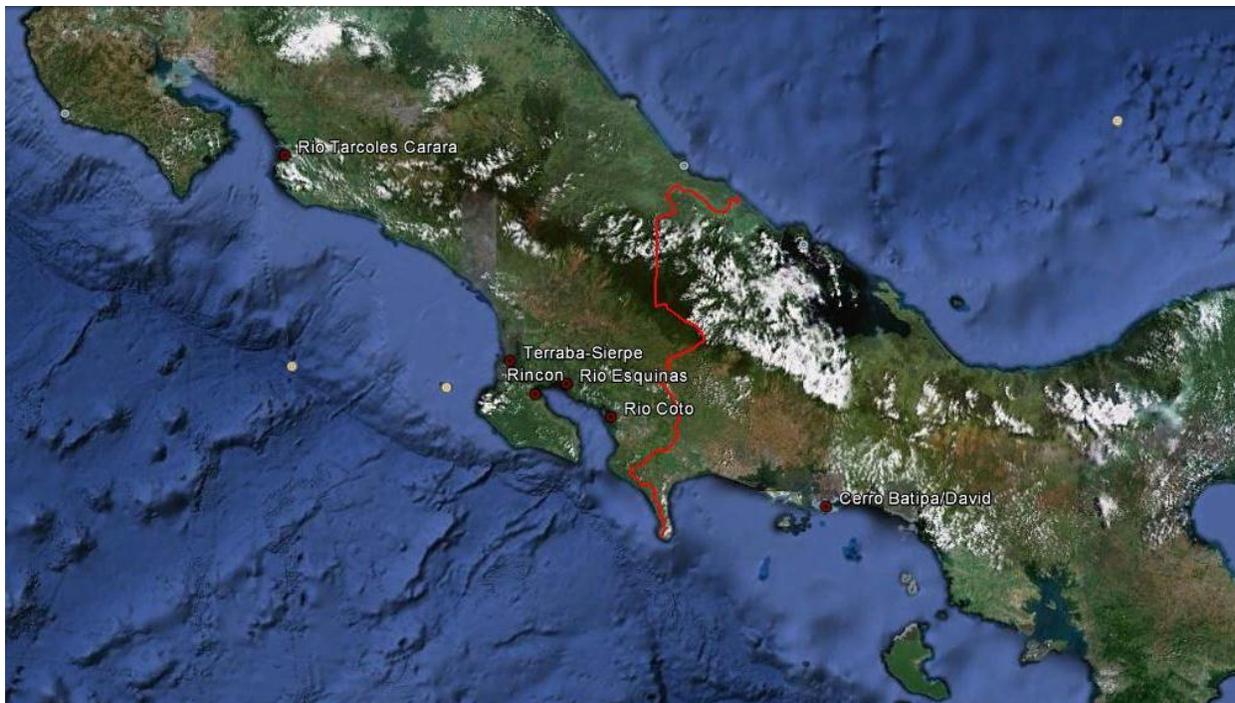


Fig 1: Current distribution of the Yellow-billed Cotinga (*Carpodectes antoniae*) in Costa Rica and Panama based on surveys conducted by Jones et al. 2009. Red dots indicate separate cotinga populations along mangrove river estuaries.

### Habitat

The Yellow-billed Cotinga appears to be a habitat specialist restricted to the mangrove river estuary and tropical rainforest ecotone. Mangroves are used for roosting and likely nesting while adjacent rainforest is used for feeding. Regional mangrove species include red mangroves (*Rhizophora mangle* and *R. harrisonii*, Rhizophoraceae), the black mangroves (*Avicennia germinans* and *A. bicolor*, Verbenaceae), the tea mangrove (*Pelliciera rhizophorae*, Theaceae), the white mangrove (*Laguncularia racemosa*, Combretaceae), and the buttonwood mangrove (*Conocarpus erectus*, Combretaceae). However this canopy dwelling species has primarily been observed in tall red mangrove. Based on one study of 3 radio-tagged birds (Leavelle 2011), roosting solely takes place in red mangrove and males spend the majority of the day in red mangrove guarding core areas between feeding trips to adjacent rainforest. A non-breeding female from the same study spent all day feeding in the rainforest only to return to the mangroves to roost at night. All three radio-tagged birds used the mangroves as protective shelter during inclement weather. The required rainforest is defined as premontane wet forest (Holdridge 1967) characterized by mixed tropical tree species. Highly frugivorous, this species requires close access to dominant Myristicaceae, Moraceae, Lauraceae, Euphorbiaceae, Annonaceae, Cecropiaceae and other avian dispersed rainforest trees. Although the Yellow-billed Cotinga is primarily a frugivore this species supplements its fruit diet with various mangrove and rainforest associated insects including winged termites (Isoptera)

and lepidopteran larvae. It is found foraging in secondary and old growth forests where mature fruiting trees are found within upland and lowland forest as well as lowland riparian areas. It uses forest buffered rivers and streams to feed and move between mangrove and intact forest habitats (Leavelle 2011). In some areas, rainforest habitat has almost fully been converted to agriculture so forest buffered waterways provide an essential mechanism for movement. Each mangrove system associated with a river tributary is by nature fragmented and discontinuous (Lugo & Snedaker 1974) making each isolated Yellow-billed Cotinga population and the habitat in which it occurs important for conservation.



*Mangrove/Rainforest ecotone, Rincon River estuary, Golfo Dulce, Osa Península, Puntarenas, Costa Rica. Copyright ©Karen Leavelle.*



*Mangroves at the Rincon River estuary, Golfo Dulce, Osa Península, Puntarenas, Costa Rica.  
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### **Seasonal Local Migration (Wandering)**

Information on local seasonal migration is in its early stages. Yellow-billed Cotingas have been thought to remain in mangroves and adjacent forest during the breeding season and then locally wander during the winter months following more limited food resources, a behavior typical in many tropical frugivorous birds (Loiselle 1991 & 1992, Stotz 1996). Indeed, cotingas have been observed at interior sites away from mangrove river estuaries during the non-reproductive season from approximately July through November. Two inland sites include Lapa Ríos ecolodge property on the southeastern end of the Osa Peninsula, and along the Río Tigre upstream near the Corcovado National Park boundary. The individuals observed at Río Tigre may be traveling upstream to feed in interior locations and returning to a small mangrove estuary located at the mouth of the Río Tigre approximately 8 km downstream. The origin of the birds observed at Lapa Ríos with respect to their breeding grounds is unknown. However, Leavelle (2011) found that radio-tagged birds never wandered more than 2.7 km from the Rincón River mangroves in the wet winter months and always returned to mangroves to roost at night. The cotinga breeding season of 2011 followed an extremely wet La Niña winter possibly resulting in an abundant fruit year which may explain the lack of wandering, however many tree species (eg., Moraceae, Lauraceae & Euphorbiaceae) produce fruit asynchronously and throughout the year (R. Aguilar, pers. com.) providing the food resources needed in close proximity to mangroves. More research is needed to understand the extent of local migrational wandering in other years. If birds are found to travel greater distances in dry years this would greatly affect conservation measures.

### **Life History and Demography**

The Yellow-billed Cotinga is thought to be a lekking species where males gather for the purposes of competitive courtship display however this term has never been formally applied. Males gather on open branches and “swoop” from one branch or tree to another and females choose their mate (Skutch 1970). In a traditional lekking species males do not attend to nests or participate in parental care though this varies from species to species. Information on nesting and reproductive behaviors is lacking. Females have been observed on many occasions collecting nesting material from rainforest trees and flying with it into the mangroves whereas the reverse movement has never been seen (Jones *et al.* 2009, Leavelle 2011). Therefore to date, it is assumed that nesting takes place in the mangroves as opposed to rainforest habitat. Despite this only one nest with two nestlings has been found at approximately 10 ft in red mangrove (A. Gallo, pers. com.). A radio-tagged female from Leavelle (2011) appeared to be a young bird and did not show signs of nesting, and neither of the two males from the same study attended a nest or showed any signs of parental care. Male core area “guarding” as described above does not appear to be for the purposes of defending a mate or nest territory. In depth research into reproductive ecology, mating systems, reproductive success, life span and survivorship is needed.

### **Population Status**

Leavelle (2011) found an average number of cotingas in a 90 ha area to be  $(38 \pm 3.1)$  for a density of 0.422 birds/ha. *The index of abundance for the total area of 308 ha is 130 birds.* This estimate should only be used as a preliminary index for the Rincón population until a full search can be conducted in difficult to reach areas and a closed model population estimate and 95% confidence intervals can be determined. Because courtship leks, the unit measure, are not distributed evenly on the landscape and the fact that leks may shift between years suggests that population counts should be conducted at each mangrove estuary where Yellow-billed Cotingas are found. The index however allows for comparisons of population trends in future years.

### **Associated Species**

There are several Neotropical migrant and resident species of conservation concern which co-occur with the Yellow-billed cotinga in either of its associated mangrove and rainforest habitats that may benefit from conservation actions (Tables 1 & 2). Species that are endemic to Costa Rica or regionally endemic to lowland pacific forests of southern Costa Rica and northern Panama are also listed (Table 1) and would benefit from conservation efforts in this area. Although some endemic species are listed at Least Concern (LC) by the IUCN, conservation actions directed towards the Yellow-billed Cotinga may mediate any future declines in these species populations. The Black-cheeked Ant-Tanager (*Habia atrimaxillaris*) is an Osa Peninsula endemic and endangered species, and is considered to be of high conservation priority.



*Black-cheeked Ant-Tanager.*  
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Table 1: Costa Rican endemic or resident species at risk that co-occur with Yellow-billed Cotinga (*Carpodectes antoniae*) in mangrove and rainforest habitats. LC = Least Concern, VU = Vulnerable, NT = Near Threat, EN = Endangered (BirdLife International 2011).

Species	Scientific Name	Endemic	Global Status (BirdLife International 2011)
Great Curassow	<i>Crax rubra</i>	N	VU
Mangrove Hummingbird	<i>Amazilia boucardi</i>	Y	EN
Baird's Trogon*	<i>Trogon bairdii</i>	Y	NT
Turquoise Cotinga*	<i>Cotinga ridgwayi</i>	Y	VU
Black-cheeked Ant-Tanager**	<i>Habia atrimaxillaris</i>	Y	EN
Three-wattled Bellbird***	<i>Procnias tricarunculatus</i>	Y	VU
White-crested Coquette*	<i>Lophornis adorabilis</i>	Y	LC
Garden Emerald*	<i>Lophornis adorabilis</i>	Y	LC
Charming Hummingbird*	<i>Amazila decora</i>	Y	LC
Fiery-billed Araçari*	<i>Pteroglossus frantzii</i>	Y	LC
Golden-naped Woodpecker*	<i>Melanerpes chrysauchen</i>	Y	LC
Orange-collared Manakin*	<i>Manacus aurantiacus</i>	Y	LC
Spot-crowned Euphonia*	<i>Euphonia imitans</i>	Y	LC

\*Regional endemic to Costa Rica and Panama.

\*\*Endemic to the Osa Peninsula, Costa Rica

\*\*\*Endemic to Honduras to Panama



*Mangrove Hummingbird © G. Gomez*



*Baird's Trogon © G. Gomez*

Table 2: North American Neotropical migratory at risk breeding bird species that co-occur with Yellow-billed Cotinga (*Carpodectes antoniae*) in mangrove and rainforest habitats. LC = Least Concern, NT = Near Threatened (IUCN 2011), BCC = United States Birds of Conservation Concern (USFWS 2008), SC = Special Concern, T = Threatened (Wisconsin Department of Natural Resources).

Species	Scientific Name	Global Status (IUCN 2011)	US Status (USFWS)	Wisconsin Status (DNR)
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	LC	BCC	SC
Olive-sided Flycatcher	<i>Contopus cooperi</i>	NT	BCC	SC
Acadian Flycatcher	<i>Empidonax virescens</i>	LC	-	T
Willow Flycatcher*	<i>Empidonax traillii</i>	LC	ESA-EN	SC
Least Flycatcher	<i>Empidonax minimus</i>	LC	-	SC
Wood Thrush	<i>Hylocichla mustelina</i>	LC	BCC	SC
Golden-winged Warbler	<i>Vermivora chrysoptera</i>	NT	BCC	SC
Prothonotary Warbler	<i>Protonotaria citrea</i>	LC	BCC	SC
Louisiana Waterthrush	<i>Seiurus motacilla</i>	LC	-	SC
Kentucky Warbler	<i>Oporornis formosus</i>	LC	BCC	T
Connecticut Warbler	<i>Oporornis agilis</i>	LC	-	SC
Hooded Warbler	<i>Wilsonia citrina</i>	LC	-	T
Canada Warbler	<i>Wilsonia canadensis</i>	LC	BCC	SC

\*ESA – EN = Endangered Species Act – Endangered



*Prothonotary Warbler* © D. Malueg

### **III. POPULATION THREATS**

Factors that may be limiting the Yellow-billed Cotinga population are not well understood. However there are several recognized anthropogenic pressures which have caused habitat loss and degradation in required mangrove and rainforest habitats that have resulted in direct threats to each population. Non-habitat threats have also been identified as having potential negative impacts on this species such as possible climate change effects on habitat and species habitat requirements. Non-habitat threats may not have a direct negative impact on the Yellow-billed Cotinga population but may contribute to population declines in the face of ecological stochastic events.

#### **Loss and Degradation of Premontane Wet Forest Habitat**

Deforestation and forest degradation in Panama results from road construction, logging, industrial gold mining, and colonization, which leads to clearing for agriculture, pasture land, and fuelwood collection. Of these activities, colonization is responsible for the bulk of deforestation resulting in a loss of 1% of primary forest annually (FAO 2007). While deforestation rates have dropped considerably in Costa Rica in the last decade, conversion of forests has been primarily for agricultural crops including annuals and tree crops such as Teak and African Oil Palm, as well as for cattle pastures for livestock grazing. Jones et al. (2009) reported heavy deforestation at the historical sites of the Río Térraba at the north end of the Térraba-Sierpe National wetlands, and at Parrita Bay in Panama indicating a 3 km plus gap between mangrove and rainforest habitats. Yellow-billed Cotingas were not observed at either site. Similarly, the same study reports an approximated 2.5 km deforested gap between the mangroves of the Río Tárcoles at the Carara Biological Reserve in the northern most Yellow-billed Cotinga site, and a large parcel of primary rainforest converted to a Teak plantation at Cerro Batipa in Panama. However, forested corridors were found connecting the two habitats at both areas as well as presence of Yellow-billed Cotingas.

Despite the reduction in rainforest and mangrove ecosystems in Panama and Costa Rica it is unclear to what extent this has affected the Yellow-billed Cotinga population and should be quantified in order to better establish current distribution and population trends. Habitat loss and degradation may be greater within adjacent rainforest habitat especially in Costa Rica where mangroves may be afforded greater protection however study at each population site using historical and current high definition imagery is required.

## **Loss and Degradation of Mangrove Habitat**

### **Mangrove Ecosystem Services**

The importance of mangroves for humans and a variety of coastal organisms has been well documented. Mangroves are known to support ecosystem services such as providing protection of shorelines from flooding and damage caused by erosion (Fosberg 1971, Dahdouh-Guebas *et al.* 2005), maintain water quality and clarity, filter pollutants, trap sediments that come from land, process nutrients (Lugo & Snedaker 1974; Aksornkoae *et al.* 2004), and play an important role in carbon sequestration (Chmura *et al.* 2003; Fujimoto 2004). They also provide nurseries for fish and invertebrates (Robertson & Duke 1987; Laegdsgaard & Johnson 1995) and support a large number terrestrial, estuarine and marine species and several vulnerable and threatened bird species (Aksornkoae *et al.* 2004). Mangroves provide protection to many canopy or mid-story dwelling species in that periodic flooding and soft mud deters predator approach from the ground. Yellow-billed Cotingas solely roost in mangroves and return to mangroves from rainforest feeding locations at the onset of inclement weather (Leavelle 2011).

### **Mangrove Ecosystem Loss and Degradation**

At least 40% of IUCN assessed animal species that are restricted to mangroves are at an elevated risk of extinction due to extensive loss of habitat (Luther and Greenburg 2009). It is estimated that 26% of mangrove forests worldwide are degraded due to over-exploitation for fuelwood and timber production. Similarly, clearing of mangroves for shrimp culture contributes ~38% of global mangrove loss, with other aquaculture accounting for another 14% (Valiela *et al.* 2001). Globally, between 20% and 35% of mangrove area has been lost since approximately 1980 (Valiela *et al.* 2001, FAO 2003). Extensive clearing of mangroves for settlement, agriculture and shrimp ponds are the major causes of mangrove decline in Latin America (Lugo 2002), even though there is little compensating economic return from conversion of mangrove areas to agriculture (Tovilla *et al.* 2001). Wood from cleared mangrove trees is used for charcoal production and as poles for light construction. Road and dyke construction have also affected the hydrology at some locations (BirdLife International 2011). Furthermore, red mangrove is an important source of tannin that is used in processing leather however stripping the bark kills the tree (Ellison and Farnsworth 1996). Chemical, industrial and urban waste is associated with heavy metal content found in mangrove seedlings and may cause stand death and an increase in shellfish poisoning. Water pollutants also result in tree defoliation and a loss of associated animal species that rely on mangrove cover (Fuller *et al.* 1990, Ellison and Farnsworth 1996) such as the Yellow-billed Cotinga.



*Fig 5: Mangrove converted to shrimp farms, Panama*

The richest and most complex mangrove forests can be found on the Pacific coast of Costa Rica and Panama where forest canopy may reach as high as 40 m in areas such as Térraba-Sierpe National Wetlands of Costa Rica, and the San Miguel and Chiriquí gulfs of Panama. Panama has the largest extent of mangroves in Central America and the greatest amount of ecosystem loss over the last 25 years. The Food and Agricultural Organization of the United Nations (FAO 2007) reports total mangrove cover of Panama in 1980 to be 250,000 ha reduced to approximately 170,000 ha in 2005, a total loss of 80,000 ha. Similarly, in 1980 mangrove cover in Costa Rica was at an approximated 63,400 ha down to 41,000 in 2005, a loss of nearly 23,000 ha. Within Pacific Panama, most of the mangroves are classified as either critical or endangered due to losses associated with human development and the conversion of mangroves to salt flats, shrimp ponds, agricultural crops, cattle pasture and non-vegetated areas (D’Croz 1993). Oil pollution is also considered to be a serious threat to the mangroves of Pacific Panama due to the high maritime traffic in the Panama Canal (Spalding *et al.* 1997). Much of the earlier mangrove loss in Costa Rica was due to conversion to shrimp ponds however shrimp farming as well as salt production activities are no longer allowed due to stricter environmental laws (FAO 2007). Mangroves in Costa Rica including those located along the Golfo Dulce river estuaries are protected by the state while the Térraba-Sierpe National Wetlands have an extra layer of protection as an official internationally recognized Ramsar wetland site. It is likely these laws that have allowed Yellow-billed cotingas to persist in each separate and isolated mangrove site making this area the species current stronghold.

## **Habitat Loss and Degradation at Térraba-Sierpe National Wetlands:**

### **Threats and Issues for Consideration**

Under the Ley Orgánica del Ambiente (LOA) of 1994, all wetland sites including mangrove river estuaries within Costa Rica are considered Natural Patrimony of the State (Patrimonio Natural del Estado) in the public domain and is administered by Sistemas Nacional de Áreas de Conservación (SINAC) (National System of Areas of Conservation) within the Ministerio del Ambiente, Energía y Telecomunicaciones (MINAET) (Ministry of the Environment, Energy and Telecommunications) (MINAET 2010). The LOA along with the adoption of the Ramsar Convention in 1991 which recognizes the international ecological significance of wetlands and the importance of wetlands as aquatic avian habitat, and the Ley de Biodiversidad (Biodiversity Law) strengthens the potential for wetlands conservation and effective management within Costa Rica. However, the broad spectrum of legislation and legal entities may be resulting in an overlap in legal inconsistencies and difficulties in on-the-ground management and conservation.

Although the Térraba-Sierpe National Wetlands is an internationally recognized protected Ramsar site, it is bounded to the northeast by Palmar Norte and Palmar Sur, two large urban areas cut down the middle by the Térraba River. Industrial chemical contaminants are likely travelling downstream polluting the fragile mangrove ecosystem, a situation affecting the Tárcoles River at Carara Biological Reserve (Fuller *et al.* 1990). Jones *et al.* (2009) found no presence of the Yellow-billed Cotinga along the Térraba River where forest in large part no longer exists and there is no apparent forested buffer surrounding the wetlands on this side which could otherwise allow for feeding to take place. Furthermore, the Golfo Dulce Forest Reserve to the south does not meet the mangrove wetland border on the southern edge leaving a 1 – 3 km gap between the two protected areas (Fig. 2). This unprotected area is primarily forested providing the critical mangrove/rainforest connection required by the Yellow-billed Cotinga. As it is the part of the mangroves where this species stronghold is located, this makes the population at this site vulnerable to further anthropogenic changes to the landscape due to the lack of legal protections. Large and small private properties dot this entire southern area inside and out of the Golfo Dulce Forest Reserve (Fig. 3). Some properties providing important rainforest habitat for cotingas are large parcels either up for sale or have already been sold into multiple lots dividing once whole unit parcels into several smaller holdings which will undoubtedly result in an increase in forest loss and degradation with additional new homes, roads and gardens taking the place of critical forest habitat.

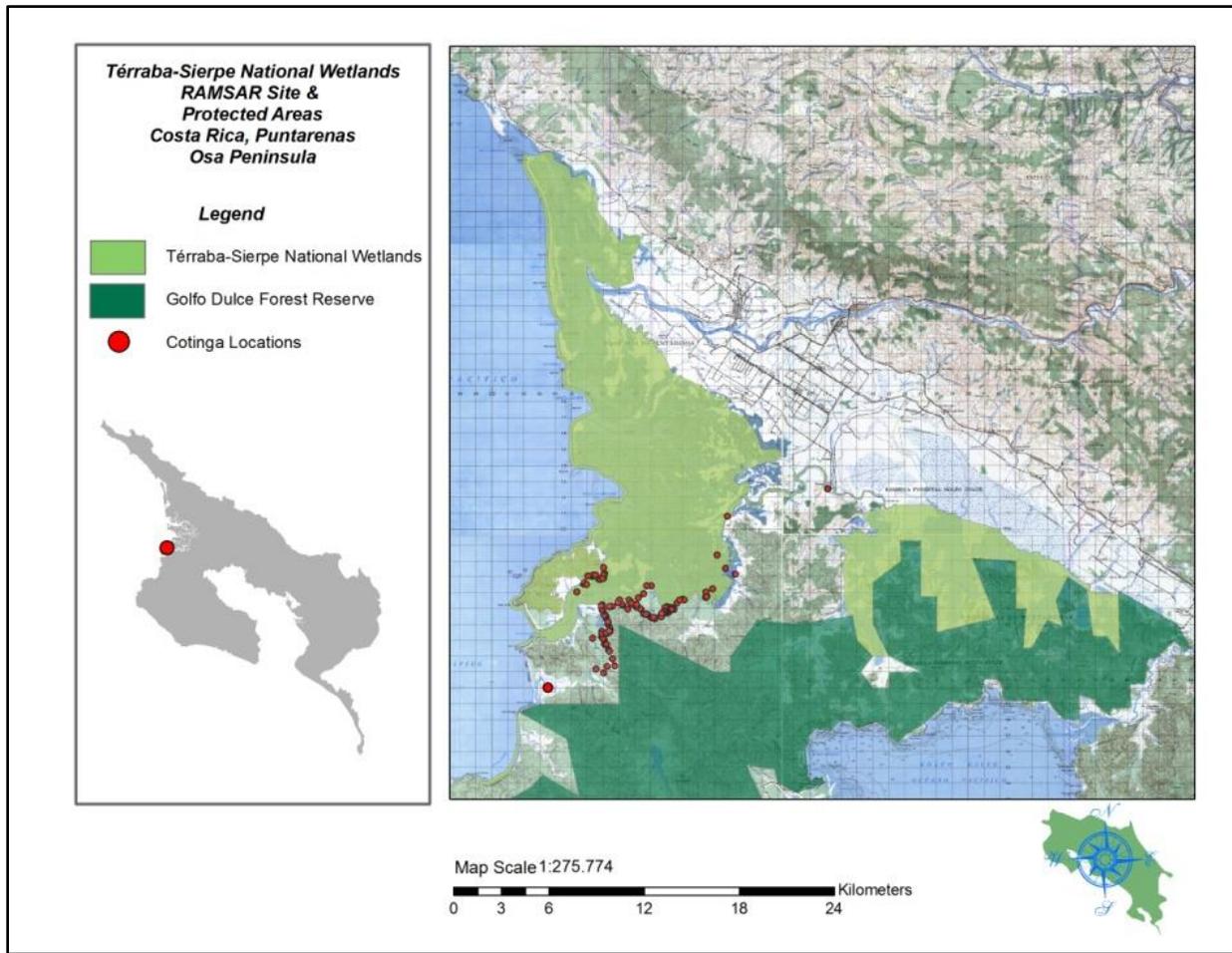


Fig. 2. Protected areas at Terraba-Sierpe National Wetlands. Cotinga locations courtesy Jones *et al.* 2009.

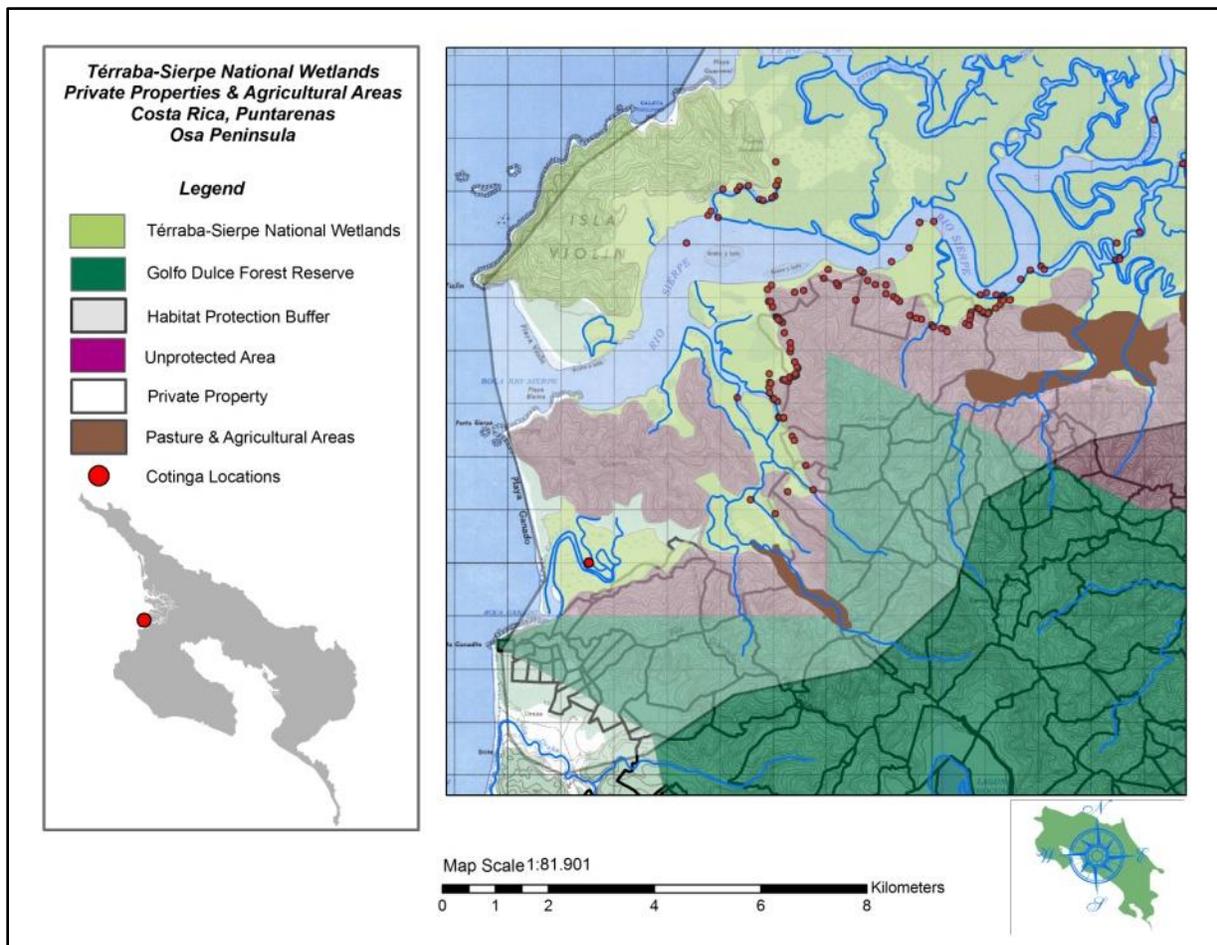


Fig. 3. Private properties and agricultural areas Terraba-Sierpe National Wetlands. Cotinga locations courtesy Jones *et al.* 2009.

### **Habitat Loss and Degradation at Rincón: Threats and Issues for Consideration**

The Yellow-billed Cotinga population found at the Rincón river estuary may be one of the 5 current areas in Costa Rica most affected by lowland rainforest loss. Of the 6.2 km length of mangroves which run from just north of the river down to the town of La Palma, only approximately 600 m at the northern end maintain a connection with adjacent upland rainforest (Figs 4 & 5) while the remaining 5.6 km is bounded by urban areas, cattle pasture, rice, teak and African oil palm plantations (Fig 6). Furthermore, the main road which runs between Puerto Jimenez and Chacarita cuts through the remaining 600 m mangrove/rainforest interface leaving this cotinga population in a precarious state. The rainforest portion of the 600 m link falls within the Golfo Dulce Forest Reserve and provides certain restrictions on human use. Hunting is illegal for example and permits are required for extraction of already felled trees from natural extreme weather events. However illegal logging still occurs and large old growth trees are at times cut at the base to facilitate falling in the case of strong winds. Additionally, the land within the Forest Reserve is a mosaic of private properties (Fig. 7)

complicating conservation measures. Private property boundaries have only been officially drawn for holdings in the Golfo Dulce Forest Reserve. Similar work is needed for all other private properties outside of the protected area. The property outlined in yellow (Fig. 7) which sits adjacent to the mangroves is property where illegal cutting of old growth trees has been observed (Fig. 8). As well, the property listed as Franklin property (Fig. 7) is an 11.8 ha parcel that falls within the core home range area of the female Yellow-billed Cotinga from Leavelle (2011) and is a parcel frequently used by many cotingas. As many as 18 cotingas have been observed entering this area within a 2.5 hour period during the breeding season. This property is currently up for sale and may be converted to African oil palm. Finally, lowland rainforest buffers line the edge of the mangroves out to approximately 100 m and it is strongly suggested to landowners by MINAET that waterways that fall on private property maintain a forested buffer of approximately 12 m on either side (Fig. 5). Legal constraints however do not appear to exist or not enforced as sections along the Rincón River and other streams are completely denuded while other sections are not. Yellow-billed Cotingas move along these forested buffers to feed therefore necessitating the need for firm protection and a well-defined law. In the case that these buffers become compromised by cattle encroachment, or by human pressures and development, and if the 600 m upland rainforest/mangrove connection becomes fragmented by illegal logging or felling of old growth trees creating large forest gaps, the probability of collapse of the Yellow-billed Cotinga population at Rincón becomes much greater.

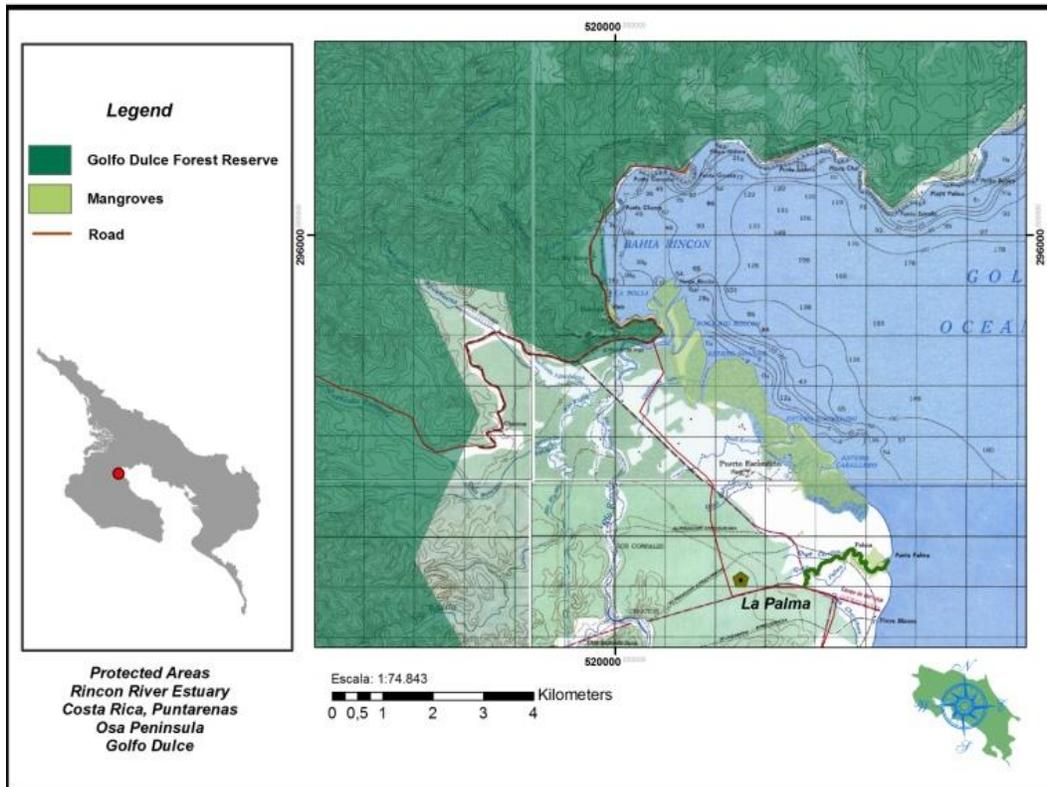


Fig. 4. Protected Areas at the Rincón River estuary, Golfo Dulce, Osa Peninsula, Puntarenas, Costa Rica

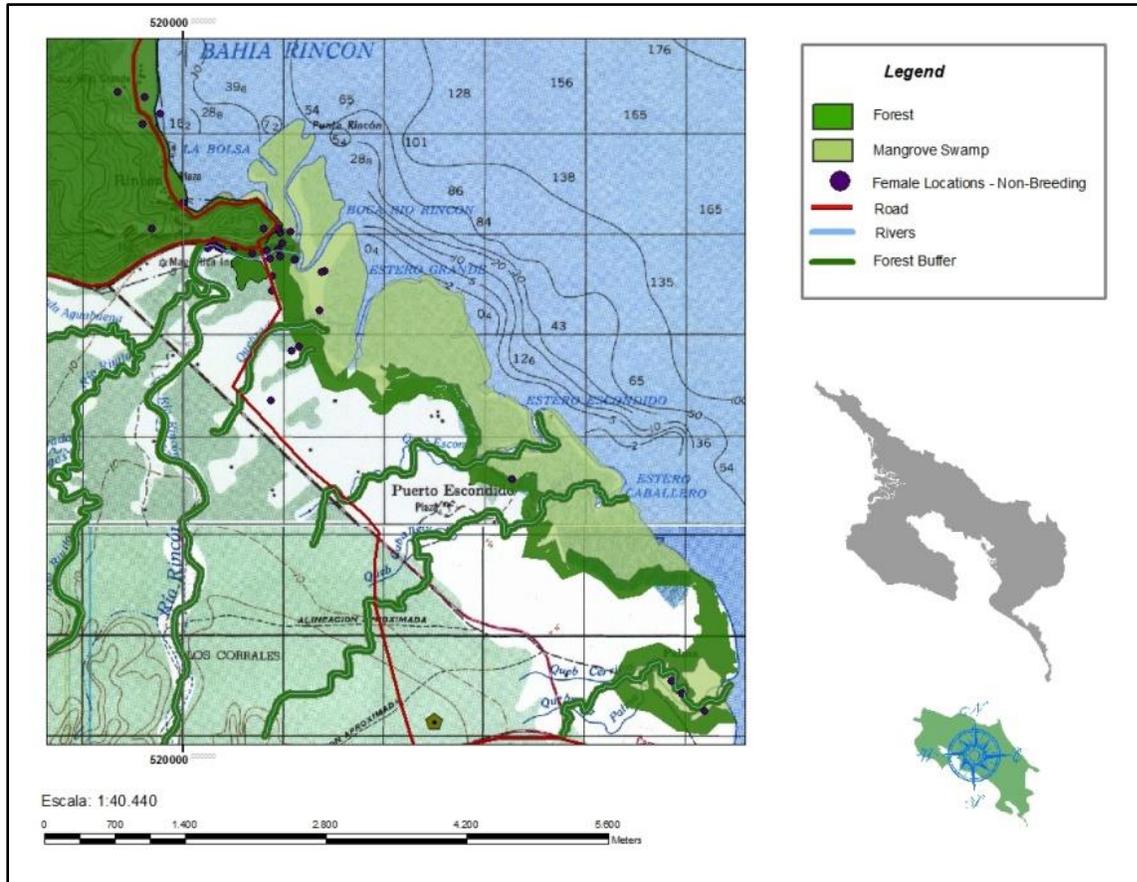


Fig. 5. Mangrove and riparian forest buffers at the Rincon River estuary, Golfo Dulce, Osa Peninsula, Puntarenas, Costa Rica. Cotinga locations courtesy Leavelle (2011).

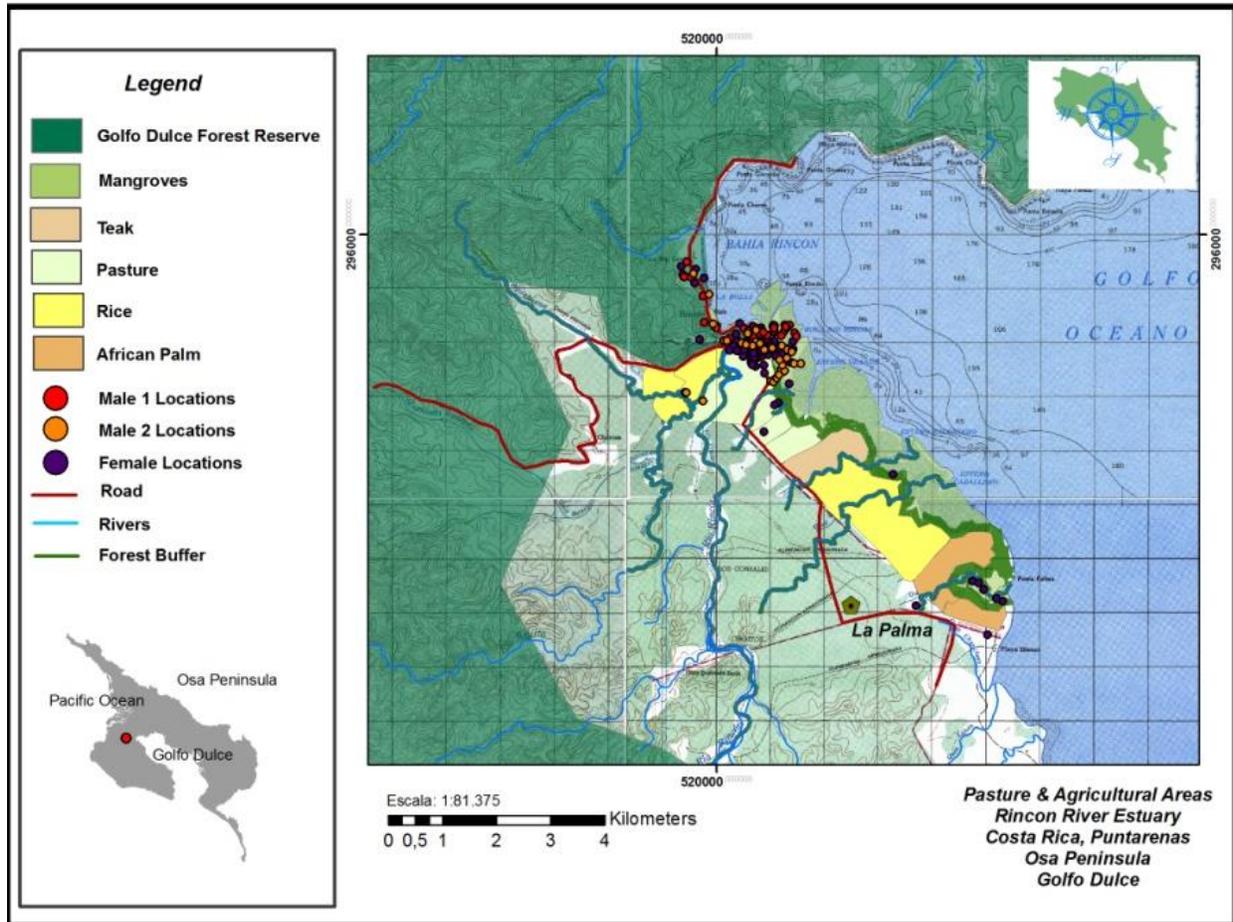


Fig. 6. Agricultural areas and cattle pasture at the Rincon River mangroves, Golfo Dulce, Osa Peninsula, Puntarenas, Costa Rica. Cotinga locations courtesy Leavelle (2011).

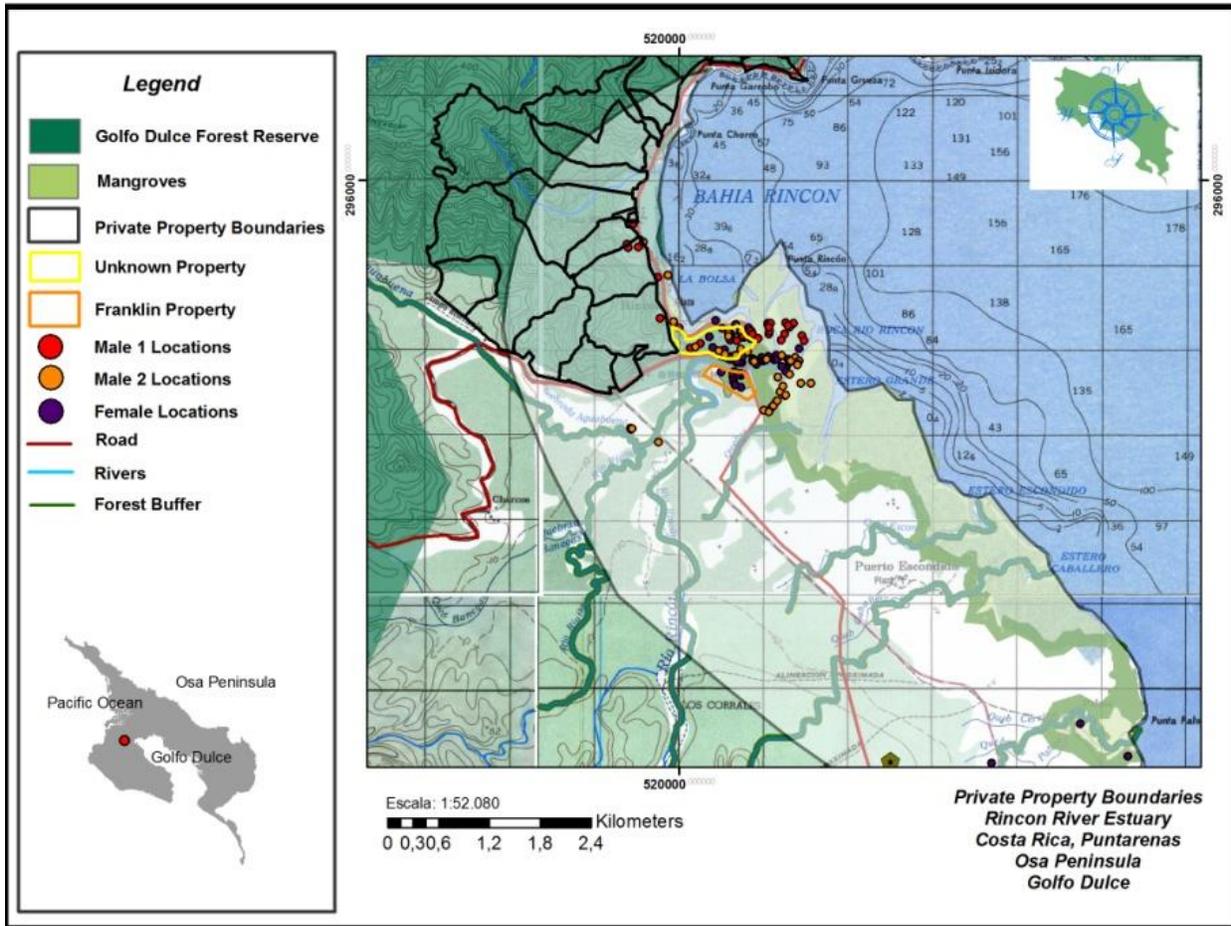


Fig. 7. Private property boundaries at the Rincon River mangroves, Golfo Dulce, Osa Peninsula, Puntarenas, Costa Rica. Cotinga locations courtesy Leavelle (2011).



Fig. 8. Old growth tree cut at the base along “unknown property” Fig. 7. Trees are cut to let winds fell the trees “naturally”.

### **Habitat Loss and Degradation at Río Esquinas: Threats and Issues for Consideration**

The Yellow-billed Cotinga population at the Esquinas River mangrove estuary may have the greatest protections afforded as compared to all other cotinga sites in the species current range. While the northern section maintains the same unprotected gap between the mangroves and the Golfo Dulce Forest Reserve, the southern section is firmly bounded to Piedras Blancas National Park (Fig. 9) along the entire length of the mangroves providing the required habitat link between ecosystems. The unprotected gap on the northern side is approximately 1 – 2 km wide with approximately 54% taken up by urban areas, pasture and agricultural lands (Fig. 10). However, the gap is narrow as compared to Sierpe and Rincón with a north/south river corridor (side tributary) linking the mangroves to the Forest Reserve on the western side providing a vital connection to the edge of the Golfo Dulce Forest Reserve. The forested buffer along the side tributary varies from 0 – 20 m on either side but stretches where the buffer is non-existent are short (<150 m) and likely not long enough to limit cotinga movement. The main river corridor which sits at the eastern tip of the mangroves is bounded by pasture (Fig. 10) with only a few trees dotting the landscape in this area likely rendering this

section of the river unusable to the cotingas. However movement northeast along the forest edge upslope is entirely possible. Here, as in other areas, there is a matrix of private properties all across the northern section of the mangroves (Fig. 10). Two of the five properties bordering the mangroves to the north are large parcels that appear to have intact habitat critical for Yellow-billed Cotinga feeding activities though ownership and private conservation status is unknown. In what appears to be denuded sections of forest within Piedras Blancas National park on the eastern end of the mangroves are all areas in forest regeneration and may provide future critical habitat to this species. Finally, the town of Charcarita sits approximately 10 km to the northeastern edge of the Esquinas mangroves. Waste and pollutants from town as well as chemical waste from agricultural areas downstream on the north side may affect degradation of the mangroves that may not be readily apparent.

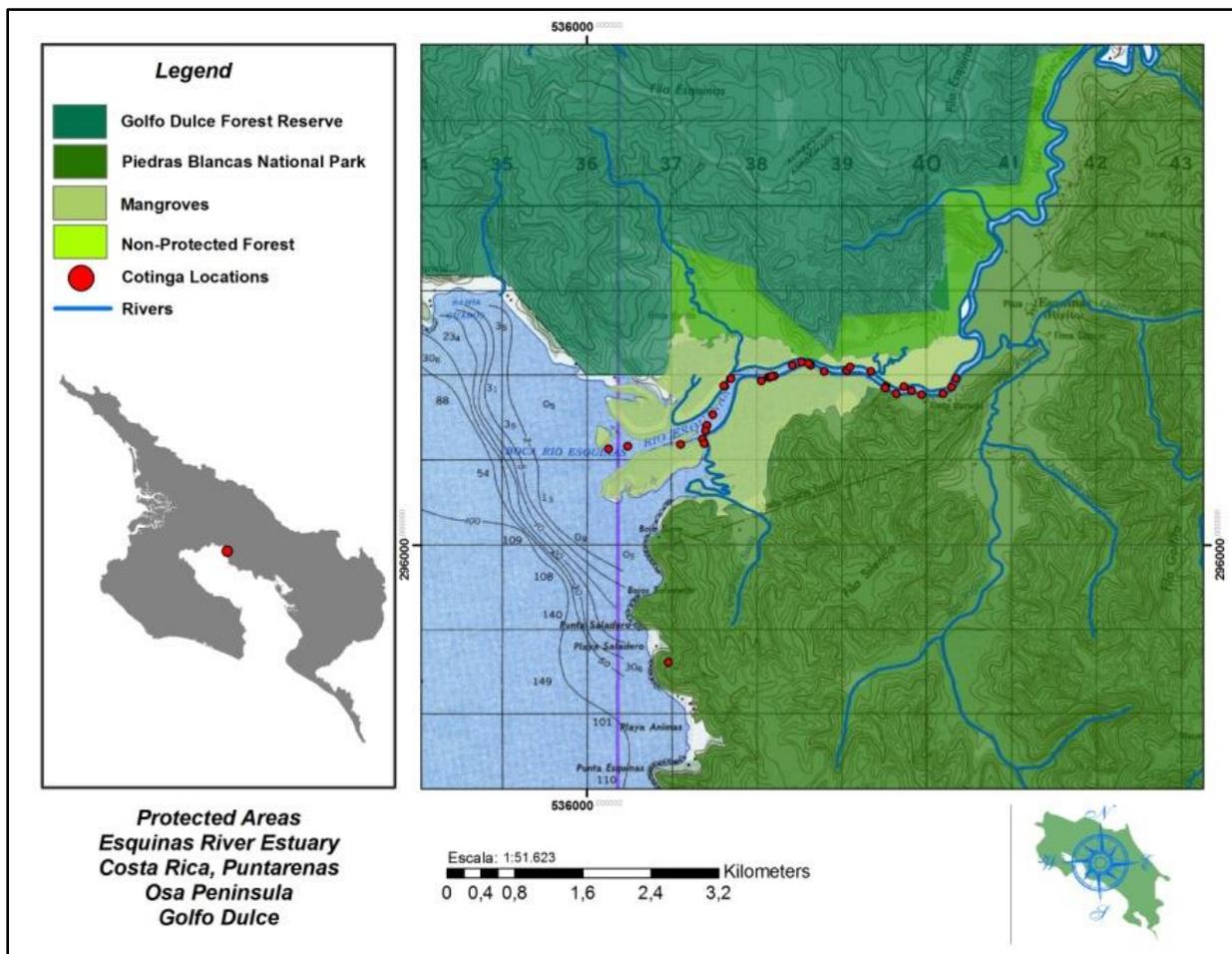


Fig. 9. Protected areas at the Rio Esquinas mangrove estuary, Golfo Dulce, Puntarenas, Costa Rica. Cotinga locations courtesy Jones et al. (2009)

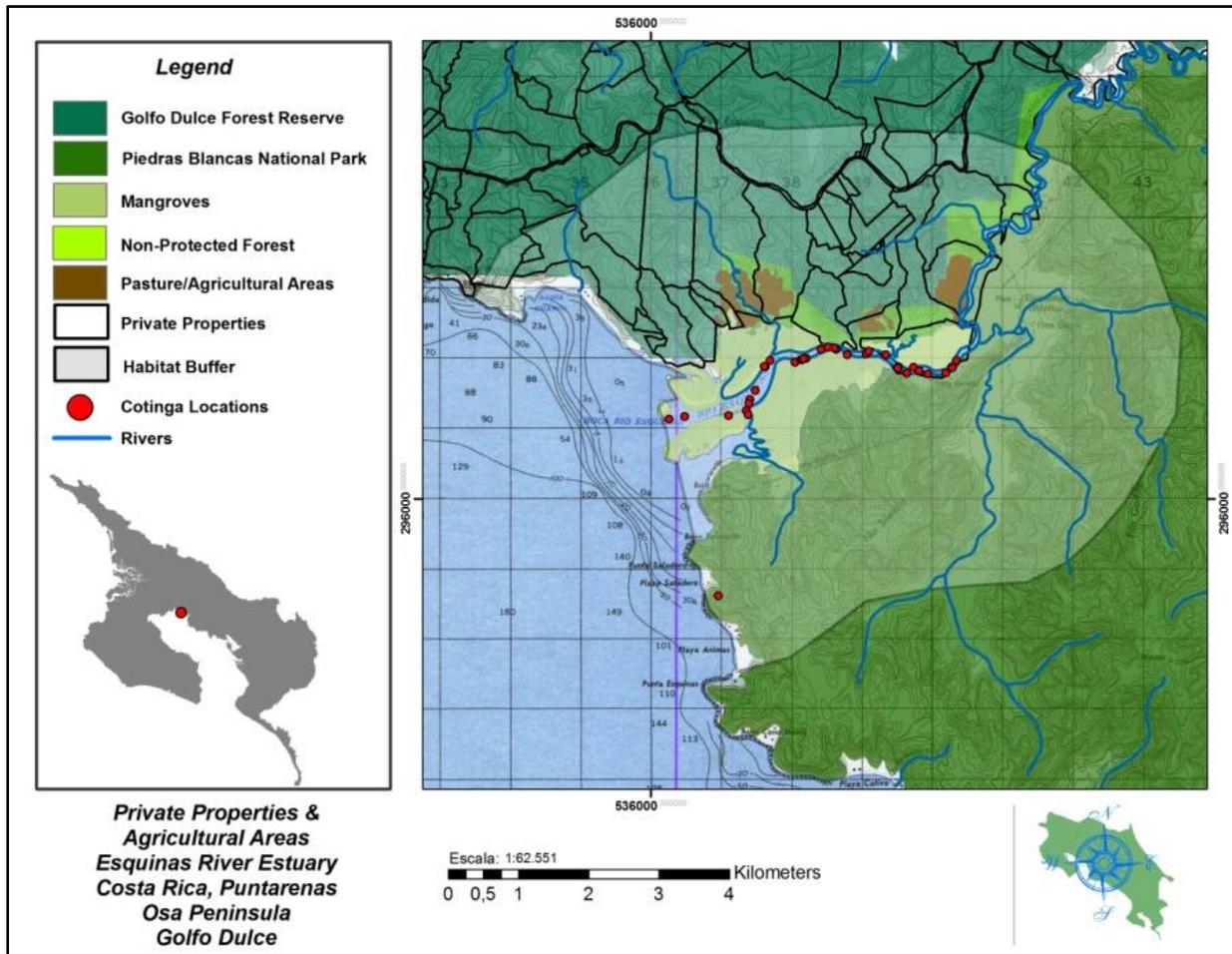


Fig. 10. Private properties and agricultural areas at the Rio Esquinas mangrove estuary, Golfo Dulce, Puntarenas, Costa Rica. Cotinga locations courtesy Jones et al. (2009)

**Habitat Loss and Degradation at Río Coto: Threats and Issues for Consideration**

The only protected areas along the Río Coto are the Golfito Wildlife Refuge and the mangroves themselves (Fig. 11). All forested areas do not fall into any category of increased legal protection and are therefore subject to landscape conversion. The island peninsula on the northern tip of the mangroves and the parcels of varying size just to the north of the mangroves are entirely forested while the large section of land to the east of the Wildlife Refuge is highly fragmented. These remaining areas however are likely providing the Yellow-billed Cotinga population with food resources and a corridor link to the Refuge and Piedras Blancas National Park to the north. In addition, there is a 7 – 10 km deforested gap between the south side of the mangroves and the next section of contiguous forest further south (Fig. 12). However, some sections of the river corridors which feed into the Río Coto on all sides of the mangroves are buffered with forest and may also be providing critical habitat and resource links to the Yellow-billed Cotinga in this area. It is extremely important to note that the mangroves at Río Coto are approximately 3 to 4 times larger than those at Rincón and Río Esquinas and may have

a larger population than either of the other two areas combined. The implications here are that a collapse of this population due to increased forest loss and fragmentation may have a large impact for conservation of this species as a whole and should therefore not be ignored.

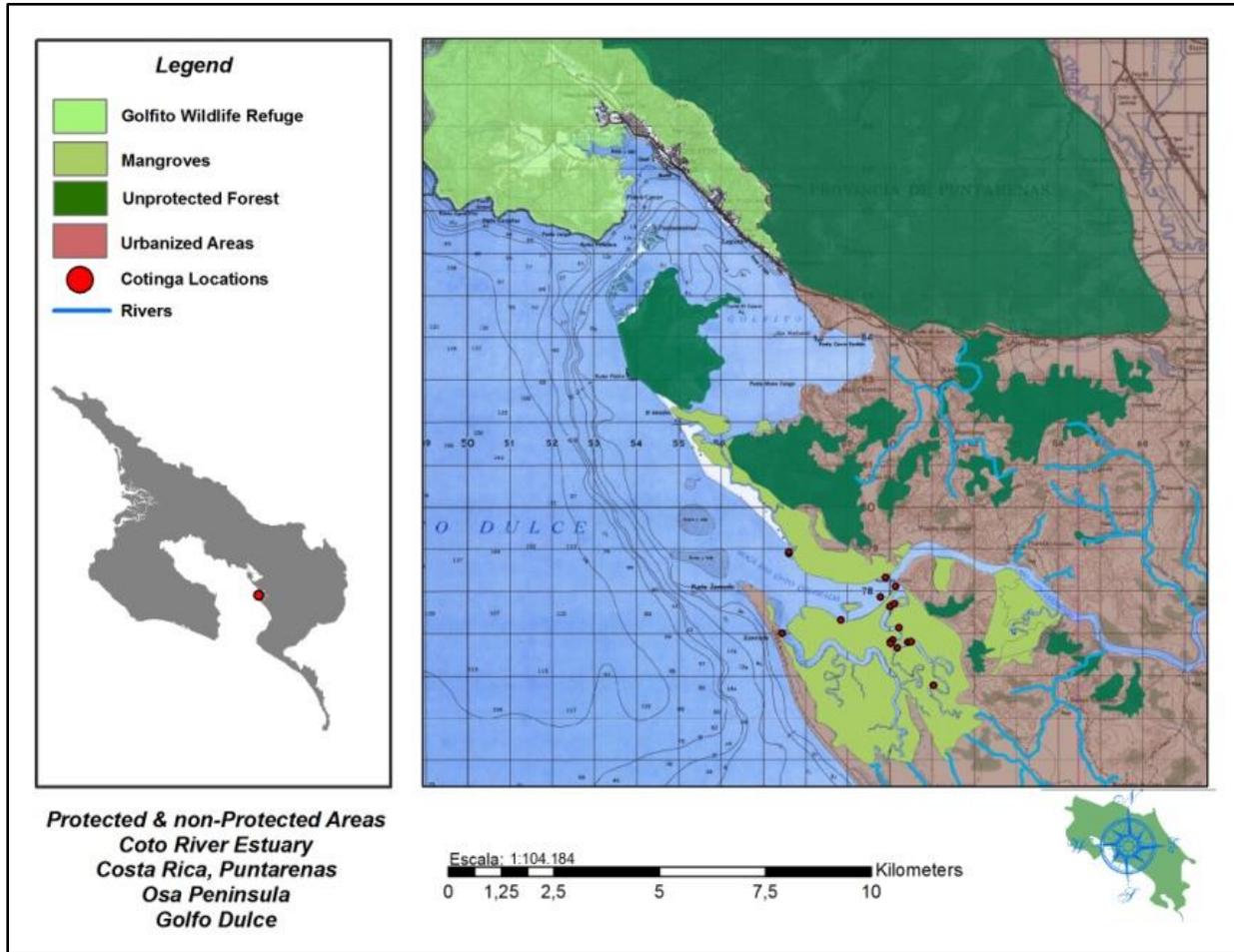


Fig. 11. Protected areas at the Rio Cota mangrove estuary, Golfo Dulce, Puntarenas, Costa Rica. Cotinga locations courtesy Jones et al. (2009)

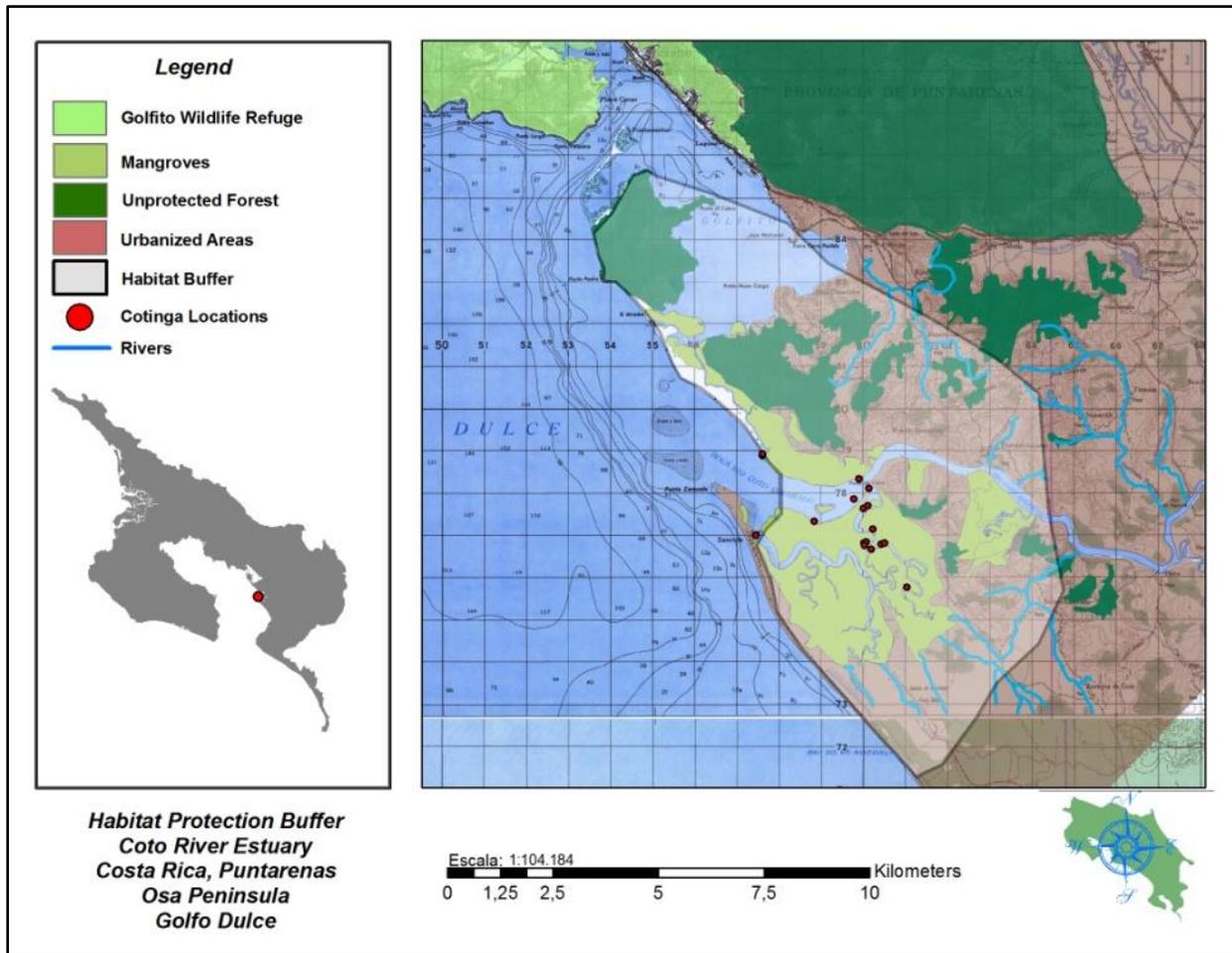


Fig. 12. Habitat protection buffer (3 km) at the Rio Coto mangrove estuary, Golfo Dulce, Puntarenas, Costa Rica. Cotinga locations courtesy Jones et al. (2009)

### **Habitat Loss and Degradation at Río Tárcoles: Threats and Issues for Consideration**

Much of the forested area around the mangroves at the Río Tárcoles has been converted to agriculture or urban areas however forest buffers remain. The southern-most section of the mangroves that was once bounded to the Río Tárcoles has been converted into rice or other agricultural products with no forest buffer present at all. A 1 km forest buffer runs along one section of the river near the mouth connecting to the Carara Biological Reserve. All other buffers found along rice field borders are highly fragmented and may not provide the corridor needed for cotinga movements. Jones et al. (2009) observed Yellow-billed Cotingas in the forest section at Carara and also noted the forest corridor running between the two habitats. The overall gap is ~2.5 km wide between the mangrove edge and the Reserve (Fig. 13). Another known problem facing this area is heavy metal contamination. Fuller et al. (1990) found high levels of Chromium, lead and zinc in mangrove sediment 2 to 3 times above normal levels downstream of leather tanneries from San Jose and other surrounding urban areas flowing down the Río Tárcoles and its tributaries. This may also be a problem affecting other mangrove

estuaries downstream from other urban industrial areas adjacent to Térraba-Sierpe and Río Coto.



Fig. 13. Río Tárcoles above the Carara Biological Reserve, Puntarenas, Costa Rica.

#### **Habitat Loss and Degradation: Biological Corridors**

The integrity and contiguity of biological corridors between Yellow-billed Cotinga populations may be as important as safeguarding the mangrove habitat itself at each river estuary. Juvenile and adult dispersal and genetic exchange between sites may depend on non-fragmented forest corridors or forest buffered watersheds to allow movement and maintain viable populations especially the smaller populations of Rincón and Esquinas which may be negatively impacted by periodic declines. The Golfo Dulce Forest Reserve provides this link between Rincón, Sierpe and Esquinas. The Río Coto population is tenuously connected to the Golfito Wildlife Refuge via fragmented forest patches (Fig. 14). Thus, any possible genetic exchange would likely come from the population at Río Esquinas as the next known site is Cerro Batipa in Panama which is ~95 km away. This now brings up the question as to the Yellow-billed Cotinga distribution in Panama, the isolation of some populations especially that of the northern most site of Río Tárcoles in Costa Rica which lies ~140 km north of Térraba-Sierpe, and of Cerro Batipa in Panama and the potential for genetic exchange between them. Investigation is needed to uncover the answers to these questions.

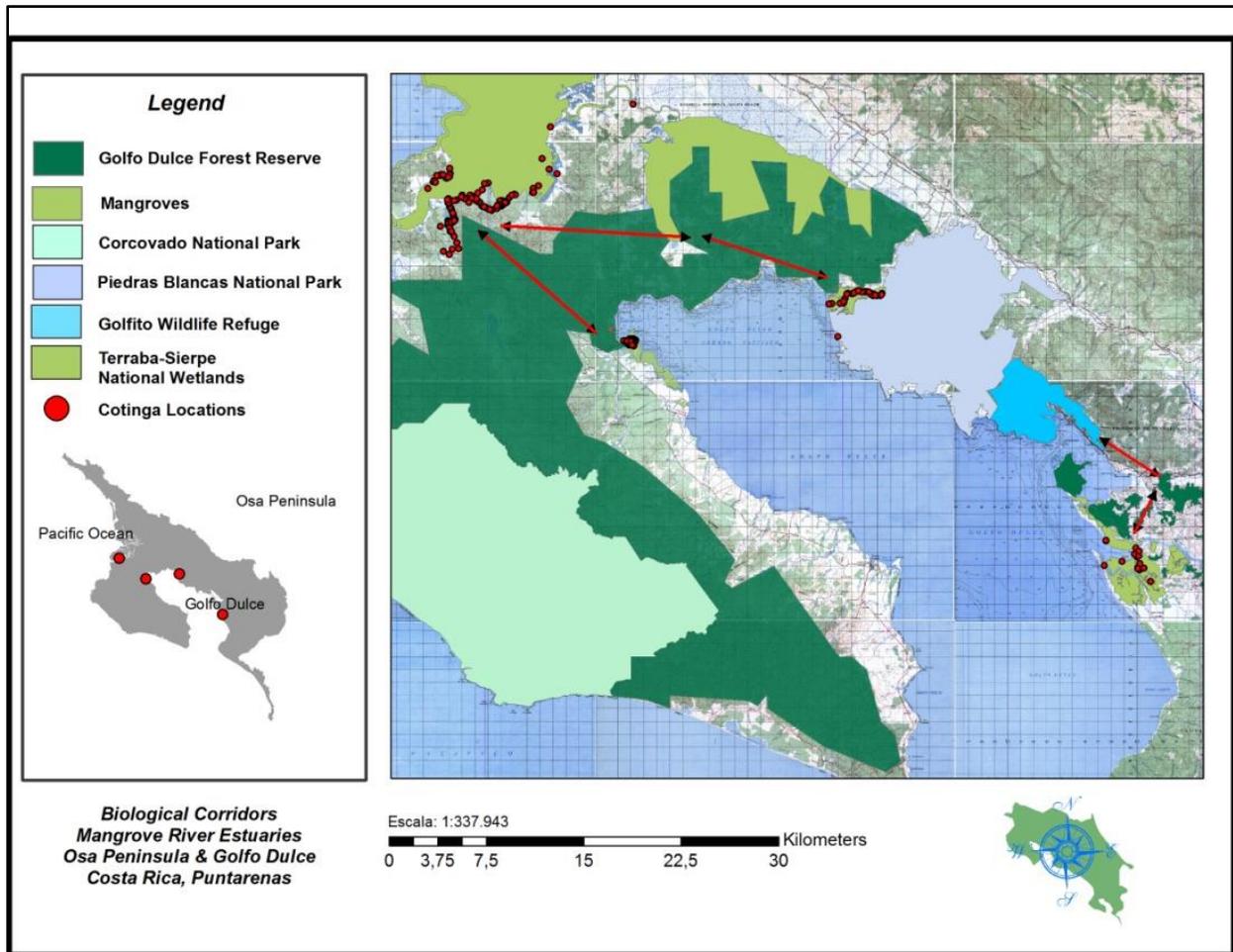


Fig. 14. Biological corridors between Yellow-billed Cotinga populations along the Golfo Dulce, Puntarenas, Costa Rica.

**Non-habitat Threats: Climate Change Effects on Habitat**

El Niño weather events cycle globally approximately every 4 years producing oceanic warming and extreme weather events. Costa Rican Pacific coastal areas were mostly affected by hot dry weather of 2009/2010, a more predictable El Niño effect for the pacific coast of Central America (NOAA 2009; Holmgren *et al.* 2001). El Niño events can have a profound effect on animal and plant communities in terrestrial ecosystems. Defoliation of mangroves and high levels of mortality of canopy trees can occur and drought conditions can result in a reduction of food resources (Lindsay *et al.* 1997) and breeding success (Grant and Grant 1987) in birds. Conversely, La Niña weather events which typically follow dry El Niño years are considerably wetter especially during the Costa Rican winter and could limit foraging opportunities and decrease fitness or survival of Yellow-billed Cotingas. Increased precipitation and high winds may destroy forest swaths or defoliate trees reducing protective cover for roosting or for escape from inclement weather events. Hurricane strength winds travelled through the Rincón area in June of 2009 destroying large patches of both rainforest and mangroves reducing

overall habitat availability for feeding, roosting and possibly nesting. Global warming could be exacerbating El Niño weather cycles and could also be the cause of unpredicted extreme erratic weather events (NOAA 2009) such as that seen in Rincón in 2009 resulting in habitat destruction and potentially causing direct mortality of individual birds.

**Specialized Ecological Characteristics**

Specific ecological and demographic characteristics may render the Yellow-billed Cotinga more vulnerable to human pressures and stochastic events. The differentiated use of rainforest and mangrove ecosystems and the required connection between them does not pose a direct threat to the species but unpredictable stochastic events and alterations to the landscape increases the probability of a reduction or collapse of the population. The fragmented nature of mangrove estuaries, the relatively small population size associated with each mangrove system and the potential genetic chain that joins each one may also increase the susceptibility of each population to anthropogenic pressures. Determining how populations are connected through emigration and dispersal is integral to understanding how anthropogenic threats influence population dynamics.

**Table 3: Threats to Yellow-billed Cotinga populations, affected habitat and priority rankings for conservation actions.**

<b>Threat</b>	<b>Habitat most affected</b>	<b>Priority</b>
Habitat loss: Land conversion to pasture, agricultural areas and roads	Rainforest	High
Illegal logging	Mangrove and Rainforest	High
Cutting to fell old growth trees	Rainforest	Medium
Area gaps between the Golfo Dulce Forest Reserve and mangroves that lack legal protections	Rainforest	High
Lack of mangrove forest buffer	Mangroves	High*
Lack of forest buffered riparian corridors	Rainforest	High*
Cattle encroachment into mangroves	Mangroves	Medium*
Chemical industrial contaminants	Mangroves	Medium
Lack of on-the-ground management and protection	Mangroves and Rainforest	High
Extreme weather events	Mangroves and Rainforest	Medium
Specialized habitat requirement of mangrove rainforest connection	Mangroves and Rainforest	Medium

\*Information is lacking and ground truthing or high definition imagery is required  
Priority rankings are assumed the same for all sites

#### **IV POPULATION GOALS AND CONSERVATION ACTIONS**

The principle population goal is to determine population status of the Yellow-billed Cotinga within its current range and monitor population trends over an established time period. The primary conservation goal should be to have no further loss in habitat or distribution with a potential increase in the population through habitat restoration. Addressing habitat loss and degradation at current sites should mitigate any further loss within isolated Yellow-billed Cotinga populations leading to positive effects in achieving overall conservation goals. Since the magnitude of effects of threats and limiting factors are not well understood, we begin to address specific conservation goals protecting, managing and restoring Yellow-billed Cotinga year-round habitat.

The highest priority threats to be addressed stem from habitat loss and degradation. The conservation strategy of greatest importance is the creation of and maintenance of a *Yellow-billed Cotinga Conservation Working Group* (YBCCWG), a broad-based private and public partnership which will work towards Yellow-billed Cotinga conservation outside the regulatory arena. Estimates of historical populations and trend data are lacking, but a loss of either rainforest and/or mangrove habitats throughout its limited range raises concerns over a potential steep population decline. Local extirpations may have occurred in historical locations highlighting the need for stringent protections in current strongholds and plans for restoration at degraded sites. Based on current knowledge of Yellow-billed Cotinga ecology the most feasible actions to promote the halting of further shrinking of distribution are habitat protection, restoration and management. The following are range-wide conservation actions identified as priorities in the next 5 years (2012 – 2016) which will be evaluated every 3 - 5 years thereafter. The newly formed YBCCWG will develop detailed implementation plans to achieve conservation and research actions and criteria to evaluate success.

##### **Assess Current Legal Protections**

Legal protections are varied and layered in Costa Rica for protected wetlands, forest and wildlife reserves. However, the broad spectrum of legislation and legal entities may be resulting in an overlap in legal inconsistencies and difficulties in on-the-ground management and conservation. Much of the remaining forest on the Osa Peninsula in Costa Rica is protected within the Golfo Dulce Forest Reserve however existing forest adjacent to mangroves is left out of the Forest Reserve leaving critical rainforest habitat unprotected and mangroves isolated. A formal assessment is needed to identify legal protections and current management practices within Costa Rica which fall under the Ramsar Convention for Térraba-Sierpe, la Ley Orgánica del Ambiente, la Ley de Biodiversidad, wetland protections which fall under Patrimony of the State, The Golfo Dulce Forest Reserve which affects Térraba-Sierpe, the Río Rincón and the Río Esquinas, the Golfito Wildlife Refuge which affects Río Coto and the Carara Biological Reserve

which affects the Río Tárcoles. An identical assessment is also needed for all forest and mangrove habitats used by Yellow-billed Cotingas in Panama.

### **Improve Habitat Protection**

Once all layers of legal protections of rainforest and wetlands are defined for each mangrove river estuary a formal assessment of management practices should be conducted to inform managers of gaps in habitat protection and actual enforcement of laws. A series of steps towards achieving conservation goals should then be taken.

- Partner with local, and regional government agencies to develop habitat management plans, communicate conservation action strategies developed and defined by the YBCCWG, and develop strategies for species protection which function under local law.
- Reduce forest fragmentation and prevent forest loss through legislation and legal enforcement against illegal logging, illegal cutting of old growth trees at the base for felling by high winds, and encroachment of cattle into the edges of mangroves. The lack of area protection and high amounts of forest loss and fragmentation along mangrove boundaries should be addressed (see Address large area gaps below). Several large private properties which maintain large tracts of forest have the potential to be divided up into smaller lots and/or sold to developers. *This is a high priority action item and should be addressed immediately.*
- Maintain and improve protection of all mangrove habitats and a target amount of large tracts of rainforest habitat adjacent to mangroves: Leavelle (2011) found that radio-tagged birds never travelled beyond 2.7 km from the edge of the mangroves into the forest, therefore based on these results a protection buffer has been drawn 3 km around all mangrove sites (Figs 3, 7, 10 & 12). All habitats fragmented or intact are priority habitats for protection and conservation within the buffer area. An additional year of the Spatial Biology study is recommended in research actions described below as a comparison year to better understand seasonal wandering or adult dispersal to other areas. The first year however has shown high site fidelity therefore justifying current buffer boundaries. Results from the Rincón study area have been extrapolated to all other mangrove areas until further study can be done.
- Maintain integrity and connectivity of rainforest corridors and buffers adjacent to mangroves and between isolated populations: Corridors between mangrove sites should be formally identified. Juvenile and adult dispersal research is recommended below the results of which will help define corridors for protection. As well, legal buffers of at least 10 m wide on either side of riparian areas should be protected; maintained or restored where habitat has been entirely lost. Mangrove edges that lack lowland rainforest buffers out to at least 100 m should be restored, especially where private property is bounded to the mangroves. *This is a high priority for the Rincón and*

*Coto areas with heavy agricultural areas where forest is depleted or highly degraded leaving very little forest connection to the mangroves.*

- Address the large gaps that exist between protected areas: In order to maintain the integrity of rainforest habitat adjacent to mangroves, the 2 – 3 km gap between the Golfo Dulce Forest Reserve and mangroves should be closed where feasible. At present the southern edge of the Sierpe wetlands are located next to unprotected private property leaving the fragile area vulnerable to habitat loss and degradation.
- Pilot habitat restoration projects: Develop explicit strategies to restore areas of degraded forest to conditions suitable for Yellow-billed Cotinga and associated endemic and migratory birds. Community restoration projects can be proposed to local landowners for planting of mixed rainforest tree species such as *bursera simaruba* (Tourist tree) or native *ficus sp.* trees along property boundaries adjacent to mangroves, along pasture and agricultural division and along waterways than run through the property as part of an overall mangrove conservation and education program. Mangrove restoration projects are also recommended in areas hard hit by extreme weather events such as Rincón. Mangroves would benefit from restoration as natural regeneration of mangroves is very slow.

Benefits to Migrants: All actions geared towards habitat protection of the Yellow-billed Cotinga will also have direct benefit to Neotropical migratory birds. Maintaining the biological connection between mangroves and adjacent rainforest is one of the most important factors for both the resident Mangrove Hummingbird as well as the Prothonotary Warbler, a North American Neotropical migrant species of conservation concern. The Prothonotary Warbler has been observed feeding on understory rainforest shrubs right at the mangrove interface and has also been observed within the mangroves during the day (Leavelle 2011). The Mangrove Hummingbird relies on both mangrove and rainforest food resources. Closing the non-protected area gaps between the mangroves and the Golfo Dulce Forest Reserve will also provide more of a guarantee that forest remains intact as more protections are afforded within the reserve. Other migratory species observed in the Rincon rainforest that would benefit from conservation actions are the Yellow Warbler, Yellow-Throated Vireo, Chestnut-sided Warbler as well as the Kentucky Warbler and the Hooded Warbler, both threatened (T) species in the State of Wisconsin.

Maintaining buffers and biological connectivity is also extremely important for migratory species that utilize corridors in migrational movements and rely on fruit and insects of rainforest trees that line riparian areas. Without these biological corridors migratory birds may be more limited in their stopover movements and feeding potential thus affecting overall survivorship on their wintering grounds.

### **Develop Outreach and Partnerships**

Collaboration with local partners will be critical to the success of the conservation of the Yellow-billed Cotinga. To promote participation in YBCCWG activities it is recommended to:

- Form new partnerships within the entire range of the Yellow-billed Cotinga in both Costa Rica and Panama, strengthen existing relationships, develop outreach and opportunities to government and non-government officials, biologists, students, local guides and guide associations and community members for the implementation of conservation measures.
- Recruit members into the YBCCWG internationally and from Costa Rica and Panama
- Work with local partners to develop outreach, ecotourism, training and capacity building projects and promote linkages between Costa Rica and Panama
- Develop partnerships and projects with a focus on education to communicate awareness of Yellow-billed Cotinga conservation issues to build local needed community support for conservation of birds and their habitats

### **Establish and Secure Funding for Management and Conservation**

As research and conservation are in its initial stages for the Yellow-billed Cotinga, a fund to support conservation projects is recommended. The purpose of the fund is to provide financial support via grants to local partners in Costa Rica and Panama for projects that target conservation efforts in the protection and restoration of Yellow-billed Cotinga habitat. It would also assist local governments in securing implementation funds for developed habitat management plans. The YBCO Fund would be set up and managed by an advisory committee made up of representatives from YBCCWG partners.

### **Refine population goals**

It is recommended that the YBCCWG identify priority focus areas for habitat conservation efforts to support population goals every 5 years or when critical information comes to light. Population goals should then be refined along with conservation objectives for the Yellow-billed Cotinga.

**Table 4: Summary of conservation goals and highest priority conservation actions to achieve the overall conservation goal of halting further loss of Yellow-billed Cotinga habitat and distribution.**

<b>Conservation Goal</b>	<b>Conservation Action</b>
Assess current protections	Assess existing levels of legal protections and management practices under each law and protected area in Costa Rica and Panama
Improve Habitat protection	<ul style="list-style-type: none"> <li>• Partner with local government agencies to develop habitat management plans</li> <li>• Reduce forest fragmentation and prevent forest loss*</li> <li>• Maintain all mangrove habitats and a target amount of large tracts of rainforest habitat adjacent to mangroves.</li> <li>• Maintain integrity and connectivity of rainforest corridors and buffers adjacent to mangroves and between isolated populations*</li> <li>• Address the large gaps that exist between protected areas: close the gap between the Golfo Dulce Forest Reserve and Mangroves.</li> <li>• Pilot habitat restoration projects</li> </ul>
Develop outreach and partnerships	<ul style="list-style-type: none"> <li>• Develop strong partnerships with local stakeholders</li> <li>• Recruit YBCCWG members</li> <li>• Work with local partners to develop outreach, ecotourism, training and capacity building projects</li> <li>• Develop education and awareness projects to build support for bird conservation</li> </ul>
Establish and secure funding for management and conservation	<ul style="list-style-type: none"> <li>• Establish a YBCO protection fund for habitat conservation</li> <li>• Assist local governments in securing implementation funds for developed habitat management plans</li> </ul>
Refine population goals	<ul style="list-style-type: none"> <li>• Refine population goals</li> <li>• Refine habitat conservation objectives</li> <li>• Identify focus areas for habitat conservation efforts to support population goals every 5 years</li> </ul>

*\*Considered highest priority*

## **V RESEARCH ACTIONS**

Many threats and limiting factors to the endangered Yellow-billed Cotinga population are unknown or poorly understood. In order to address specific conservation goals and actions, an important component of the species survival is to conduct research on the threats believed to be negatively impacting populations. Vital information gaps must be reduced so that threats can be addressed and mitigated by well-informed future conservation actions. Research actions focus on mangrove and rainforest habitat protection and the required connection between the two, as well as protection of the biological corridors between mangrove wetlands and each associated Yellow-billed Cotinga population. The following research actions are identified as priorities for the next five years (2012-2016) (Table 5)

Research conducted by Jones et al. (2009) revealed important current distributional information for the Yellow-billed Cotinga however site specific information especially within Panama is still lacking. Historical distribution indicates Yellow-billed Cotinga presence over to Parrita within Panama Bay however Panama Bay has the largest extent of mangroves in the country as far east as San Miguel. Detailed systematic surveys of Cotinga presence are necessary for areas not previously visited such as San Miguel as well as repeat surveys in areas of known historical presence where Jones et al. (2009) did not detect cotingas such as Golfito in Costa Rica and Boca Bravo and Boca Chica in Panama. Quantification of habitat loss at a landscape level, especially in areas more affected such as Panama sites, is necessary through examination of historical and present day high definition imagery and analysis of overall loss to mangroves and adjacent rainforest. Results will inform researchers and conservation professionals of a more exact current distribution and available habitat, revealing focal areas for management and study. Once Yellow-billed Cotinga presence is more clearly established survey protocols and methods should be established to obtain information on abundance and occupancy at each known site. Surveys should be conducted at an established time period set by the YBCCWG. Surveys should be conducted every 3 – 5 years is recommended in order to determine population status and trends over time. If surveys are to be conducted using lek locations it is important to note that leks are not distributed evenly across the landscape and therefore scouting of leks the day prior to each survey is necessary to establish lek locations. This will also be necessary each round of surveys as leks can shift across years.

Because of inland observations during wet winter months coupled with findings of a lack of seasonal migrational wandering in three radio-tagged cotingas from Leavelle (2011), it remains unclear as to whether birds may migrate or wander in some years and not in others. Therefore a second year of study of the spatial biology of the Yellow-billed cotinga is recommended at the Rincón River estuary as a comparison year to more effectively determine winter movements.

This will better inform conservation actions especially if birds are observed using rainforest habitat farther away from their reproductive grounds.



*Adult Male Yellow-billed Cotinga, Feb. 16, 2011.  
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*Immature Female Yellow-billed Cotinga, Feb. 15, 2011.  
Copyright©Karen Leavelle.*

Lowland rainforest buffers exist along the edge of the mangroves protecting the mangroves themselves from human or domestic animal encroachment (Fig 6). However, the width of buffers is varying. As a research action, the existence and width of buffers should be quantified either through high definition imagery or systematic ground-truthing at established distance intervals along the length of the mangroves. It has been observed at the Rincón River (Leavelle per obs) that sections of mangroves are completely devoid of any rainforest buffer protection resulting in agricultural areas or tree plantations butting right up against vulnerable mangrove habitat. Where cattle pasture joins mangroves, understory vegetation is at times cut to allow feed grass to grow and cattle to move into mangrove edges compacting mangrove sediment and potentially altering the hydrology in certain areas, destroying natural mangrove understory vegetation and possibly the trees themselves. The lack of rainforest buffers also results in loss of fruiting trees for Yellow-billed Cotingas and other birds that depend on those food resources.

Similarly, rainforest buffers also exist along riparian watersheds that run from nearby upland forest and into the mangroves along main river channels down to small creeks (Fig 5). Buffer width is varying depending on property owner land use along the stretch of the channel. Some areas may extend out to 10 m or more while other parts of the channel may have only grass or agricultural products right up to the edge. Forest buffers are known to provide critical habitat for birds whether along water channels, agricultural boundaries or other human altered areas. Leavelle (2011) found that three radio-tagged cotingas used river, stream and small creek corridors buffered with mixed fruiting rainforest trees for feeding and moving from mangrove to rainforest providing critical links between habitats where riparian areas are isolated and

surrounded by human altered and degraded areas. Jones *et al.* (2009) also found similar buffered corridors at the Río Tárcoles providing routes between mangroves and feeding areas in nearby upland forest at the Carara Biological Reserve in Costa Rica. Buffers along river and stream corridors should be quantified through high definition satellite or photographic imagery or systematic ground-truthing where possible at established distance intervals to determine the existence and width of forest buffers. Results will help inform conservation actions to protect existing buffers and restore riparian areas devoid of natural rainforest vegetation which maintains corridors for movement of Yellow-billed Cotingas and provides critical food resources in already degraded and fragmented areas.

Chemical industrial pollution and waste that runs into streams and into gulf waters results in heavy metal toxicity and a degraded habitat over the long term (Fuller *et al.* 1990) the impacts of which may not be fully apparent until the damage is already done. Water pollutants causing tree defoliation and stand death within mangroves could cause a collapse in the Yellow-billed Cotinga population at certain sites, especially those surrounded by urbanization and agriculture such as Sierpe, Coto, Tarcoles and Rincón. Nearly every cotinga mangrove site is vulnerable to chemical contamination either from upstream urban centers or localized crop chemicals which spill into rivers or small creeks which flow from crop edges straight into mangrove mud sediment. Fuller *et al.* (1990) reports on contaminants found in the mangroves of the Rio Tarcoles which should sound the alarm for chemical testing in all other mangrove estuaries. Immediate water testing should be conducted for presence of heavy metal pollutants in all Costa Rican mangrove estuaries where Yellow-billed Cotingas are found with consideration for future testing of Panama sites as well. Repeat testing should be conducted on an annual basis with results incorporated into conservation actions taken for reduction of inflowing pollutants at sites determined to be priority as per test results.

Reproductive information for the Yellow-billed Cotinga is lacking. In order to better understand life history traits, demographics, and potential factors that may be limiting this population, it will be important to fill reproductive information gaps. Reproduction may be limited within this system by availability of preferred nest sites, habitat fragmentation or other factors ultimately affecting recruitment into the larger metapopulation. If nesting solely occurs in the mangroves as it is believed then it is possible that nest sites are limited to certain mangrove species which provide appropriate nest substrates. It is then important to determine actual availability of preferred nest sites to understand potential reproductive output. If nest sites are limited by anthropogenic pressures such as habitat loss or degradation then conservation actions should be geared towards protection and restoration.

Mangrove estuaries are by nature linear, fragmented and isolated, and some are smaller than others. Small populations are more vulnerable to anthropogenic pressures and both stochastic

natural events which may cause reductions in populations, or at worst, local extirpation of a species. Small populations rely on recruitment into the population and genetic exchange via emigration and fledgling dispersal. The relatively small Yellow-billed Cotinga population found at Rincón, for example, may experience ebbs and flows in abundance requiring an influx of individuals from large neighboring mangrove sites such as the Tórraba-Sierpe National Wetlands to maintain the population. Research into fledgling dispersal should be considered as a means to understanding the interconnectedness and movement between sites and dispersal from Sierpe into other areas such as Rincón. Sierpe is the largest mangrove wetland site with presumably the largest population. An increase in habitat loss and fragmentation resulting in a decrease in the Yellow-billed Cotinga population at Sierpe could result in a decrease in recruitment into the population and fledgling dispersal into smaller nearby populations. This cascade of events could lead to the reduction or extirpation of the smaller population. If dispersal occurs from Sierpe into other smaller mangrove sites, results would indicate Sierpe as a high priority level site for conservation actions to mitigate future habitat loss and a reduction in that population. Investigation into fledgling dispersal should also be considered from other sites. *Any investigation into fledgling dispersal requires radio telemetry of fledglings and should be carefully considered due to the species endangered status.*

**Table 5. Summary of research actions, the threats addressed, the anticipated outcome and priority level for each.**

<b>Research Action</b>	<b>Threats Addressed</b>	<b>Anticipated Outcome</b>	<b>Priority Level</b>
Survey/Resurvey areas for Cotinga presence	Habitat Loss & Degradation	Clarify current distribution/ Identify areas still in question	High
Quantify habitat loss and current availability through high definition satellite or photographic imagery	Habitat Loss & Degradation	Determine population status and trends via imagery	High
Conduct population surveys for abundance & occupancy at each site through <i>Osa Birdwatch</i>	Habitat Loss & Degradation	Determine population status and trends at the site level for more exact measures	High
Determine existence and width of rainforest buffers along mangrove edges & along riparian corridors.	Lack of mangrove forest buffer/Cattle encroachment into mangroves/Lack of forest buffered riparian corridors	Inform conservation action to protect and/or restore lowland rainforest buffers, the edge of the mangroves and provide and maintain food	High

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		availability along the length of the mangrove habitat and riparian corridors/ Strengthen or create legal protections	
Investigate nest site preferences and availability	Habitat Loss and Degradation	Defined reproductive habitat requirements for conservation and increased protection of mangroves	Medium/High
Conduct Year 2 of the Spatial Biology study at the Rincón River mangrove estuary	Habitat Loss & Degradation	Determine winter movements and habitat use to inform conservation actions and habitat protection in winter areas	Medium
Test waters flowing into mangrove estuaries for heavy metal contaminants	Chemical industrial contaminants/Habitat loss and Degradation	Determination of toxicity levels to inform conservation actions for reduction of inflowing contaminants	Medium
Investigate fledgling dispersal from Terraba-Sierpe National Wetlands via radio telemetry	Habitat Loss and Degradation	Understanding of connectedness and between site movements of first year young from Sierpe. Results determine conservation priority of Sierpe, the function of that site as a source population and the level of action taken to mitigate continued habitat loss, fragmentation and degradation	Medium/Low
Model the potential for impacts of catastrophic weather due to cyclical El Nino events and/or global warming	Extreme Weather Events/Habitat Loss	Predictive models to assess potential impacts on populations	Medium/Low

## VI EVALUATING ACCOMPLISHMENTS

The YBCCWG will refine methods and protocols for monitoring to determine a baseline population size of the Yellow-billed Cotinga across its range in order to monitor population trends over time. The working group will then establish an agreed upon population goal to be achieved over a specified time period. Assessing progress towards a desired population goal of will be reached through *Osa Birdwatch*. *Osa Birdwatch* will be a range-wide monitoring program created and developed specifically to monitor and track abundance, occupancy and distribution of the Yellow-billed Cotinga throughout its current range using field-tested, peer-reviewed and statistically robust methods, and is intended to be updated annually. *Osa Birdwatch* will also be set up to monitor all other threatened associated species which overlap in habitat with the Yellow-billed Cotinga (See Tables 1 & 2). Survey methods will be varied for different species, especially for the Yellow-billed Cotinga due to its leking behavior and quiet nature. Though *Osa Birdwatch* will serve southern Costa Rican bird populations, it will also monitor Yellow-billed Cotinga populations in Panama as well either under *Osa Birdwatch* or another entity decided upon by the international YBCCWG. *Osa Birdwatch* will provide refined global population estimates over the longer term allowing for a more defined and appropriate conservation status listing of the Yellow-billed Cotinga and other threatened resident bird species and provide information and facilitate conservation actions of Neotropical migrants while on their wintering grounds. Monitoring will be implemented annually to assess population status and trends for a period exceeding 5 years. Preliminary results will allow for evaluation of progress towards reaching goals and making any refined changes to those goals as necessary.

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