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RESOURCE INVENTORY PROJECT**

CARIBBEAN – SAINT LUCIA

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**THE STATUS AND CONSERVATION OF
SAINT LUCIA'S FOREST BIRDS**

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1 Executive Summary

This report presents the findings of a survey of all bird species at 31 sites, chosen to represent all the main forest types across the whole of Saint Lucia, in 2009. These data were augmented by auxiliary data from four additional bird surveys, conducted between 2006 and 2009, and focussing on more limited numbers of target species and restricted to smaller survey areas. In addition, migrant bird records from Saint Lucia dating back almost one century were also examined.

Over 60% of all Saint Lucia's resident bird species were recorded during this survey, including four of Saint Lucia's five endemic bird species. A suite of 16 'priority bird species' were selected for closer examination. These priority species were chosen based on endemism (at the species and subspecies level), and the severity of threats to their survival at a global and national level. Twelve (75%) of these priority species were found. The four that were not detected were Semper's warbler (*Leucopeza semperi*), not recorded 1961 and possibly now extinct; the Saint Lucia forest thrush (*Cichlherminia lherminieri sanctaeluciae*) known only from a handful of sightings on Saint Lucia in the last century; the Saint Lucia rufous-throated solitaire or mountain whistler (*Myadestes genibarbis sanctaeluciae*), known only from elevations higher than any visited during this survey; and the Saint Lucia nightjar (*Caprimulgus rufus otiosus*), also very rare, and which is normally only detectable at night by its call.

The abundance and occurrence of the priority species varied widely. Some like the Lesser Antillean saltator (*Saltator albicollis albicollis*), the Saint Lucia warbler (*Dendroica delicata*) and the Saint Lucia pewee (*Contopus latirostris oberi*) were found to be widely distributed. The Saint Lucia oriole (*Icterus laudabilis*) and the grey trembler (*Cinclocerthia gutturalis macrorhyncha*) were also recorded as widespread, but less common and seemingly more patchily distributed. Auxiliary data make it clear the Saint Lucia amazon (*Amazona versicolor*) is widespread and common within the lower montane rainforest. The remaining species were infrequently encountered and appeared to have a more restricted distribution. They were the bridled quail dove (*Geotrygon mystacea*), great blue heron (*Ardea herodias occidentalis*), the Lesser Antillean flycatcher (*Myiarchus oberi sanctaeluciae*), the rufous-throated solitaire (*Myadestes genibarbis sanctaeluciae*), the Saint Lucia nightjar, the Saint Lucia black finch (*Melanospiza richardsoni*), Saint Lucia wren (*Troglodytes aedon mesoleucus*), and the white-breasted thrasher (*Ramphocinclus brachyurus sanctaeluciae*). In the case of at least two of these species, their restricted range appears to be due to habitat specificity, with the great blue heron being restricted to wetlands and the rufous-throated solitaire restricted to higher elevations. Of most concern in this regard are the priority species found only in deciduous seasonal forest – the Saint Lucia nightjar, Saint Lucia wren and white-breasted thrasher – are very restricted in terms of their distribution on Saint Lucia.

This variation in the abundance and distribution of the (*a priori*) priority species stimulates discussion of which of these species – and which of their forest habitats – should be of the most conservation concern. From a consideration of the findings of all the surveys considered in this report, and from other published sources, a number of observations are apparent:

- (a) The Forest Reserves plays a critical role in conserving priority species, with about one fifth of them (19%) occurring *only* within these lower montane and montane rainforests. In addition, another two fifths (44%) of the priority species occur both inside and out of the Forest Reserves.
- (b) However, the remaining two fifths (38%) of priority species occur almost entirely in habitats *outside* the Forest Reserve.

- (c) Over 80% of all priority species depend in part or in whole on deciduous seasonal forest to support their populations, and almost 60% of all priority species depend in part or wholly on semi-evergreen seasonal forest. Over 60% depend in part or in whole on lower montane or montane rainforest.

Amongst the priority species, a number of criteria related to declines in abundance and distribution, severity of threats faced, and cultural and economic value are considered. These suggest a ranking within Saint Lucia's priority species with the most critical being:

- the Saint Lucia nightjar;
- the forest thrush;
- the Saint Lucia black finch;
- Semper's warbler
- the Saint Lucia amazon;
- the white-breasted thrasher; and
- the Saint Lucia wren.

Threats to Saint Lucia's priority birds and their habitats are discussed, with conversion of forest (at present, primarily from large-scale tourist developments) and alien invasive species (primarily introduced mammalian predators such as the Asian mongoose) standing out as the most severe threats.

A limited number of recommendations are made, based on the identification of these species and habitat priorities:

- Securing the management and restoration of critical deciduous seasonal and semi-evergreen seasonal forest areas on Saint Lucia.
- Controlling the introduction and spread of alien invasive species that endanger forest birds.
- Conducting research into habitat restoration and alien predator control in the context of adaptively managing Saint Lucia's avifauna.
- Strengthening local and national understanding and support for the conservation of forest birds and their habitats.

1. Introduction

1.1. Purpose and scope

This survey was conducted as a part of the National Forest Demarcation and Bio-Physical Resource Inventory Project, funded by the European Community under the Saint Lucia SFA2003 Programme of Economic and Agriculture Diversification and Poverty Reduction through Integrated National Resources Management. The purpose of this inventory project was “to survey and demarcate the physical parameters of the public forest reserve and conduct a comprehensive biophysical inventory/ assessment and management system of forest resources”. This report forms a part of Result 3: “A comprehensive report on the current state of forest resources (Timber, Non-Timber, biodiversity, wild fauna etc) with recommendations for sustainable management practices”.

The purpose of this report is to derive management recommendations for the conservation of forest birds on Saint Lucia. In keeping with reports on other taxa under this project (e.g. Clarke, 2009; Daltry, 2009; Graveson, 2009; and Ivie, 2009), ‘forest’ in this context is taken to mean all forms of natural or near-natural terrestrial vegetation, most of which, on Saint Lucia, are secondary. Recommendations consider both species and site conservation needs from a *national* perspective.

The scope of the survey work conducted for this report was limited to rapid surveys of birds using standardized point counts at 33 sites across Saint Lucia, selected to represent major forest types on the island. Emphasis was given to sites and forest types outside the Government Forest Reserves, as more bird data exist for these rainforests. During the point counts, all bird species detected were identified and individuals counted (see section 2 for details). However, for the examination of species’ distribution, a suite of 16 ‘priority species’ were selected by one of us (A. Toussaint) as being of high priority for conservation management on Saint Lucia. The distribution maps for these species were also augmented, where possible, with location records from up to four additional bird surveys on Saint Lucia over the period 2006-2009. These additional surveys all restricted themselves to limited sets of target species, with the species composition of sets varying between different surveys. Finally, records of migrant species collated by John (2004) are also presented and discussed in this report.

The scope for comparing and analysing the relative importance of different types of forest to birds was limited by both time and sample size. This scope precluded meaningful statistical analyses of, for example, habitat preferences. In addition, at the time of writing, an accurate vegetation (forest type) map was not available. Instead, for target species, qualitative comparisons were made between records inside the Forest Reserve (predominantly lower montane rainforest, montane rainforest and cloud montane rainforest: Graveson, 2009) and areas outside of the Reserve (predominantly deciduous seasonal forest and remnant semi-evergreen seasonal forest: Graveson, 2009). This qualitative examination was augmented by the combined bird watching experience of two of the authors (A. Toussaint and L. John) over the past 20 years. It should be remembered, however, that not all possible analyses of the data collected during this survey, nor the auxiliary surveys collated herein, have been conducted due to the limited duration of the project. A lot more remains to be examined in these data.

The classification of birds on Saint Lucia has changed considerably in the past two decades, notably seeing the Saint Lucia pewee, Saint Lucia nightjar and Saint Lucia wren reclassified from endemic species (*Contopus oberi*, *Caprimulgus otiosus* and *Troglodytes mesoleucus* respectively) to endemic subspecies (*Contopus latirostris oberi*, *Caprimulgus rufus otiosus* and *T. aedon mesoleucus*: AOU, 1998 + supplements). This situation can cause some confusion with older reports and may have the unfortunate consequence of making

these birds appear of lesser global significance (for example, to funding agencies). In the absence of more recent taxonomic authorities, however, the present report follows BirdLife International's (2009a) extensive and current taxonomic review and uses the taxonomy proposed by the American Ornithologists Union (AOU 1998 + supplements), whilst recognizing that this classification may well be revised again in the future. That said, it is felt that in the case of the three aforementioned subspecies endemic to Saint Lucia, prefixing their common names with the term 'Saint Lucia' (as in 'Saint Lucia nightjar', for example) is warranted and desirable, as it both reflects an internationally recognized level of taxonomic uniqueness to Saint Lucia and emphasizes the national priority status of some of these endemic birds. Other subspecies endemic to Saint Lucia (for example the pearly-eyed thrasher) are not felt to be conservation priorities for Saint Lucia (see section 2.3) and are not prefixed with 'Saint Lucia'. This convention on vernacular names also maintains consistency with earlier reports, work plans and other documentation – not least of which is the Wildlife Protection Act of 1980 – currently in use in Saint Lucia. It has been followed throughout this report.

1.2. Saint Lucia

Saint Lucia is the second largest island of the Lesser Antilles, with an area of 616km², and with a maximum length and width of 43km and 21km, respectively. It is located within the Windward Islands of the Lesser Antilles in the West Indies, with Martinique 32km to the north, and Saint Vincent 40km to the south. With a human population close to 166,838 residents, there is a mean density of approximately 1,036/km², but much of the island's interior is uninhabited.

Predominantly igneous, Saint Lucia has a mountainous topography dominated by a central ridge running almost the full length of the island from north to south with valleys ('ravines') extending on either side to the coasts. Some valleys are broad with relatively large areas of flat land occupied by banana plantations, including those at Cul-de-sac, Roseau and Mabouya. These valleys, together with the area around the town of Vieux-Fort in the South, account for most of the flat lands of the country. The central southern part of the country has high mountains (Mount Gimie being the highest at 958m). The coastlines, particularly the east coast, are deeply indented by near-vertical cliffs and have a number of narrow sandy beaches.

The island has a tropical marine climate characterized by relatively uniform high temperature throughout the year. There is a dry season from roughly January to April and a rainy season from May to August, with usually sunny, warm weather from September to October. (This pattern is variable, however, and the present study regularly experienced torrential storms). Tropical storms and hurricanes are infrequent, with the majority of West Indian tropical cyclones passing to the north of Saint Lucia. The hottest period is May to October, and the coolest, December to March, giving a mean annual temperature of approximately 26°C at sea level. Annual rainfall varies from 1,524-1,778mm in the north to 2,540-3,683mm in the mountainous interior of the south.

There are over 20,000 hectares of natural vegetation types in Saint Lucia, of which 9,196 hectares are within the Government Forest Reserve (protected forests). Graveson (2009) described the different types of forest cover, which range from a very xeric littoral shrubland and mangroves on the coast to a lush rainforest and elfin shrubland on the high peaks.

Approximately 30% of Saint Lucia's land area is pastoral and arable land. Originally the mainstay of the economy, agriculture has been in decline in recent years, contributing only 3.4% of Gross Domestic Product (GDP) in 2005, with bananas the principal export crop. The economy of Saint Lucia has shifted to a service economy, with tourism the largest economic sector, accounting for 13.6% of GDP in 2005.

1.3. Previous ornithological work on Saint Lucia

Keith (1997) provides a useful overview, with references, of the history of ornithological exploration on Saint Lucia from the 1840s to the 1990s. Since then, birding trips have continued to Saint Lucia, often documented online (for example, Frazier, 1999, Grimshaw, 2005, and several birding accounts, photography and other information collated by Toussaint, 2009). Additionally, John (2004) has collated a large number of sightings of migrant birds on Saint Lucia.

Much of this work has taken the form of brief birding expeditions resulting in lists of species, typically from a small number of sites, and often the same sites as previous expeditions. Although limited in their value for assessing the status of bird species on Saint Lucia, these works have resulted in comprehensive checklists of bird species for Saint Lucia, such as that in Annex I (compiled from Clements *et al.*, 2007, and personal observations) used as the basis for this study.

Exceptions to this approach include a number of visits (listed in Keith, 1997) to collect specimens for museums; the more systematic wildlife assessments of Faaborg & Arendt (1985) that include bird netting records; and Diamond's (1972) study of vertical stratification of feeding birds in different forest types on Saint Lucia. More recently, Anthony & Dornelly (2008) produced site-based assessments of 'Important Bird Areas' (IBAs) on Saint Lucia. Useful field guides include Raffaele *et al.* (1998) and Toussaint (2007).

However, the most detailed studies of Saint Lucian birds have been restricted to a few species of conservation concern: the Saint Lucia wren (Gilardi & John, 1998); the white-breasted thrasher *Ramphocinclus brachyurus santaeluciae* (Babbs *et al.*, 1988; Ijsselstein, 1992; John, 1995; Temple 2005; Young *et al.*, 2006; Temple *et al.*, 2006, 2009; Dornelly *et al.*, 2007b; Young *et al.*, 2009; White, 2009); and the Saint Lucia amazon *Amazona versicolor* (Butler *et al.*, 1977; Butler, 1978, 1980, 1981, 1992; Jeggo, 1976; Jeggo & Tayton, 1981; Jeggo *et al.*, 1983; Jeggo *et al.*, 1989; Jeggo & Anthony, 1991; Dornelly *et al.*, 2007a; Morton *et al.*, 2008; Young *et al.*, in prep.). As indicated by the dates of these references, this work on the latter two species is ongoing as a collaboration between the Saint Lucia Forestry Department (SLFD) and Durrell Wildlife Conservation Trust (Durrell). Work on these two species has also included surveys of other priority bird species on Saint Lucia.

2. Methods

2.1. Standardized bird counts

This survey used standardized counts at survey points. The surveyor (A. Toussaint on all occasions) stood at a survey point and detected (saw and/or heard) as many bird species as possible, scanning in all directions. For each species, the number of individuals detected was noted. This was done for a 10 minute interval, starting at the surveyor's arrival at the survey point. The period of 10 minutes was chosen to make the data from this survey more readily comparable with data from previous bird surveys. The surveyor then repeated this count for an additional two minutes whilst 'pishing' – imitating a generalized alarm call to draw birds in towards the surveyor. All counts were carried out between 06:00 and 09:00 and between 15:00 and 18:00, and not during strong winds or heavy rain.

2.2. Allocation of survey points

Thirty three sample points were allocated by eye in ArcView GIS (Fig. 1). Allocation was according to four criteria:

- (a) They coincided with, or were close to, the botanical survey plots used in this project (Graveson, 2009).
- (b) They, by eye, achieved a representative spread across 24 cells dividing the island into 12 east-facing cells of equal latitudinal separation and 12 west-facing cells of equal latitudinal separation (refer to Graveson, 2009, for further details).
- (c) They were placed in five of the main (by area) forest types predicted at the start of Graveson's (2009) survey (see Table 1). Note that these forest classes are not named according to the system ultimately developed by Graveson (2009), though their extent is broadly correct except for what is referred to as mesic forest in Table 1, which was much less extensive than predicted.
- (d) There was an intentional bias towards areas outside of the wet forest (largely encompassed by the Forest Reserve) as there were existing, current (2009) survey data for many of the target bird species from this wet forest area.

Table 1 shows the allocation of sample points across the strata used. The under-representation of semi-evergreen seasonal forest was due to the sparse occurrence of this forest type, with most of it having been replaced by agriculture (Graveson, 2009). The over-representation of deciduous seasonal (dry) forest was partly to compensate for this whilst sampling remaining forest areas outside the Forest Reserves, but also because two predicted forest types - anomalous hilltop forest and dry forested hilltops – subsequently were classified as only one type, deciduous seasonal forest. However, this bias is somewhat offset by the fact that eight points originally designated as dry forest in fact fell in different, smaller (by area) types classified by Graveson (2009): five in littoral evergreen forest and shrubland, two in mangrove and one in herbaceous swamp.

2.3. Selection of priority species

Although all bird species detected were counted on every point count, a suite of 16 priority species were selected for the production of individual species distribution maps by one of us (A. Toussaint) as being of high priority for conservation management on Saint Lucia. This selection was a subset of Anthony & Dornelly's (2008) selection of IBA species based on the criteria of Wege & Anadon-Irizarry (2008), but focussing on *national* priorities. Selection of the 16 priority species for this survey was based primarily on endemism. All

Saint Lucian endemics were selected plus a number of Saint Lucian endemic subspecies (see Table 2 and Fig. 2).

Fig. 1. Allocation of bird count sample points within 24 cells stratified by latitude and aspect and six predicted forest types (see text for further details).

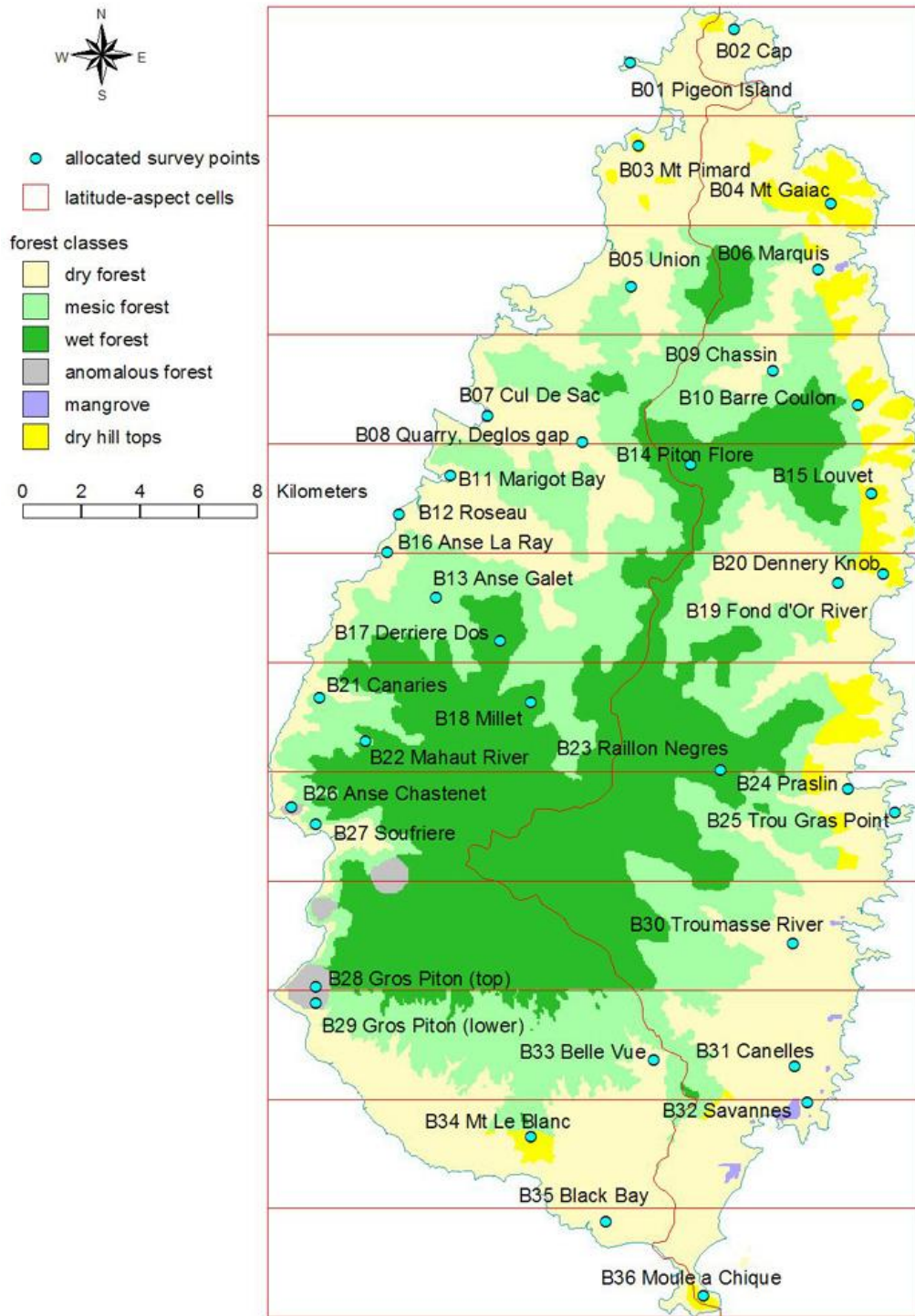


Table 1. Allocation of bird count sample points within forest type strata.

<i>Predicted</i>	<i>Forest stratum</i>	<i>Bird count sample points</i>	
	<i>Final classification</i>	<i>Allocated</i>	<i>Completed</i>
Dry forest	Deciduous seasonal forest*	21	21
Mesic forest	Semi-evergreen seasonal forest	5	5
Wet forest **	Lower montane rainforest }	4	4
	Montane rainforest }		
	Cloud montane rainforest }		
Anomalous hill forest	Deciduous seasonal forest*	3	1
Dry forested hilltops	Deciduous seasonal forest*	3	2
Total		36	33

* This stratum also includes a number of smaller (by area) types classified by Graveson (2009); within the 21 points allocated here, 5 were in fact in littoral evergreen forest and shrubland, 2 in mangrove and 1 in herbaceous swamp.

** Although the final classification of this stratum subdivided it into the three substrata shown here, the count points were only located in one of them: lower montane rainforest.

Table 2. Priority bird species selected for this survey.

For a full listing of all bird species recorded from Saint Lucia, see Annex I which also notes all the species having subspecies endemic to the island.

<i>Common name</i>	<i>Latin name</i>	<i>Endemic species</i>	<i>Endemic subspecies</i>	<i>Regional endemic</i>
Bridled quail-dove	<i>Geotrygon mystacea</i>			■
Forest thrush	<i>Cichlherminia lherminieri sanctaeluciae</i>		■	
Great blue heron	<i>Ardea herodias</i>			
Grey trembler	<i>Cinlocerthia gutturalis macrorhyncha</i>		■	
Lesser Antillean saltator	<i>Saltator albicollis albicollis</i>			■
Lesser Antillean flycatcher	<i>Myiarchus oberi sanctaeluciae</i>		■	
Rufous-throated solitaire	<i>Myadestes genibarbis sanctaelucinae</i>		■	
Semper's warbler	<i>Leucopeza semperi</i>	■		
Saint Lucia amazon	<i>Amazona versicolor</i>	■		
Saint Lucia black finch	<i>Melanospiza richardsoni</i>	■		
Saint Lucia nightjar	<i>Caprimulgus rufus otiosus</i>		■	
Saint Lucia oriole	<i>Icterus laudabilis</i>	■		
Saint Lucia pewee	<i>Contopus latirostris oberi</i>		■	
Saint Lucia warbler	<i>Dendroica delicata</i>	■		
Saint Lucia wren	<i>Troglodytes aedon mesoleucus</i>		■	
White-breasted thrasher	<i>Ramphocinclus brachyurus sanctaeluciae</i>			■

The inclusion of species with subspecies endemic to Saint Lucia was based on species known or believed to be declining and/or rare at a national level. Thus, certain endemic subspecies such as the carib grackle (*Quiscalus lugubris inflexirostris*) and the Lesser Antillean bullfinch (*Loxigilla noctis sclateri*) are excluded, even though the latter is a Caribbean Important Bird Area (IBA) species (Wege & Anadon-Irizarry, 2008), because they appear to be very abundant on Saint Lucia, to the point that some are regarded as pests in certain quarters (see section 4.6). However, it should be borne in mind that these additional endemic subspecies are of some global significance; all are noted in Annex I.

Fig. 2. Priority bird species for Saint Lucia (see text for details). *Continues next page.*



(a) Bridled quail dove



(b) Forest thrush



(c) Great blue heron



(d) Grey trembler



(e) Lesser Antillean flycatcher



(f) Lesser Antillean saltator

Fig. 2 (continued). Priority bird species for Saint Lucia (see text for details). *Continues next page*



(g) Saint Lucia nightjar



(h) Saint Lucia Amazon



(i) Saint Lucia rufous-throated solitaire



(j) Saint Lucia black finch



(k) Saint Lucia oriole



(l) Saint Lucia pewee

Fig. 2 (continued). Priority bird species for Saint Lucia (see text for details).



(m) Saint Lucia warbler



(n) Saint Lucia wren



(o) Semper's warbler



(p) Saint Lucia white-breasted thrasher

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2.4. Auxiliary data from other recent bird counts on Saint Lucia

From 2006 to 2009, four additional bird surveys involving point counts were conducted in Saint Lucia:

- (a) “Parrot Survey”: In January-March 2009, a survey of the Saint Lucia amazon was conducted by SLFD and Durrell throughout the wet forests of Saint Lucia (Young *et al.*, in prep.).
- (b) “WBT-S Survey”: From 2006-2009 annual surveys of the white-breasted thrasher’s southern sub-population were carried out by SLFD and Durrell in the deciduous seasonal forest area between the Rivers Praslin and Dennery (Young *et al.*, 2006; White, 2009). Only the data from 2009 were examined for this report.
- (c) “WBT-N Survey”: In 2006, the white-breasted thrasher’s northern sub-population, in Saint Lucia’s North East Corridor between the Rivers Fond d’Or and Dauphin, was surveyed by SLFD and Durrell (Young *et al.*, 2006).
- (d) “Iyanola Survey”: In the second half of 2007, SLFD and Durrell conducted a pilot survey to estimate occupancy (using the methods of Mackenzie *et al.*, 2006) of 31 target species of birds, all meeting

Caribbean IBA criteria (Wege & Anadon-Irizarry 2008), as well as other non-bird priority taxa. This pilot study sampled the three large estates of the North East Corridor: Marquis, Grand Anse and Louvet Estates (Morton, 2007b).

Table 3. Inventory priority species that were target species during previous bird surveys on Saint Lucia.

Sampling intensity varied between surveys: *n* indicates the number of survey points that birds were counted at; *effort* indicates the number of times each point was surveyed. For comparison, for the 2009 inventory survey, *n* = 33 and *effort* = 1.

2009 inventory survey priority species	2009 Parrot Survey <i>n</i> = 379 <i>effort</i> : 1-4	2009 WBT-S Survey <i>n</i> = 96 <i>effort</i> : 2	2007 Iyanola Survey <i>n</i> = 20 <i>effort</i> : 6-10	2006 WBT-N Survey <i>n</i> = 100 <i>effort</i> : 1
Bridled quail-dove	■	■	■	■
Forest thrush	■	■	■	■
Great blue heron			■	
Grey trembler	■	■	■	■
Lesser Antillean saltator		■	■	■
Lesser Antillean flycatcher		■	■	■
Rufous-throated solitaire	■			
Semper's warbler	■		■	
Saint Lucia amazon	■			
Saint Lucia black finch	■	■	■	■
Saint Lucia nightjar				
Saint Lucia oriole	■	■	■	■
Saint Lucia pewee	■	■	■	■
Saint Lucia warbler			■	
Saint Lucia wren			■	
White-breasted thrasher		■	■	■

Surveys (a), (b) and (c) used distance sampling (Buckland *et al.*, 2001) to estimate species density and abundance, but the count protocols are directly comparable to the present 2009 inventory survey: 10 minutes of counting followed by 5 minutes of ‘pishing’ and counting. The survey effort in all four studies was much higher than in the current survey, both in terms of number of counts (see Table 3) and density of survey points. Survey (d) is less comparable as it involved many repeat counts at the same survey points (to estimate detection probabilities and hence occupancy; Mackenzie *et al.*, 2006) and count periods of 30 minutes, with ‘pishing’ throughout. Nevertheless it does provide data from point counts using similar methods to the current survey.

Surveys (a), (b) and (c) were designed to estimate density and abundance of single species – the Saint Lucia amazon (a) and the white-breasted thrasher (b and c) – but also sampled a suite of additional species, kept to a small number to make learning identification feasible for non-ornithologist surveyors. Survey (d) was a multiple species survey (with 31 target bird species). Unlike the current survey, these four surveys all used survey points that were randomly and/or systematically (functionally at random) located. However they all had more limited sampling areas (which were not randomly selected and were expected to contain higher bird diversity) compared to the current survey (see Fig. 9) which attempted to draw a representative sample from the entire forest coverage of Saint Lucia.

For the purposes of comparison with the data from the current survey, data from these four surveys are presented as detections only (i.e. not counts and not density, abundance or probability of occupancy estimates). In other words, they are used only to augment the *distribution* data collected in the current survey and only for those target species that they shared in common with the priority species of the current survey. These shared target species are shown in Table 3.

2.5. Auxiliary data from recent sightings of migrant birds

The data collated by John (2004) were examined to provide information on migrant birds that were not covered to any great extent by the current survey. Unlike the auxiliary data covered in Section 2.4, and the current survey, these observations of migrant birds were from a variety of sources and with no standardized data collection method. They do, however, provide a valuable record of less commonly encountered bird species.

3. Results

3.1. Survey effort

Thirty three of the 36 allocated survey points were surveyed once each between the 27th of June and the 4th of October 2009. Most were surveyed by the observer standing at points within 50m of their original allocated location (Fig. 1); ten were re-allocated in the field by distances of 50m to 2.2km from their original allocated location (see Fig. 3). Relocation was necessary due in some cases to topographic obstacles and in others, as a result in poor GPS receiver performance in locating points. In both cases, it was necessary to re-allocate points in order to keep surveys within the standardized time intervals (06:00-09:00 and 15:00-18:00).

3.2. Species recorded

The results of the current inventory survey are summarized in Table 4. Of the 49 species recorded, all but three (6%) are resident in Saint Lucia (see Annex I). Only 5% of all migrant species recorded from Saint Lucia were found during this survey and no vagrants were recorded.

High proportions of endemic species and subspecies were recorded (Table 4). The survey was successful at detecting the priority species (listed in Table 2), with 75% being detected. The four out of 16 priority species that were not detected were Semper's warbler (*Leucopeza semperi*), not recorded since the last confirmed record in 1961 at Louvet and possibly now extinct; the Saint Lucia forest thrush (*Cichlherminia lherminieri sanctaeluciae*) known only from a handful of sightings on Saint Lucia in the last century; the Saint Lucia rufous-throated solitaire or mountain whistler (*Myadestes genibarbis sanctaeluciae*), known only from elevations higher than any visited during this survey (Diamond, 1973; Keith, 1997); and the Saint Lucia nightjar, also very rare, and which is normally only detectable at night, chiefly from the males' calls during the months of February to July.

Table 4. Numbers of all bird species recorded during the 2009 inventory survey.

<i>Species</i>	<i>Previously recorded from Saint Lucia</i>	<i>Recorded during inventory</i>	<i>% recorded during 2009 inventory</i>
All species	168	49	29%
Resident species	72	46	64%
Migrant species	63	3	5%
Vagrant species	33	0	0%
Priority species	16	12	75%
Endemic species	6	5	83%
Endemics subspecies	14	7	50%

3.3. Relative counts of recorded species

The full list of bird species recorded during the current inventory survey is shown in Fig. 4, which sorts the records by total number of individuals of each species recorded over the duration of the survey. In Fig. 5, the same set of all species recorded is shown sorted by the number of points at which they were recorded during the current survey.

From the paler blue bars in Fig. 4, it appears that some species, such as the Lesser Antillean bullfinch, the bananaquit (*Coereba flaveola martinicana*) and the black-whiskered vireo (*Vireo altiloquus barbatulus*) are particularly susceptible to being drawn to surveyors 'pishing'. If these paler blue bars are disregarded, a lot of the variation in numbers of individuals shown is greatly reduced.

Considering count data from only the first 10 minutes of counting, only 15 species had 20 or more individuals recorded over 33 surveys. These 15 species include two of the inventory survey's priority species, the Lesser Antillean saltator (*Saltator albicollis albicollis*) and the Saint Lucia warbler (*Dendroica delicata*). However, the other 10 priority species (out of the remaining 14) that were detected were all represented by 10 or fewer individuals across all counts.

The data in Fig. 5 paint a similar picture, with the same species that were most numerous across all points also being the most widely distributed (recorded at many points). Fig. 6 shows some of these species. Again, these include the Lesser Antillean saltator and the Saint Lucia warbler, but, in this case also the Saint Lucia pewee. The remaining priority species appear not only less numerous (Fig. 4), but also less widely (or more patchily) distributed.

Fig. 4. The number of individuals for all species recorded during the inventory survey, separated into numbers recorded during the first 10 minutes of counting and the last two minutes of ‘pishing’.

An asterisk (*) and purple (total in first 10 minutes) plus pink (total from pishing) bar indicate a priority species for this survey (see section 2.3).

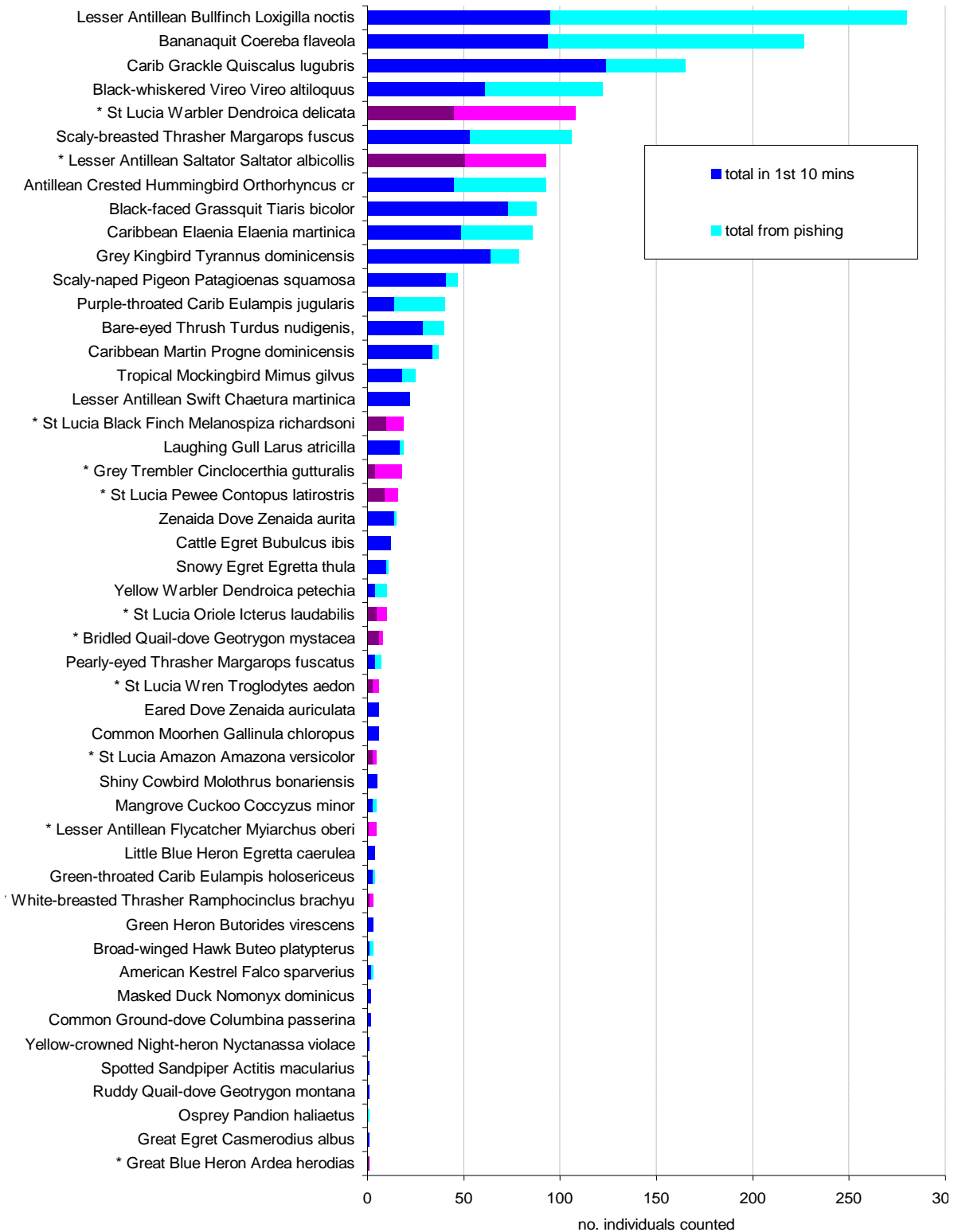


Fig. 5. Total number of points at which each species was recorded during the inventory survey.

An asterisk (*) and brighter green bar indicate a priority species for this survey.

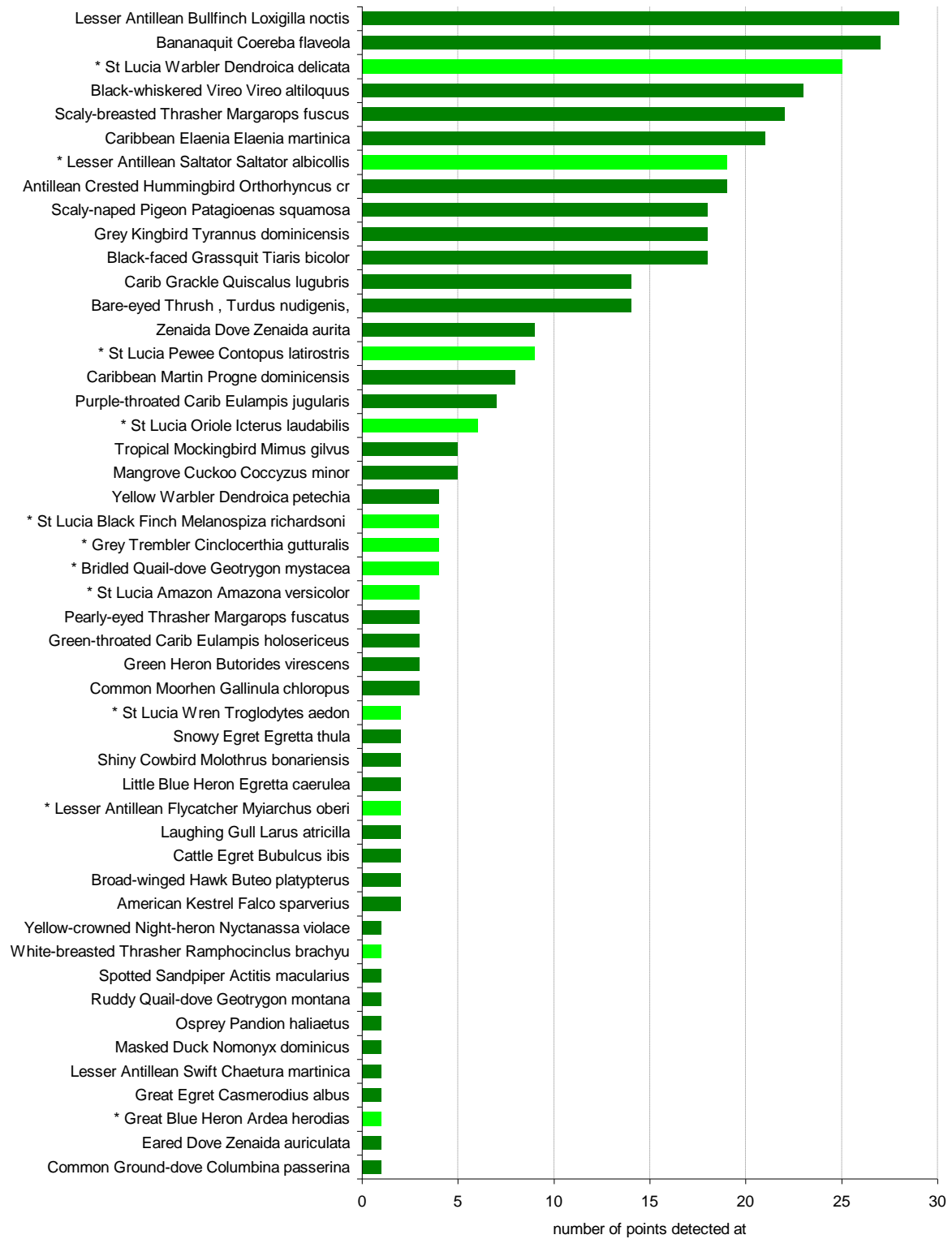


Fig. 6. Some of the most commonly encountered species on the 2009 inventory survey.

Photos: (a) © G. Guida; (b, c, d) © Tseng Chiu-wen Hank.



(a) Bananaquit



(b) Black-whiskered vireo



(c) Lesser Antillean bullfinch



(d) Scaly-breasted thrasher

Many of the least frequently encountered species were not identified as priority species. In most cases, these were wetland and coastal species, such as the little blue heron (*Egretta caerulea*), cattle egret (*Bubulcus ibis ibis*) and spotted sandpiper (*Actitis macularius*); or species of open areas such as the zenaida dove (*Zenaida aurita aurita*), the shiny cow bird (*Molothrus bonariensis minimus*), the Lesser Antillean swift (*Chaetura martinica*), the broad-winged hawk (*Buteo platypterus rivierei*) and the American kestrel (*Falco sparverius caribaeorum*). In all these cases, and for many of the other species less frequently encountered on this survey, personal observations (A. Toussaint, L. John) suggest they are in fact common and widespread on Saint Lucia. Some examples are shown in Fig. 7.

Fig. 7 Some of the less commonly encountered species on the 2009 inventory survey that are nonetheless believed to be common on Saint Lucia.

Photos: (a, b) © G. Guida; (c, d) © Tseng Chiu-wen Hank



(a) Little blue heron



(b) Snowy egret



(c) Broad-winged hawk



(d) Zenaida dove

However, a few of the less frequently encountered species in these open, wetland and coastal categories do appear from personal observation to be rare on Saint Lucia, such as the masked duck (*Nomonyx dominica*) and the osprey (*Pandion haliaetus*). A few other, less frequently encountered species in these categories remain of uncertain status on Saint Lucia, including the ruddy quail dove (*Geotrygon montana martinica*) and the mangrove cuckoo (*Coccyzus minor*). Others, like the yellow-crowned night heron (*Nyctanassa violacea bancrofti*), may be very localized in their distribution on Saint Lucia (L. John, pers. obs.). Fig. 8 shows some examples.

Fig. 8 Some less commonly encountered species on the 2009 inventory survey believed to be rare on Saint Lucia (a, b), of uncertain status (c) or very localized in distribution (d).

Photos: (a, b, d) © A. Toussaint; (c) © M. Morton / Durrell.



(a) Masked duck



(b) Osprey



(c) Mangrove cuckoo



(d) Yellow-crowned night heron

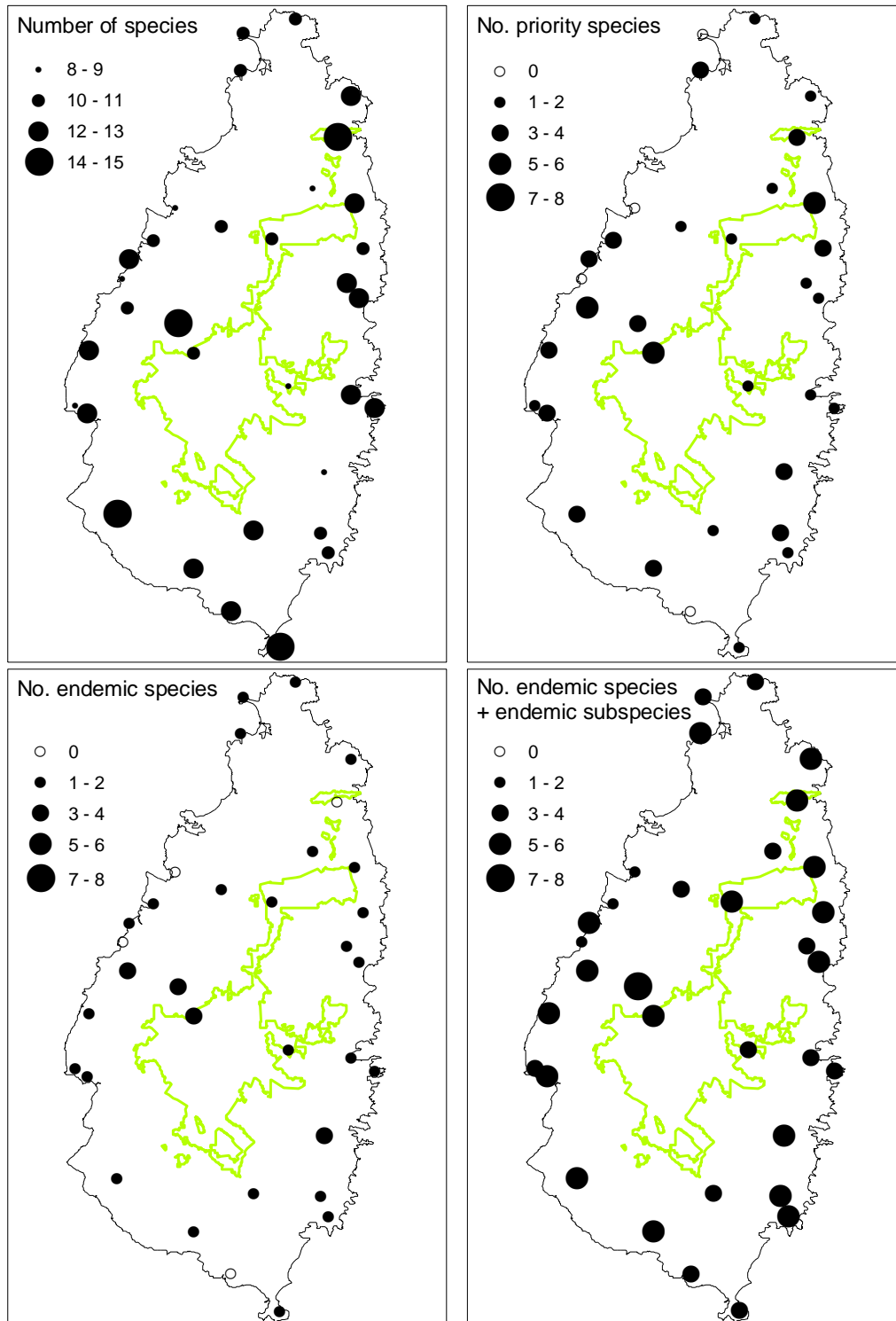
3.4. Distribution of recorded species

Some general observations on species distribution are made in the previous section (3.3). Fig. 9 shows the species diversity (number of species) recorded at all points during the present survey.

No very obvious spatial patterns of species diversity seem apparent in Fig. 9, although for all species (Fig. 9, top left) there is some suggestion that diversity is higher in the north east and south west than in the north west or south east, the latter two quadrants of Saint Lucia being more heavily developed for urban settlement and livestock agriculture respectively. For the priority species (Fig. 9, top right) there is some suggestion that the north east and the central part of the west coast extending in to the Forest Reserve is more diverse in these species. Note, however, that Fig. 9 does not show the auxiliary data from the wet forest (see Fig. 10, for individual priority species).

Fig. 9. Bird species diversity (all species) at inventory survey points (top left) and diversity of priority species (top right), endemic species (bottom left) and all endemics (species plus subspecies, bottom right).

The green outline indicates the boundary of the Forest Reserve. Note that the legend for total number of all species (top left) is to a different scale to the remaining three maps.



3.5. Distribution of priority species

This section restricts itself to those priority species that were recorded during the present inventory survey, augmented with distribution data from other recent surveys (as described in section 2.4), plus auxiliary data for the rufous-throated solitaire and some personal observations (M. Morton) of the Saint Lucia nightjar. Fig. 10 shows distribution maps for each of these species. Neither the forest thrush nor Semper's warbler were found on the inventory survey or any of the auxiliary surveys; both are rarely seen on Saint Lucia (pers. obs.). The last confirmed sighting of Semper's warbler, at Louvet, dates back to 1961, although Keith (1997) also reported unconfirmed sightings from Gros Piton in 1989 and Piton Flore in 1995. Keith (1997) reported the forest thrush to be very rare in Saint Lucia for most of the last century, and recorded sightings from La Sorcière and La Chaloupe ravines (seasonal deciduous forest) and Edmund Forest Reserve (lower montane rainforest). More recently, there have been a small number of unconfirmed sightings mostly from seasonal deciduous forest in the North East Corridor (Barre Coulon in 1998; Louvet in 2003; and multiple reports from La Sorcière in 2007-2008), and from semi-evergreen seasonal forest (Chassin in 2007) and lower montane rainforest (Des Cartier in 2007; Quillesse in 2007; and Millet in 2009).

As noted in section 3.3, the Lesser Antillean saltator, the Saint Lucia warbler and the Saint Lucia pewee were found to be widely distributed. The latter was less frequently recorded than the first two in the inventory survey, but the auxiliary data makes it clear the pewee is a common species. The Saint Lucia oriole (*Icterus laudabilis*) was also recorded as widespread, but less common and, in contrast to the pewee, the auxiliary data suggest it is in fact more patchily distributed, although well represented in the two areas of east coast deciduous seasonal forest included in these auxiliary surveys. Likewise, the grey trembler was infrequently recorded, but at widely spread locations, all in deciduous seasonal forest areas: the auxiliary data for this species show a similar pattern of relatively infrequent encounters even in the relatively high quality deciduous seasonal forest areas surveyed.

The Saint Lucia amazon was poorly represented in the present inventory survey, but Fig. 10 strongly suggests this was due to the decision to not intensively survey the Forest Reserve (Table 1). The auxiliary data revealed it to be common and widespread in these rainforests.

The remaining species were infrequently encountered and appeared to have a more restricted distribution. They were the bridled quail dove (*Geotrygon mystacea*), great blue heron (*Ardea herodias occidentalis*), the Lesser Antillean flycatcher (*Myiarchus oberi sanctaeluciae*), the rufous-throated solitaire (*Myadestes genibarbis sanctaeluciae*), the Saint Lucia nightjar, the Saint Lucia black finch (*Melanospiza richardsoni*), Saint Lucia wren, and the white-breasted thrasher. In the case of at least two of these species, their restricted range appears to be due to habitat specificity, with the great blue heron being restricted to wetlands and the rufous-throated solitaire restricted to higher elevations.

The bridled quail dove, Lesser Antillean flycatcher and Saint Lucia black finch were found (across all surveys considered here) in deciduous seasonal forest, semi-evergreen seasonal forest, and lower montane rainforests, but all appeared to be very patchily distributed.

Fig. 10. Distribution records for priority species. *Continues on next page.*

Map legend follows at the end of the maps.

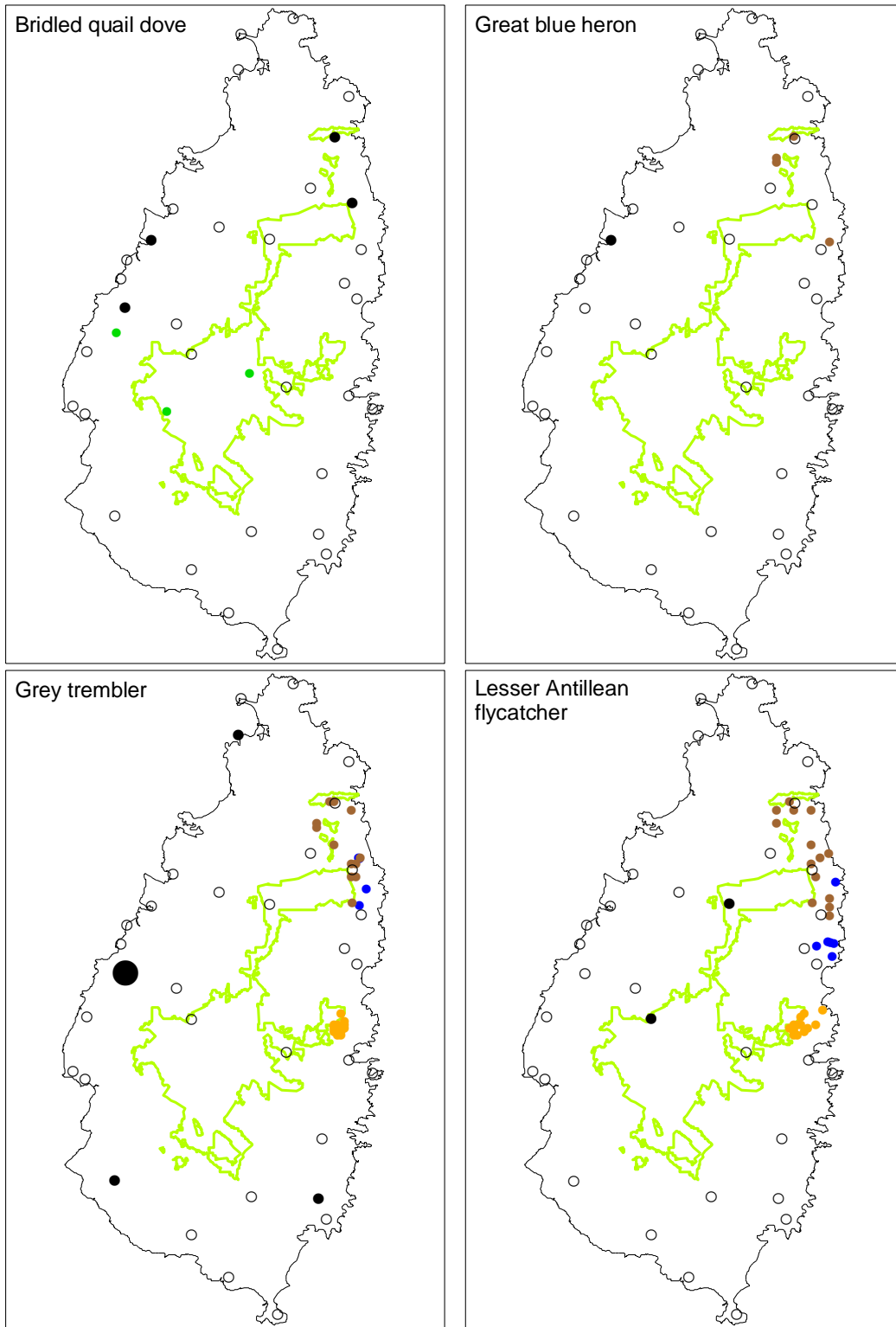


Fig. 10. Distribution records for priority species. *Continues on next page.*

Map legend follows at the end of the maps.

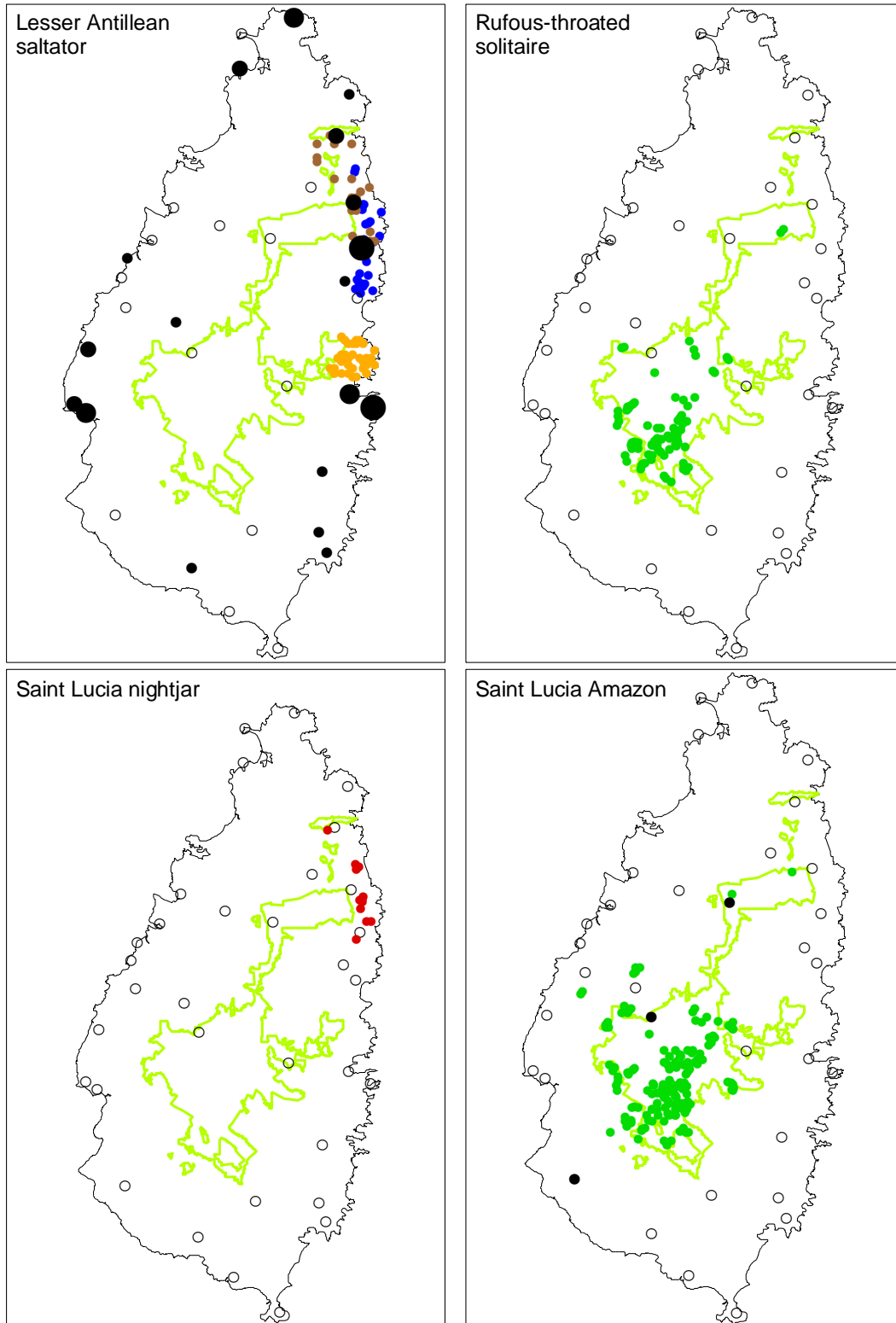


Fig. 10. Distribution records for priority species. *Continues on next page.*

Map legend follows at the end of the maps.

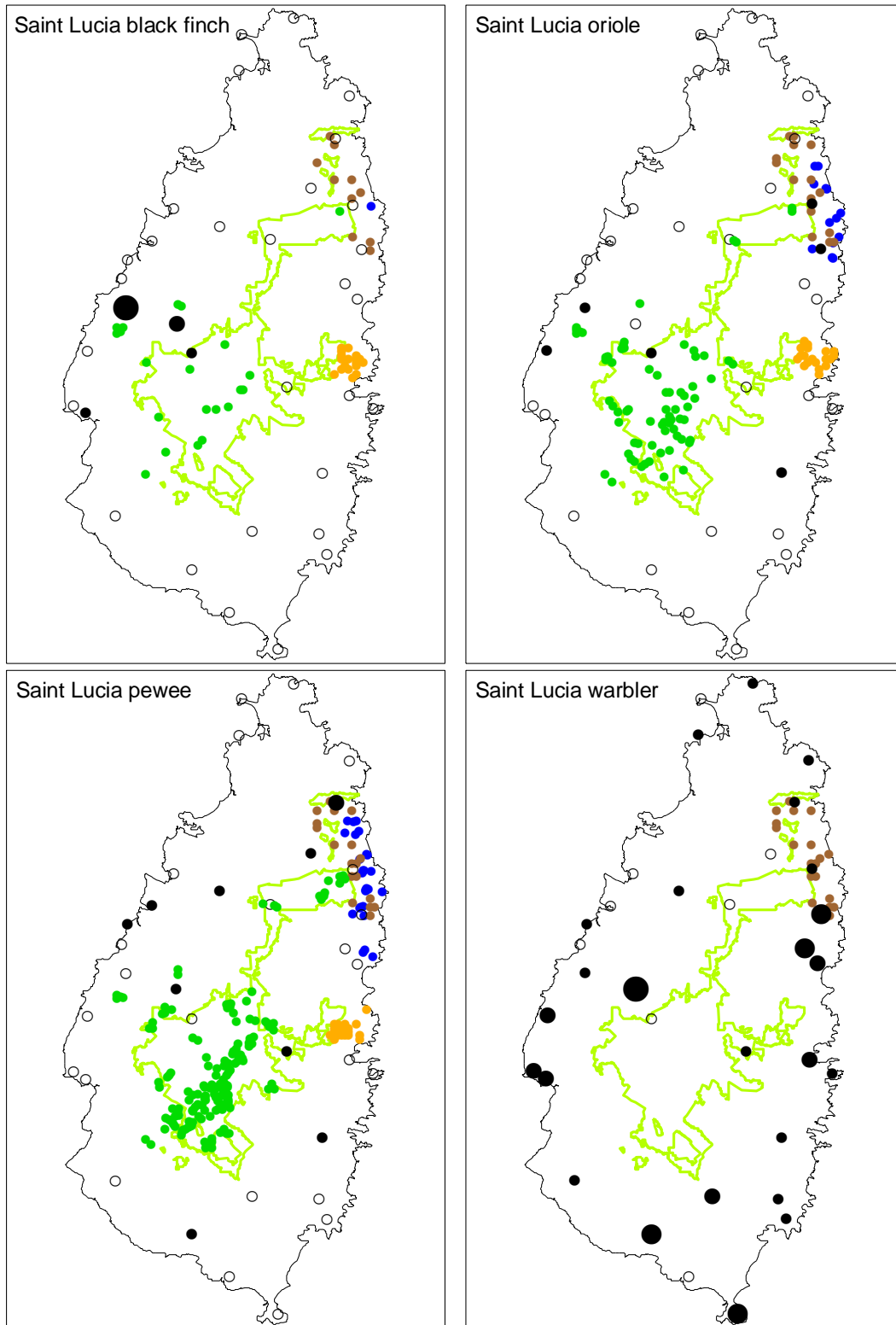
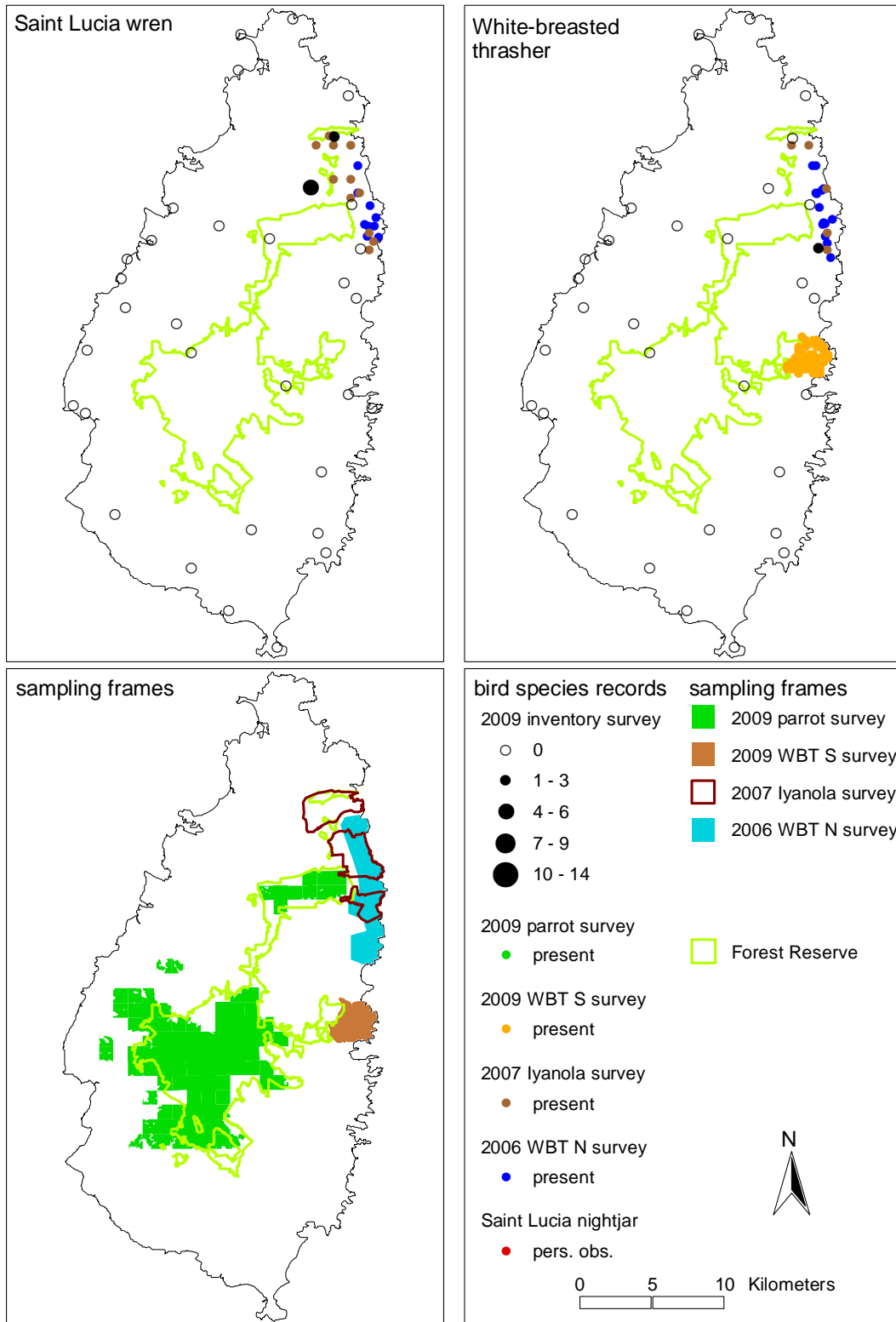
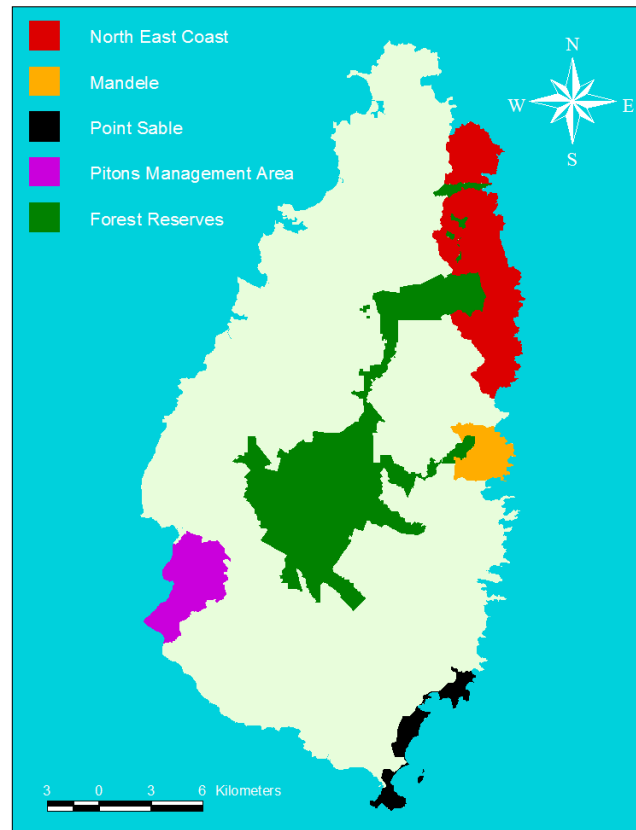


Fig. 10. Distribution records for priority species.



The three species found only in deciduous seasonal forest – the Saint Lucia nightjar, Saint Lucia wren and white-breasted thrasher – are very restricted in terms of their distribution on Saint Lucia. The North East (comprising the North East Coast and Mandelé IBAs, LC001 and LC004 respectively; Anthony & Dornelly, 2008; see Fig 11) is a stronghold for these species, and indeed the only location known for the nightjar and white-breasted thrasher. The Saint Lucia wren is also recorded from a single very small area in the South West, not covered by any of the surveys considered here, on the slopes of Gros Piton (A. Toussaint and L. John, pers. obs.). These two North East areas also appear to be a stronghold for several other priority species: the grey trembler, the Lesser Antillean flycatcher, the Saint Lucia black finch and the Saint Lucia oriole, at least.

Fig. 11. Important Bird Areas (IBAs) on Saint Lucia. See Anthony & Dornelly (2008) for more details.



3.6. Migrant bird species and sites

Records of migrant birds on Saint Lucia from the period 1990-2004 were extracted from the data collated by John (2004) to give a list of 105 species (Fig. 12), although this does include some vagrants such as the short-eared owl (*Asio flammeus*). There is a little confusion over the exact number of species that should be considered migrants. In one case at least, the osprey (*Pandion haliaetus*), a species may have both migratory (*P. h. carolinensis*) and resident (*P. h. ridgwayi*) subspecies in Saint Lucia. The masked duck, a species once considered a migrant, is now known to have a year round presence on Saint Lucia, with sightings of juveniles (L. John, pers. obs.). Thus a few of the species recorded as migrants in the following migrant bird data may be partly or fully resident in Saint Lucia; others include the Caribbean coot, the Caribbean martin (*Progne dominicensis*) and the black swift (*Cypseloides niger*) (L. John, pers. obs.).

Records per species per site are given in Annex II, and Fig. 13 shows the data mapped, grouped by bird groups assigned by John (2004). The lack of information on survey effort (likely to be different for many of these species) makes these data difficult to compare directly with the surveys considered in the previous sections. Considering only those migrants recorded on Saint Lucia in the last 20 years (i.e. in the period 1989-2002 for this data set) produces a subset of 70 species. About 20% of these 70 species appeared to be relatively common, mostly sandpipers and plovers and gulls, terns and other seabirds (also included here is one of the inventory project's priority species, the great blue heron). As noted that, at least some of these more common migratory species are believed to have year-round populations on Saint Lucia including the masked duck and the Caribbean osprey. This is also true of some of the more rarely reported migrants such as the West Indian red-billed tropicbird (*Phaethon aethereus mesonauta*: Keith, 1997) and the Caribbean martin (*Progne dominicensis*: Raffaele, 1998).

Fig. 12. Records of migrant bird species on Saint Lucia. (Data taken from John, 2004).

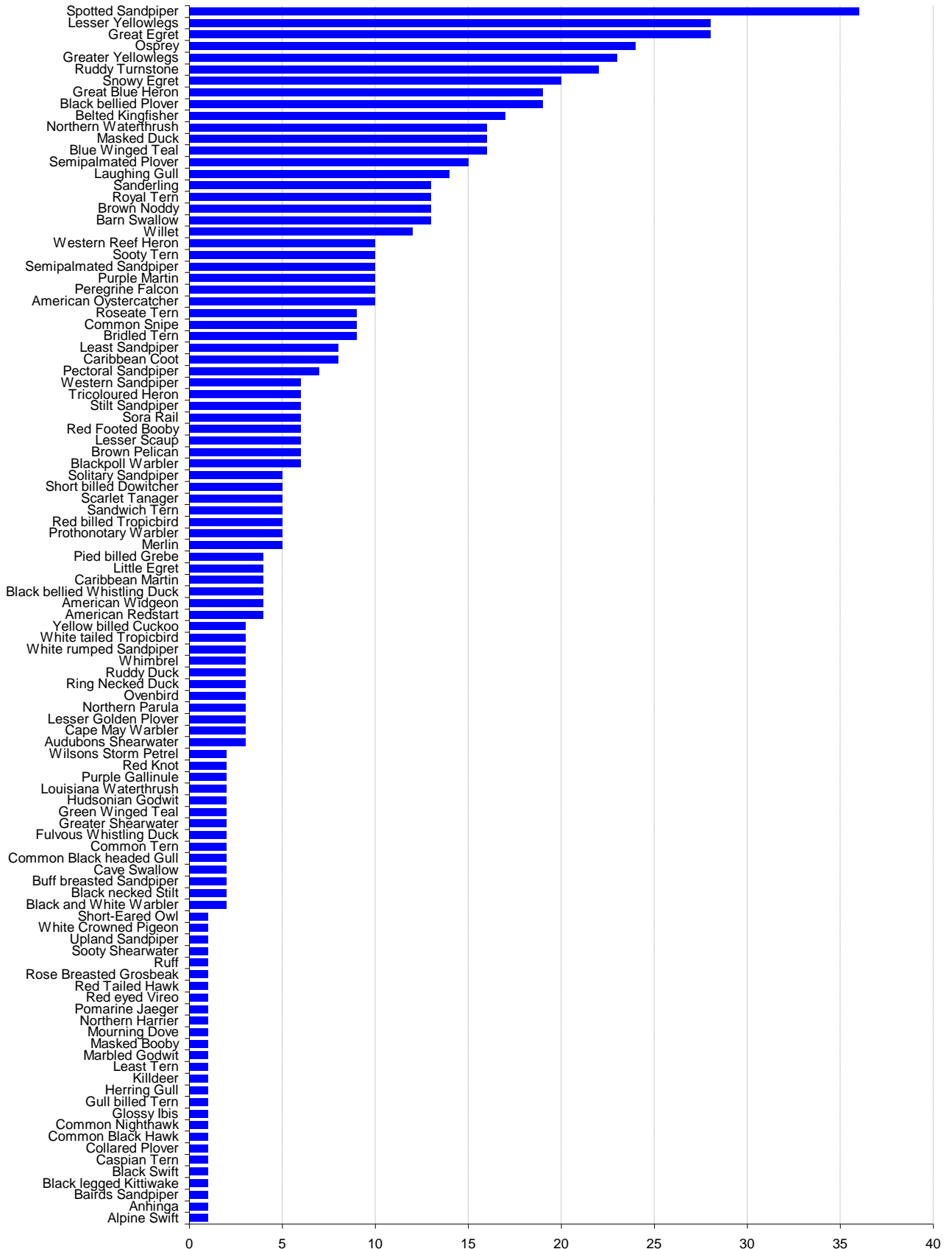
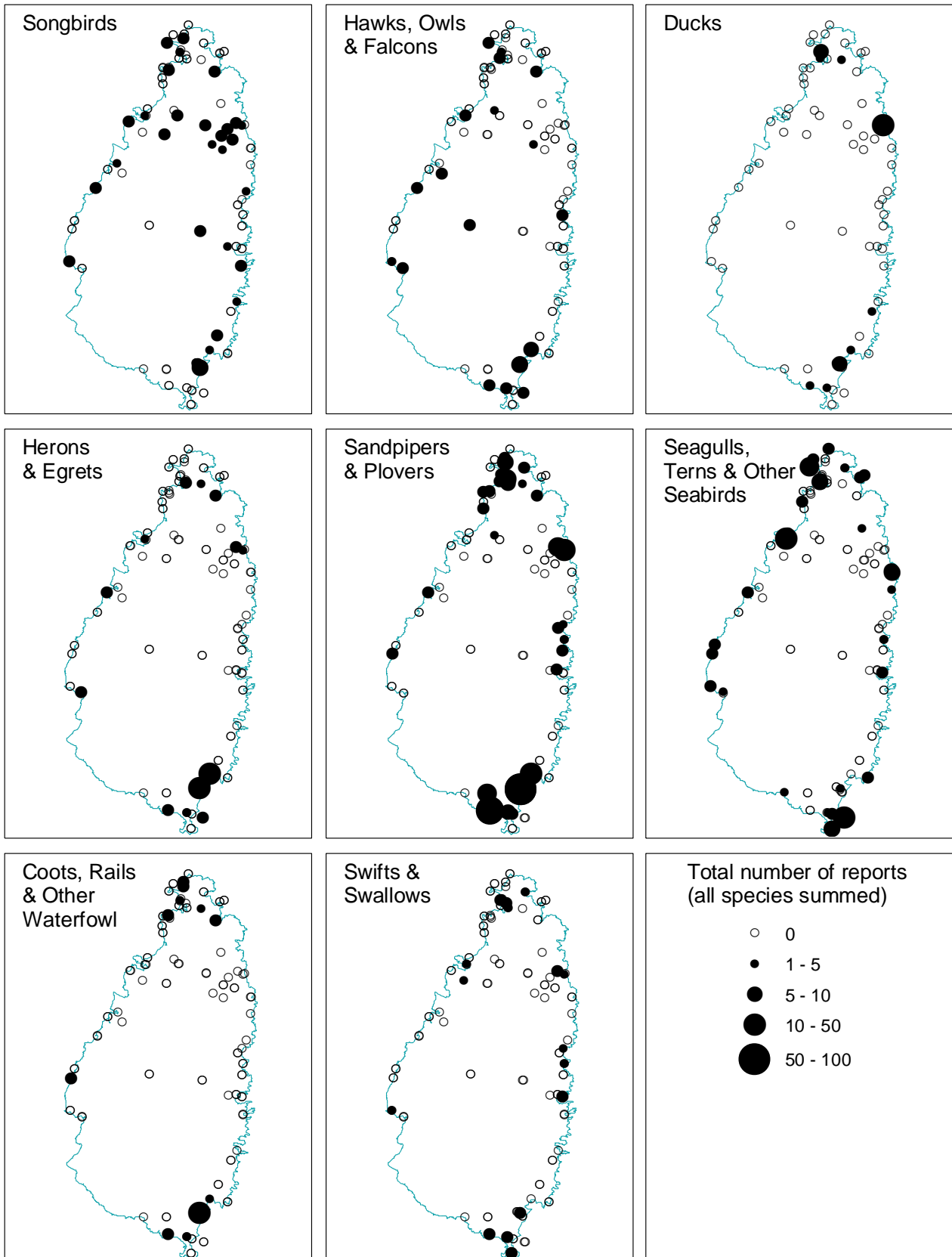


Fig. 13. Migrant bird species diversity, by bird groups, across Saint Lucia during 1990-2004.

(Data taken from John, 2004).



With two exceptions, all 70 species with records on Saint Lucia in the last 20 years have a global threat (red list) status of Least Concern (IUCN, 2009); the two exceptions are the buff-breasted sandpiper (*Tryngites subruficollis*) and the Caribbean coot (*Fulica caribbaea*), both listed as Near Threatened. Thirteen of these species however are US Fish and Wildlife Service (USFWS) ‘Birds of Conservation Concern’, two of them listed as Endangered (US Fish and Wildlife Service 2008); see Table 5. (Note that USFWS’s term Endangered is a different designation to IUCN’s Endangered category). One of these species – the mangrove cuckoo – is considered resident on Saint Lucia and is not recorded in this migrant bird data set. Table 5 also lists an additional four species of conservation concern (one of them endangered) not recorded from Saint Lucia in the last 20 years.

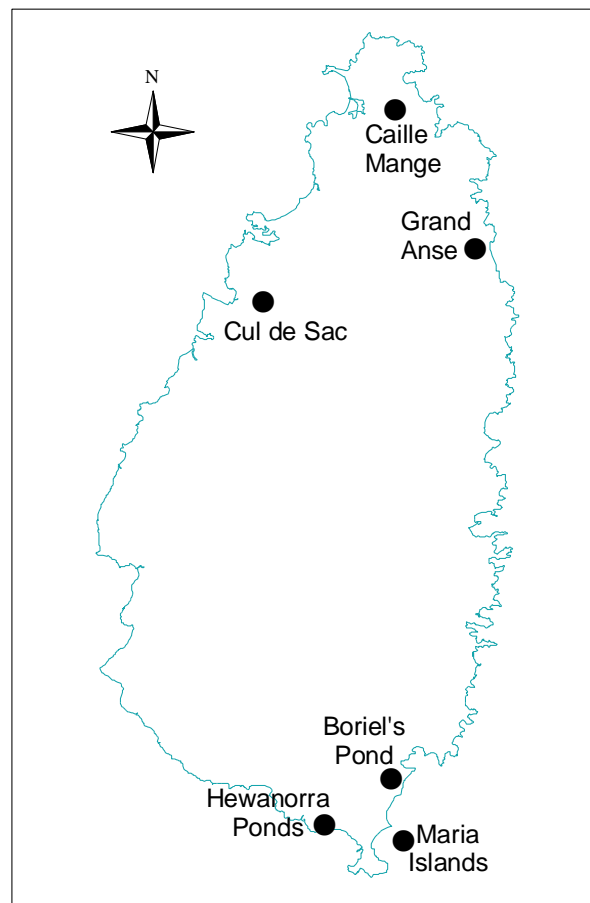
Table 5. Migratory Birds of Conservation Concern (indicated by an asterisk) and Endangered Birds (indicated by **E**); US Fish and Wildlife Service 2008.

No. sites is the number of different sites on Saint Lucia from which this species has been reported. This table also includes Note that the mangrove cuckoo is not included in John’s (2004) data set; the 2 records for the buff-breasted sandpiper identify no site(s).

Species recorded in the last 20 years	No. sites	Most recent record
American Oystercatcher (<i>Haematopus palliatus</i>) *	4	1997
Brown Pelican (<i>Pelecanus occidentalis</i>) E	6	2001
Hudsonian Godwit (<i>Limosa haemastica</i>) *	2	1992
Lesser Yellowlegs (<i>Tringa flavipes</i>) *	8	2001
Mangrove Cuckoo (<i>Coccyzus minor</i>) *	n/a	n/a
Marbled Godwit (<i>Limosa fedoa</i>) *	1	2000
Peregrine Falcon (<i>Falco peregrinus</i>)*	8	2002
Prothonotary Warbler (<i>Protonotaria citrea</i>) *	4	1997
Red Knot (<i>Calidris canutus</i>) *	2	1992
Roseate Tern (<i>Sterna dougallii</i>) E	5	1997
Semipalmated Sandpiper (<i>Calidris pusilla</i>) *	6	2001
Short-billed Dowitcher (<i>Limnodromus griseus</i>) *	3	1992
Short-eared Owl (<i>Asio flammeus</i>) *	1	2000
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>) *	2	1994
Species not recorded for over 20 years		
Black Swift (<i>Cypseloides niger</i>) *	1	1988
Buff-breasted Sandpiper (<i>Tryngites subruficollis</i>) *	?	1970
Gull-billed Tern (<i>Gelochelidon nilotica</i>) *	1	1935
Least Tern (<i>Sternula antillarum</i>) E *	1	1970

Examining the data by site, four sites have 10 or more migrant species recorded in the last 20 years; an additional fifth site – Cul de Sac – does not appear in these data because it has only come into existence as a wetland in the last eight years, but is now also known to have a high migrant bird diversity (L. John, A. Toussaint, pers. obs.). These sites are shown in Fig. 14, along with the Maria Islands (Maria Minor and Maria Major) which, although they have a lower migrant bird diversity, are conspicuous for the large congregations of nesting seabirds they support. Boriel's Pond, Cul de Sac and Hewanorra Ponds are all herbaceous swamp habitat (Graveson, 2009), a man-made habitat type on Saint Lucia that is also found at Grand Anse, along with deciduous seasonal forest and littoral evergreen forest and shrubland. The ponds at Caille Mange are also man-made.

Fig. 14. Important migrant bird sites on Saint Lucia.



4. Discussion

The limitations of the surveys presented here are discussed in section 1.1 and they mean that the data in this report need to be interpreted with some care. Nonetheless, the data from the inventory survey and the four auxiliary surveys are broadly in agreement with one another, and with the personal observations of two of the authors (A. Toussaint and L. John) and other bird experts on Saint Lucia. This is especially true for the suite of 16 priority species targeted for special attention.

4.1. Diversity, abundance and distribution of resident species

Bird species resident in Saint Lucia were well represented in the present inventory survey data, with 64% of all residents having been recorded (Table 4). A lot of the variation in the distribution and relative abundance of different species within the inventory counts seems attributable either to habitat specificities not adequately sampled using the survey's forest-biased methodology, or to variations in the detectability of different species.

Examples of species favouring wetland and coastal areas, or open areas, none of which were well represented in the inventory sample points, were noted in section 3.3. They include herons and egrets, raptors and swifts, as well as coastal and sea birds (although many of the latter are migrants on Saint Lucia). As is to be expected in a survey of forest birds, passerines (perching birds or songbirds) dominate the counts, and this group includes most of Saint Lucia's endemics. Detectability of individual species is discussed below (section 4.2).

Whilst some species were widely distributed across most of the inventory survey points, most species recorded were not (Fig. 5). In many of these latter cases, the small number of points that they were recorded at seems primarily attributable to habitat specificities in the same way as the lower abundance of many species (mostly the same species). The exceptions to this are primarily most of the priority species identified at the start of this survey and most of the remainder of the discussion will focus on those priority species. However, a few additional species stood out as being rarely encountered during the inventory survey and of uncertain status on Saint Lucia. These include the mangrove cuckoo (Fig. 8), which may be in decline (A. Toussaint, pers. obs.), the black-crowned night heron (*Nycticorax nycticorax hoactli*; not recorded during this survey) and the resident population of the masked duck (see section 3.6; Fig. 8).

4.2. Abundance and distribution of priority species

Almost all of the priority species identified for this survey are known to occur across one or more of the main forest types (Table 1) that were the focus of the inventory survey (Diamond, 1973; pers. obs.). (The two exceptions appear to be the great blue heron being restricted to wetlands, and the rufous-throated solitaire restricted to montane rainforest at higher elevations). In practice, however, the majority of these priority species appear to either be restricted to small areas within these forest types or appear to be very patchily distributed. Only the Lesser Antillean saltator, the Saint Lucia pewee and the Saint Lucia warbler appear to be widespread (Fig. 10), although the Saint Lucia amazon appears to have become widespread through much of the lower montane rain forest types in the last few decades (Young *et al.*, in prep.) and is known to venture into lower elevation forest types too (pers. obs.). A number of the widespread priority species (whether patchily distributed or not) are found in more than one forest type; others seem restricted predominantly to single forest types though are known to occasionally venture into other types (see section 4.3).

4.2.1. Species detectability

Differences between species' detectability may account for some of the apparent rarity of some of the priority species: some species are more difficult to see or hear than others. This is difficult to assess from the data collected using the count methodology of the inventory survey. However, data for target species of the 2007 Iyanola pilot survey do shed some light on this, as that survey used a methodology explicitly designed to estimate detectability. Data for 19 target species are presented in Annex III. Although formal detectability estimates from this data are beyond the scope of this report, maps with large symbols (and at more points) in Annex III indicate more easily detectable species, while those with smaller symbols indicate less easily detectable ones. For example, the Antillean euphonia (*Euphonia musica flavifrons*; Fig. 15) appeared to be particularly difficult to detect and was, in fact, not detected at all during the inventory survey. This does not necessarily mean that it is rare and personal observations outside of these surveys (A. Toussaint) suggest that they are more active in the late morning to mid afternoon, seemingly more so with increasing sunlight. Antillean euphonias were frequently sighted and heard before and after the survey period and are believed to be not uncommon, and hence they were not included as a priority species.

Fig. 15. Examples of more easily detectable (a) and less easily detectable (b) species on Saint Lucia.

Photos (a) © A. Toussaint; (b) © Tseng Chiu-wen Hank.



(a) Saint Lucia pewee



(b) Antillean euphonia

However, caution is needed in interpreting these species detectability data. Firstly, they may not be applicable outside of the sampling frame they represent (i.e. the large estates in the North East Corridor; see Fig. 10). As an example, the white-breasted thrasher appears to have low detectability in this area, but is estimated to have much higher detection probabilities in the southern part of its range (Morton, 2007c). Given its higher population density in that latter area (Young *et al.*, 2009), this is not unexpected: if a species is more abundant in one area than another it is likely it will also be more easily detected in that area (MacKenzie *et al.*, 2006). Secondly, the Iyanola survey was conducted at different times of day (08:30 – 16:30) to the inventory survey. This might account, for example, for the high detectability of the Saint Lucia pewee (Fig. 15) during the Iyanola survey than in the present study, because this species - which occupies a flycatcher niche that is most active in good light - is more conspicuous later in the day (A. Toussaint, pers. obs.).

Given the extensive ornithological work on Saint Lucia in the past and to the present day (see section 1.3), and from personal observation (A. Toussaint, L. John), it appears that lower detectability may to some extent account for the low number of observations of most of the priority species in the present inventory survey count. Nevertheless, it does appear that these species are in fact uncommon on Saint Lucia (which is the global range for many of them as species or subspecies) and restricted to small areas or very patchily distributed.

4.3. Critical habitats and sites for priority bird species

Table 6 shows the different forest types (*sensu* Graveson, 2009) within which each of the priority species is well represented, based on the available data from the surveys under consideration here (summarized in Fig. 10), published sources (using Keith, 1997, as the main review) and the authors' personal observations. Three things are immediately apparent from this table:

- (a) The Forest Reserves plays a critical role in conserving priority species, with about one fifth of them (19%) occurring *only* within these montane or lower montane rainforests. In addition, another two fifths (44%) of the priority species occur both inside and out of the Forest Reserves.
- (b) The remaining two fifths (38%) of priority species occur almost entirely in habitats *outside* the Forest Reserve.
- (c) Over 80% of all priority species depend in part or in whole on seasonal deciduous dry forest to support their populations, and almost 60% of all priority species depend in part or in whole on semi-evergreen seasonal forest. Over 60% depend in part or in whole on montane or lower montane rainforest.

Table 6. Representation of priority bird species in different forest types, within or outside of the Forest Reserve.

Forest type indicates the type(s) of forest that each species is predominantly found in; however most are known to venture into other types occasionally. Percentages are rounded to the nearest whole number.

Priority species	Forest type	% number of species	Status
Great blue heron	herbaceous swamp	6%	Species population not in Forest Reserve (38%)
Saint Lucia nightjar	Deciduous seasonal forest	19%	
Saint Lucia wren			
White-breasted thrasher			
Lesser Antillean saltator	Deciduous seasonal forest and semi-evergreen seasonal forest	13%	
Saint Lucia warbler			
Rufous-throated solitaire	Montane and lower montane rainforest	19%	Almost entirely in Forest Reserve (19%)
Semper's warbler			
Saint Lucia amazon			
Bridled quail dove	Deciduous seasonal forest, semi-evergreen seasonal forest and lower montane rainforest	44%	Part of species' population in Forest Reserve (44%)
Forest thrush			
Grey trembler			
Lesser Antillean flycatcher			
Saint Lucia black finch			
Saint Lucia oriole			
Saint Lucia pewee			

The lower montane and montane rainforests that are largely included in Saint Lucia's Forest Reserve have clearly been very important in conserving priority species that are largely or entirely restricted to them, such as the rufous-throated solitaire and Saint Lucia amazon respectively. The Forest Reserve seems to be especially important to the Saint Lucia oriole too, which may be more patchily distributed outside of it (Fig. 10). The Saint Lucia pewee is common in the reserve, but also outside of it, in the lower elevation forests. The bridled quail dove, Lesser Antillean flycatcher and Saint Lucia black finch occur less commonly in the reserve than outside of it. Semper's warbler, last confirmed on Saint Lucia in 1961, though with unconfirmed sightings in 1985 and 1995 (Keith, 1997), may now be extinct (Anthony & Dornelly, 2008); but historically it appears to have inhabited lower montane rainforest, including Piton Flore within the Forest Reserve.

Most priority species, however, depend on forests outside the Forest Reserve, with a fifth of all priority species restricted to seasonal deciduous forest. Some use both deciduous seasonal forest and semi-evergreen seasonal forest, but the latter is now a rare type on Saint Lucia (Graveson, 2009) and care was taken to select some inventory survey points within this type rather than in its more predominant surrounding matrix of agricultural land. Thus, most of these species are likely at present to be relying largely on deciduous seasonal forest. Whilst this underlines the importance of deciduous dry forest to these species, it also suggests the potential for recovering semi-evergreen seasonal forest to improve their chances of survival.

Table 7. Inventory survey priority species represented within Saint Lucia's five IBAs.

The IBAs are: LC001: North East Corridor; LC002: Government Forest Reserve; LC003: Pitons World Heritage Site Management Area; LC004: Mandelé; LC005: Point Sable; see also map in Fig. 11. Note that this table does not include all of the 36 bird species that meet BirdLife International's IBA criteria (Anthony & Dornelly, 2008), only the present inventory's designated priority species.

<i>Common name</i>	<i>Important Bird Area</i>				
	LC001	LC002	LC003	LC004	LC005
Bridled quail-dove	■		■	■	
Forest thrush	■			■	
Great blue heron	■				■
Grey trembler	■			■	
Lesser Antillean saltator	■		■	■	
Lesser Antillean flycatcher	■			■	
Rufous-throated solitaire		■			
Semper's warbler		■			
Saint Lucia amazon		■	■		
Saint Lucia black finch	■	■	■	■	
Saint Lucia nightjar	■			■	
Saint Lucia oriole	■	■	■	■	
Saint Lucia pewee	■	■	■	■	
Saint Lucia warbler	■		■	■	■
Saint Lucia wren	■		■	■	
White-breasted thrasher	■			■	
% of priority species	83%	38%	50%	63%	13%

Section 4.7 assesses the relative importance of the priority bird species. The 19% of all priority species that appear to be restricted to deciduous seasonal forest (the Saint Lucia nightjar, the Saint Lucia wren and white-breasted thrasher) are amongst the most important of all, along with two species of montane and lower montane rainforest (the Saint Lucia amazon and Semper's warbler) and two found in all the main forest types (the forest thrush and the Saint Lucia black finch).

In 2007, the Saint Lucia Forestry Department (SLFD) and Durrell identified IBAs on Saint Lucia for BirdLife International (Anthony & Dornelly, 2008). The two dry forest IBAs, the North East Corridor (LC001) and Mandelé (LC004), represent 81% and 63% respectively of all the priority species, more than any other IBAs on Saint Lucia (Table 8). Although not all these species were recorded at inventory survey points within the North East Corridor (none of the inventory points fell within Mandelé), they are recorded in the auxiliary surveys, with the exception of the forest thrush (for which there have been unconfirmed sightings within LC001) and the nightjar (for which there are confirmed records from within LC001 alone; Fig. 10).

Collectively, the IBA boundaries for Saint Lucia cover the ranges of all of the priority species well, and were, of course, selected in part to do this. However, it is of concern that the two IBAs capturing most bird diversity, and most of the priority bird species identified in this report, are the North East Corridor and Mandelé, these being the only two of Saint Lucia's IBAs without any statutory protection (apart from a small Marine Reserve at Grand Anse in the North East Corridor).

4.4. Critical habitats and sites for migrant bird species

Critical sites for the greatest diversity of migrant species, identified using John's (2004) data, are examples of herbaceous swamps: a man-made habitat type, but one that is also rare on Saint Lucia (Graveson, 2009). These are shown in Fig. 14. All of these sites are near the highway on Saint Lucia – and hence easily accessible to the many birders whose records make up the bulk of John's (2004) data – apart from Grand Anse (which is also a part of the North East Corridor IBA). All are small sites of less than a hectare each, but Boriel's pond (the site with the highest reported migrant bird diversity in the last 20 years) is also immediately adjacent to – but not included in – the Mankoté mangroves to the south and the Savannes Bay mangroves to the north. Both are Ramsar wetlands of international importance since 2002 (Ramsar, 2009), with Mankoté in particular being another site with high migrant bird diversity. The Mankoté Ramsar site is important for roosting, breeding and foraging waterbirds, especially herons and egrets, and warblers. Boriel's pond itself an especially important site on Saint Lucia for ducks and coots but has been under threat of destruction for development for several years now, despite the two Ramsar sites that border it to the north and south being now also included in the Point Sable Environmental Protection Area (PSEPA) gazetted in 2007 (Gardner, 2009).

Two additional sites considered of high priority for migrant birds do not stand out from the data set compiled by John (2004): the Cul de Sac wetland and the Maria Islands Nature Reserve. The Cul de Sac wetland is a larger site (covering about 3 ha) and does not appear in John's (2004) data set (which spans the period 1911 to 2002) as it was only recently created following the construction of the Millennium Highway (in 2001) and the abandonment of banana cultivation in this part of the River Cul de Sac's estuarine floodplain. In the short period since then there have been reports of a range of migrant birds using this site, Caribbean coot (*Fulica caribaea*), black-bellied whistling duck (*Dendrocygna autumnalis*), roseate spoonbill (*Platalea ajaja*) and masked duck among them.

The man-made nature of most of Saint Lucia's critical sites for migrant birds – and the rapid adoption of the newly created site at Cul de Sac – does suggest that habitat creation may be one option for mitigating any loss of such sites. An exception may be Boriel's pond which clearly forms a part of a wider (and not man-made) wetland system (the largest on Saint Lucia: Ramsar, 2009) that includes the mangroves at Savannes Bay and

Mankoté. For other herbaceous swamp sites, creation of new sites may offset losses, but only if it is carried out with adequate funding and management in place.

The Maria Islands have a lower diversity of migrant birds recorded from them than the main herbaceous swamp sites discussed above (seven species in the last 20 years), but are of conspicuous importance because of the very high densities of congregatory birds nesting annually on these two islands. Anthony & Dornelly (2008) reported over 20,000 sooty terns (*Sterna fuscata*) and 250-500 bridled terns (*Onychoprion anaethetus*) each year, with regionally important numbers of roseate and royal terns (*Sterna dougallii dougallii* and *S. maxima*) and red-billed tropicbirds (*Phaethon aethereus*). There is little doubt that this importance is due in large part to the absence of introduced mammalian predators on the islands, a state of affairs that it is critical to actively maintain. This absence of introduced predators also makes these island a critical habitat for a number of Saint Lucia's endemic reptile species (Daltry, 2009). The Maria Islands were gazetted as a Nature Reserve in 1988 and vested in the Saint Lucia National Trust; they are also included within the PSEPA (Gardner 2009).

4.5. Threats to critical habitats for bird species

The current survey did not attempt to assess threats to bird habitats on Saint Lucia, but the main threats are well documented by the Government of Saint Lucia's (GOSL) 1998 *Biodiversity Country Study Report*. Degradation, fragmentation and loss of habitat has occurred from conversion to agricultural land (which expanded greatly in the 1960's: Devaux, 1992), road construction and extractive uses (such as fuelwood extraction). GOSL (1998) clearly identified a major problem underlying these causes of forest conversion: the lack of an adequate land use policy on Saint Lucia, a state of affairs that persists to the present day. In more recent years, this underlying problem has manifested itself in the greatest threat to forest habitats (for birds and other species) being from the conversion of forested lands for touristic development (Morton, 2007a; Anthony & Dornelly, 2008; Daltry, 2009; White, 2009), along with the associated developments (road construction, urban sprawl) they are likely to encourage.

Although encroachment on the Forest Reserves was identified as a threat by GOSL (1998) and continues on a small scale to the present day, the most severe impacts from these threats face the seasonal deciduous and semi-evergreen seasonal forests, partly because they – with a few small exceptions – lie outside Saint Lucia's Protected Area system and partly because they have a higher land capability (less steep slopes) to support development. Seasonal deciduous forest is also more prone to another threat: wildfires (Robbins *et al.*, 2008), which could have catastrophic effects on offshore islands such as the Maria Islands.

Natural hazards such as hurricanes and landslides are also cited by GOSL (1998) as threats to Saint Lucia's forests. Severe impacts are rare, with most hurricanes missing Saint Lucia; but in 1980, Hurricane Allen damaged or destroyed over 80% of Saint Lucia's forest (Anthony & Dornelly, 2008) and resulted in the loss of an estimated 30% of the Saint Lucia amazon population (Butler, 1990).

4.6. Threats to priority bird species

Loss of habitat (section 4.5) appears to be the greatest threat currently facing bird species dependant entirely, or in part, on seasonal deciduous and semi-evergreen seasonal forests (see Table 6, section 4.3). The other most obvious severe threat facing many bird species on Saint Lucia is from alien invasive species, primarily introduced predatory mammals. The small Asian mongoose (*Herpestes javanicus*) in particular has had a devastating impact on native fauna (Espeut, 1882; Allen, 1911; Seaman, 1952; Seaman & Randall, 1962; Wege & Anadon-Irizarry, 2008) and is implicated in the decline (and possible extinction) of Semper's warbler (Keith, 1997) as well likely impacts on various other Saint Lucian birds – but especially those foraging and/or nesting on or near the ground (see Table 10) – as well as other native Saint Lucian animals (Morton, 2007a; Daltry, 2009). Other alien mammals of threat to Saint Lucia's birds are cats (*Felis catus*), dogs (*Canis familiaris*) and

rats (*Rattus* spp., especially the arboreal *R. rattus*). It is suspected that the mannikou, or possum (*Didelphis marsupialis*) – another introduced mammal – will likely also have negative impacts on native fauna (Daltry, 2009). Monkeys (species not yet confirmed) have been reported from the north of Saint Lucia, from Des Rameaux, near Monchy and Marisule. It is not clear at the time of writing whether these monkeys continue to survive or have become established, but non-native monkeys flourish on some other Caribbean islands and are reported to have negative impacts on local wildlife (e.g. Global Invasive Species Database, 2007). The absence of introduced predators on the Maria Islands Nature Reserve and, more recently, on Dennery, Praslin and Rat Islands (Durrell Wildlife Conservation Trust & Saint Lucia Forestry Department, 2008), is of special importance to bird conservation efforts on Saint Lucia, primarily for migrant species (see section 4.4), although Maria Major is nested in large numbers by *ramier* (scaly-naped pigeon, *Patagioenas squamosa*) too.

It is likely that the pressure, and resultant impact, from alien invasive species will increase with the increases in human population density and activity that accompany development. Thus the threat to Saint Lucia's birds from the current main threat to habitat (conversion for development; section 4.5) is likely to also increase the threat from alien predators.

The impacts of non-mammalian alien invasive species on Saint Lucia's birds are not well documented or understood. At least two non-native parrot species have been sighted in the wild in Saint Lucia in the last few years, one of them the orange-winged parrot (*Amazona amazonica*). Programmes for the surveillance of birds to detect West Nile virus and avian influenza on Saint Lucia have been discussed (Gongora *et al.*, 2008), although any impacts on birds in Saint Lucia are as yet unrecorded. These diseases, themselves alien invasives, are a warning that the introduction alien birds may have impacts for humans as well as native bird species.

Some native Saint Lucian bird species may also pose a threat to other native priority bird species. Pearly-eyed thrashers (*Margarops fuscatus klinikowski*) are believed to compete strongly with Saint Lucia amazons for nesting cavities with a resultant “substantial... reproductive failure, with low success per parrot nesting attempt mainly the result of nest predation by thrashers” (SLFD unpublished Data, cited in Wiley *et al.*, 2004). Cruz *et al.* (1990) reported shiny cowbird parasitism of the nests of Caribbean elaenias (*Elaenia martinica*), black-whiskered vireos (*Vireo altiloquus*), yellow warblers (*Dendroica petechia*), Carib grackles and Saint Lucia orioles, but only reported harmful impacts on the warbler and vireo: the level of impact on the Saint Lucia oriole has not been established. Shiny cowbirds favour disturbed, cleared areas and, although native to Saint Lucia, may have had their numbers artificially increased by conversion of forest.

Historically, hunting is believed to have contributed to severe declines in some priority species such as the Saint Lucia parrot and the forest thrush (Keith, 1997). Hunting pressures declined greatly under a moratorium on hunting introduced with the 1980 Wildlife Protection Act, and the associated awareness raising campaigns run by SLFD and RARE (Butler, 1990; Wiley *et al.*, 2004), seeing a reversal of fortune for the Saint Lucia parrot (Young *et al.*, in prep.), although the forest thrush remains rare. John (2001) reported a shift in public attitudes away from favouring hunting and at present, under the continuing moratorium on hunting, it appears to be a relatively minor threat to birds on Saint Lucia (see also Morton, 2009a), although it remains a threat to some non-bird species such as the Saint Lucia iguana (Morton, 2007a). There has, however, been a recent prosecution by SLFD for theft of ramier eggs from the Maria Islands Nature Reserve, and other low level impacts may be occurring. Keith (1997) cited hunting for the pet trade as a historical cause of decline in the Saint Lucia amazon population. The continuing very high prices reportedly asked for this species on the international black market must provide sufficient incentive to wildlife criminals that this threat remains a cause for concern in Saint Lucia. Largely in response to this concern, SLFD do not publicly divulge the locations of any nesting cavities known to be used by this species.

There are some recent examples of persecution of birds, for example the poisoning of the regionally endemic Lesser Antillean bullfinch – and, collaterally, of other bird species too – by a hotel regarding them as pests. The

level of poisoning or trapping of birds to protect crops is unknown, although it is known to occur (pers. obs.), but does not appear to be a major threat. That said, recent complaints of crop damage outside of the Forest Reserves by the Saint Lucia amazon are a reminder than human-wildlife conflicts have the potential to lead to serious impacts on protected species.

4.7. Assessing the importance of priority species and other Saint Lucian endemics

Saint Lucia has more single island endemic bird species, and more globally threatened bird species, than any other country in the Eastern Caribbean (Table 8; BirdLife International, 2009b, c). The intrinsic value of these species goes beyond their obvious uniqueness to Saint Lucia and resides also in their irreplaceability: if they are lost from Saint Lucia, they are lost from the world and cannot be replaced. These species are listed in Table 9. Not all of Saint Lucia’s endemic subspecies were designated as priority species in the inventory survey despite being found nowhere else in the world. The five omitted subspecies were the Carib grackle *Quiscalus lugubris inflexirostris*, the Lesser Antillean bullfinch *Loxigilla noctis sclateri*, the scaly-breasted and pearly-eyed thrashers, *Margarops fuscus schwartzi* and *M. fuscatus klinikowski*, and the yellow warbler *Dendroica petechia babad*. All five are abundant and widespread birds on Saint Lucia, and, the first three were amongst the commonest species recorded in the inventory (Fig. 4).

Table 8. Endemic and globally threatened bird species in the Eastern Caribbean (ranked by endemics).

Data from BirdLife 2009b (on endemic species); BirdLife 2009c (on globally threatened species with red list status VU, EN or CR); Avibase, 2009 (on introduced species). The figures refer to full species only, not subspecies.

Country	Endemics	Globally threatened	Introduced
Saint Lucia	4	5	1
Dominica	2	4	3
Saint Vincent and the Grenadines	2	2	2
Guadeloupe	1	1	14
Martinique	1	2	15
Grenada	1	1	1
Montserrat	1	2	0
Trinidad & Tobago	1	2	4
Barbados	0	1	10
Antigua & Barbuda	0	1	3
Netherlands Antilles	0	1	4
Saint Kitts & Nevis	0	1	0
Anguilla	0	0	1

Table 9. Species (5) and subspecies (13) endemic to Saint Lucia.

See text.

<i>Common name</i>	<i>Latin name</i>	<i>Priority species</i>	<i>Endemic species</i>	<i>Endemics subspecies</i>
Carib grackle	<i>Quiscalus lugubris inflexirostris</i>			■
Forest thrush	<i>Cichlherminia lherminieri sanctaeluciae</i>	■		■
Grey trembler	<i>Cinclocerthia gutturalis macrorhyncha</i>	■		■
Lesser Antillean saltator	<i>Saltator albicollis albicollis</i>	■		
Lesser Antillean bullfinch	<i>Loxigilla noctis sclateri</i>			■
Lesser Antillean flycatcher	<i>Myiarchus oberi sanctaeluciae</i>	■		■
Pearly-eyed thrasher	<i>Margarops fuscatus klinikowski</i>			■
Rufous-throated solitaire	<i>Myadestes genibarbis sanctaeluciae</i>	■		■
Scaly-breasted thrasher	<i>Margarops fuscus schwartzi</i>			■
Semper's warbler	<i>Leucopeza semperi</i>		■	
Saint Lucia amazon	<i>Amazona versicolor</i>	■	■	
Saint Lucia black finch	<i>Melanospiza richardsoni</i>	■	■	
Saint Lucia nightjar	<i>Caprimulgus rufus otiosus</i>	■		■
Saint Lucia oriole	<i>Icterus laudabilis</i>	■	■	
Saint Lucia pewee	<i>Contopus latirostris oberi</i>	■		■
Saint Lucia warbler	<i>Dendroica delicata</i>	■	■	
Saint Lucia wren	<i>Troglodytes aedon mesoleucus</i>	■		■
White-breasted thrasher	<i>Ramphocinclus brachyurus sanctaeluciae</i>	■		■
Yellow warbler	<i>Dendroica petechia babad</i>			■

Table 10 summarizes a number of criteria that can be used to rank the relative priority for conservation of each of the priority species. For each species, each criterion has been assigned a rank of increasing importance from ● to ●●●, corresponding to the numerical scores 1 to 3. A “o” symbol indicates not applicable; a “?” symbol indicates the possibility of some importance, but requires more information. The sum of the numerical scores for each criterion has then been used to assign a rank of 1 (most important, at the top of the table) to 13= (least important *within the priority species set*).

Table 10. Conservation ranking of selected priority species based on various criteria.

This table includes only the 16 birds identified as priority species in section 2.3. With the exception of the first two criteria, the remaining criteria are applied with a focus on national priorities; for the remaining criteria, endemic subspecies are treated as the population of interest (e.g. the Saint Lucia nightjar scores ●●● for endemism as the subspecies is endemic to Saint Lucia) – see text for further details. ^g insectivore that forages or nests on the ground; ^u insectivore using forest understory (omnivorous species that take insects have been included as insectivores here). See text for details.

Priority Species	Ranking criteria							TOTAL SCORE	RANK
	(1) Listed as globally threatened with extinction by IUCN	(2) Endemic to a restricted area	(3) Suggested national red list status	(4) Restricted or patchy range on Saint Lucia	(5) Species of actual or potential economic or subsistence use	(6) Species of cultural significance	(7) Impact level of threats		
Saint Lucia nightjar ^g	○	●	●●●	●●●	●●	●●	●●●	17	1
Forest thrush	●	●●	●●●	●●●	●	●	●●	16	2=
Saint Lucia black finch ^{g,u}	●●	●●●	●●●	●●	●●	●	●●●	16	2=
Semper's warbler ^{g,u}	●●●	●●●	●●●	●●●	?	●	●●	15	4=
Saint Lucia amazon	●	●●●	●	●●	●●●	●●●	●●	15	4=
White-breasted thrasher ^{g,u}	●●	●●	●●	●●	●●	●●	●●●	15	4=
Saint Lucia wren ^{g,u}	○	●●●	●●●	●●	●●	●	●●●	14	7
Saint Lucia oriole ^u	●	●●●	●	●●	●●	●●	●●	13	8
Grey trembler	○	●●	●	●●	●	●	●●	9	9=
Rufous-throated solitaire ^g	○	●	○	●●●	●	●	●	7	10
Saint Lucia warbler	○	●●●	○	●	●	●	●	7	10=
Bridled quail-dove ^g	○	○	●	●●	●	●	●●	7	10=
Lesser Antillean flycatcher	○	●●	○	●	●	●	●	6	13=
Lesser Antillean saltator	○	●●	○	●	●	●	●	6	13=
Saint Lucia pewee	○	●●	○	●	●	●	●	6	13=
Great blue heron	○	○	○	●●	●	●	●	5	13=

Ranks were assigned as follows: Criteria (1) and (2) consider species using internationally recognized taxonomy (BirdLife, 2009a; AOU 1998 + supplements). These two criteria correspond to the criteria A1 (threatened species) and A26 (restricted range species, Eastern Caribbean) used by BirdLife International for

identifying IBAs on Saint Lucia (Wege & Anadon-Irizarry, 2008); Thus these criteria capture the IBA criteria for Saint Lucia too.

(1) Listed as globally threatened with extinction by IUCN: refers to red list categories: ● Near Threatened (Saint Lucia oriole) or Vulnerable; ●● Endangered; ●●● Critically Endangered.

(2) Endemic to a restricted area: ● only occurs regionally (in the Eastern Caribbean); ●● only found on a small number of islands within the Eastern Caribbean; ●●● found only on Saint Lucia.

Together, criteria (1) and (2) capture the international attention focussed on these species, but do not recognize the endemism of, or the threat of extinction to, bird subspecies unique to Saint Lucia. Thus, for example, the Saint Lucia nightjar is recorded as neither endemic nor globally threatened; but as a subspecies it is clearly both. Criteria (3) - (7) re-evaluate these birds as subspecies for those subspecies endemic to Saint Lucia (see Table 2, section 2.3).

(3) Suggested national red list status: ● Vulnerable *on Saint Lucia*; ●● Endangered *on Saint Lucia*; ●●● Critically Endangered *on Saint Lucia*. For birds endemic to Saint Lucia at the species or subspecies level, these categories reflect the *global* status of these species or subspecies – these endemics are irreplaceable.

(4) Restricted or patchy range on Saint Lucia: ● widespread across Saint Lucia; ●● widespread but patchily distributed across Saint Lucia *or* found only in a small number of locations (which can include large locations, such as the Forest Reserve for the Saint Lucia amazon); ●●● restricted to one or two *small* areas on Saint Lucia. Again, for birds endemic to Saint Lucia at the species or subspecies level, these categories reflect the *global* ranges of these species or subspecies.

(5) Species of actual or potential economic or subsistence use: Economic uses include sales of the species or its products, or its use as a tourist attraction or in marketing. Subsistence uses include household consumption as food or bush medicine. ● very minor contribution to household income or subsistence; ●● a moderate contribution to the income or subsistence of some households; ●●● a significant contribution to a large number of households; significant to the national economy. There is little data on the uses of birds on Saint Lucia; for this assessment, endemics of especial interest to birders (endemics) score ●● and all others except the parrot score ● as having some potential or actual value in generating money for bird watching tours. The parrot scores ●●● because its image (in ersatz and realistic representations) is widely marketed on Saint Lucia.

(6) Species of cultural significance: Indicators of the cultural significance of a species include its appearance in ancient or modern art, proverbs, folklore, religious symbolism, traditional foods and handicrafts, logos, and place names: ● very low or limited recognition (the majority of people are believed to be unaware of, or indifferent to, the this species); ●● recognized on a local scale in some communities; ●●● very well recognized and valued on a national scale - a source of national pride.

(7) Impact level of threats ● not currently believed to be facing any severe threats on Saint Lucia; ●● population impacted, or predicted to be impacted by one severe threat (e.g. ground nesting birds especially susceptible to alien invasive predators or predominantly lower elevation species facing habitat loss to development) and/or several less severe threats (e.g. nest parasitism or accumulation of pesticide residues); ●●● impacted, or predicted to be impacted by least two severe threats.

4.8. Prioritizing bird species conservation on Saint Lucia

The two most severe threats facing birds on Saint Lucia appear to be habitat loss (in the last century primarily to agriculture; at present from tourist developments) and alien invasive species (primarily introduced mammalian predators). These are outlined in sections 4.5 and 4.6 respectively. The most obvious responses to these threats should be site-based management and research, accompanied by awareness raising efforts.

Table 10 (section 4.7) suggests that some of the priority species selected for the present survey are of especially high concern and could benefit from more focussed conservation efforts. A discussion of such individual species priorities follows in section 4.9 and is expanded upon, for selected target species, in Morton (2009b). It is clear from Table 6 (section 4.3) that conservation of all the major forest types on Saint Lucia – seasonal deciduous forest, semi-evergreen seasonal forest, lower montane rainforest and montane rainforest – is essential to effectively conserve Saint Lucia’s priority bird species. Pre-empting section 4.9, it is obvious from Table 10 that three of species of most concern (i.e. at the top of Table 10) occur primarily in the rainforests – the Saint Lucia amazon, the forest thrush and Semper’s warbler – with a fourth (the Saint Lucia black finch) occurring in both this and the other main forest types. The other three of the species of most concern – the Saint Lucia nightjar, the white breasted thrasher and the Saint Lucia wren are exclusively found in the seasonal deciduous and semi-evergreen seasonal forests.

4.8.1. Site-based conservation within the Forest Reserves

Conservation of the birds of Saint Lucia’s montane rain forest has been conspicuously successful (e.g. Wiley *et al.*, 2004; Young *et al.*, in prep.) with the Government Forest Reserves accounting for an impressive 13% of the island’s land area, the vast majority of them comprising lower montane rainforest. Whilst not dedicated to conservation alone, this has been one of the major functions of these reserves and has clearly helped the survival of a number of priority species, most notably the Saint Lucia amazon which has seen an order-of-magnitude increase in its population over the last 40 years (Young *et al.*, in prep.), but also other species such as the rufous-throated solitaire and the Saint Lucia oriole (see Fig. 10). Whilst introduced mammalian such as the Asian mongoose are present in the Forest Reserves (D. Anthony, pers. comm.) they appear to be less abundant than in the more populous deciduous seasonal and semi-evergreen seasonal forest areas outside the reserves (pers. obs.). Feral pig (*Sus scrofa*) numbers, however, appear to be increasing, and primarily within the Forest Reserves (Morton, 2009a; Dornelly & Jn Baptiste, in prep.). This species, along with mongooses are likely to predate birds nesting or foraging on or near the ground. A number of these bird species are flagged in Table 10, including the Saint Lucia black finch and the bridled quail dove. There are no data, however, on the level of impacts of such alien invasive species on birds in the Forest Reserves (and little data for areas outside).

4.8.2. Site-based conservation outside the Forest Reserves

By contrast with Saint Lucia’s rainforests, the deciduous seasonal forest and remnant semi-evergreen seasonal forests have little protection or conservation management on Saint Lucia. Exceptions are the PSEPA (see section 4.4), the small Forest Reserves at Marquis and the drier (easternmost) parts of the Castries Waterworks Reserve around La Sorcière, and the semi-evergreen seasonal forest parts of the Dennery Waterworks Reserve at Mandelé. The PSEPA already receive conservation management, most notably on the Maria Islands Nature Reserve (e.g. Durrell Wildlife Conservation Trust & Saint Lucia Forestry Department, 2008) and, at least until recently, at Mankòtè from the Au Picon Charcoal and Agricultural Producers Group (Samuel & Smith, 2000, and Anon., no date). The sites at Marquis and especially La Sorcière and Mandelé represent opportunities for SLFD to more actively manage some of their non-rainforest reserves for the conservation of biodiversity on Saint Lucia.

However, these small areas of non-rainforest reserves do not adequately capture of the priority birds (or other taxa; e.g. Daltry, 2009) outside of the Forest Reserve. The IBAs identified by Anthony & Dornelly (2008) in the North East Corridor (LC001) and Mandelé (LC004) indicate clearly where the critical areas for conserving these species are on Saint Lucia (see Table 7, section 4.3). Some of the most important priority species (Table 10, section 4.7) are found only within these two IBAs, such as the Saint Lucia nightjar and the white-breasted thrasher, whilst for others, such as the Saint Lucia black finch and the Saint Lucia wren, they stand out as obvious strongholds. With little to no active conservation management of these areas at present, it seems

obvious that sites within these areas need urgent attention. The mechanisms for achieving this will be more challenging than for the Government-owned Forest Reserves, but the necessary actions can be identified.

These areas (the North East Corridor and Mandelé) do not contain pristine habitat (Graveson, pers. comm.). Rather, the biodiversity of the North East Corridor seems to derive mainly from its relative remoteness: along with Saint Lucia's interior mountain ranges it is the area furthest from paved roads (Morton, 2007a). It is also made up of a small number of large estates (Louvet, Grand Anse and Marquis) that have received little human impact for many years. This latter point is true of Mandelé too (home to the onetime Dennehy Estate, now under development as Louvet Estate Paradis, but also the Crown Lands at the Bordelais Correctional Facility).

These observations suggest a number of actions:

Firstly, some sites within these areas could be improved (habitat restoration) by careful management to mitigate losses at other sites within these areas. Restoration of deciduous seasonal and semi-evergreen seasonal forest need not preclude human uses of these sites, but clearly heavy-footprint developments and other land uses that destroyed natural habitats would be in conflict here.

Secondly, increasing human access and activity following development in these areas needs to be carefully managed. This is likely to require the declaration of some kind of protected area status at certain sites, an action that need not preclude or conflict with development plans and could provide a mechanism for enshrining co-management plans (covering wider areas that incorporate critical sites) with developers. Managing human activity is also likely to require sensitization of people using these sites (see next section) as anthropogenic pressures seem to be the cause of the retreat of some species (such as the Saint Lucia iguana; Morton, 2007a) to these areas.

Thirdly, the survival in these areas, and nowhere else on Saint Lucia, of some priority birds that nest at or near the ground – most notably the Saint Lucia nightjar, the white-breasted thrasher and the Saint Lucia wren – suggests that the impacts of terrestrial introduced predators (primarily mongooses) may at present be lower in these IBAs. This would be consistent with the findings of Quinn & Desley (2005) in Puerto Rico, who found that higher human densities supported higher mongoose densities. Thus another obvious action would be to mitigate the impacts of introduced predators at nesting sites and times of year through exclusion or control (eradication seems unlikely to be feasible).

4.8.3. Awareness of the conservation needs of Saint Lucia's birds

Sensitization of people using critical areas to the impacts of alien invasive species seems warranted. From personal observation it appears there is widespread and common confusion even over what alien invasive species are, with many people believing the native (and endemic) fer de lance (*Bothrops caribbaeus*) to be introduced and the introduced Asian mongoose to be native. Another common perception is of the Asian mongoose as a useful species based on the belief that it controls fer de lance populations, although there is little evidence to support this idea. Likewise, the introduced mannikou (opossum) is regarded as naturalized, and given the highest level of protection under the Wildlife Protection Act of 1980, whilst the level of its impacts on Saint Lucia's native fauna remain unknown.

With some of the most critical areas on Saint Lucia for bird conservation lying outside of the Forest Reserves, there is also a need to raise awareness of the value of non-rainforest habitats on Saint Lucia. John (2001) reports that questionnaire respondents from the Saint Lucian public rated "dry bush lands" (i.e. deciduous seasonal forest and probably also semi-evergreen seasonal forest) as the "least important" of the habitat types on Saint Lucia. This may in part be due to the fact that much of the land once covered by these forest types is now covered by very degraded vegetation, and in part due to the fact that the more important areas of these habitats (i.e. the Mandelé and North East Corridor IBAs) are rarely visited by most Saint Lucians. Raising

awareness of the importance of these habitats should be a prelude to sensitizing people to the threats that disproportionately endanger these forests, such as unplanned developments and wildfires.

Birds may be especially useful in raising awareness of such issues, as they tend to be among the most popular of wildlife for the general public, in part because their conspicuousness makes them easier to see or hear than other more cryptic taxa, and in part because they are seen as less threatening or repugnant (L. John, pers. obs.). The Saint Lucia amazon campaign demonstrated the huge potential of flagship species on Saint Lucia, being a flagship for the lower montane rainforest. The ‘pride campaign’ run by RARE and SLFD to sensitize the Saint Lucia public to the plight and the value of the Saint Lucia amazon has been hugely successful (Butler, 1990) and another awareness initiatives – ‘Feathered Friends’ and a school group at Millet – have been initiated by SLFD with an emphasis on bird species in areas both inside and outside of the Forest Reserves. The wide diversity of migrant bird species at a number of easily accessible sites may provide additional opportunities for using bird diversity to inspire public interest in the conservation issues facing Saint Lucia’s birds.

4.9. Individual species priorities

Table 10 suggests some obvious prioritization for bird species conservation action on Saint Lucia. Two of the most highly ranked species – **Semper’s warbler** and the **forest thrush** – are both extremely rarely encountered on Saint Lucia, and indeed the former may now be extinct. There have been more sightings of the forest thrush, but nonetheless, 34 surveyors spending six weeks surveying birds in the Forest Reserves in 2009 failed to detect a single individual (Young *et al.*, 2009). This extreme rarity means that conservation measures beyond general habitat conservation and alien invasive predator control do not seem feasible. On Saint Lucia, Semper’s warbler is reported primarily from montane forest (Keith, 1997) whilst the forest thrush has been recorded from both deciduous seasonal and montane rain forest (Diamond, 1973; Keith, 1997; Raffaele, 1998; A. Toussaint, pers. obs.), with a number of scattered observations in recent years (see section 3.5). Incidental surveillance and raising awareness are perhaps the only obvious species-specific actions that can be recommended at present.

For the remaining 14 priority species though, extant populations are known and opportunities for conservation exist or can be created. The **Saint Lucia amazon** and the **white-breasted thrasher** both stand out as very high priority species and both have been and continue to be the subject of ongoing conservation programmes by SLFD, Durrell and other agencies.

It is notable that the **Saint Lucia nightjar** is ranked even more highly than any of the other species in Table 10 though, primarily because of its extremely restricted range, and the multiple severe threats it faces. It has been subject to recent taxonomic revision (AOU, 1998) following the work of Robbins & Parker (1997). However, Robbins & Parker suggest there is no evidence to believe the Saint Lucia population of this migratory and the species is found nowhere else in the West Indies (the nearest population is in Venezuela). Additionally, field notes recorded by Parker in 1989 (ML Audio 51032, Cornell Lab of Ornithology Macaulay Library 2009) indicated that Saint Lucia nightjars were attracted by recordings of other Saint Lucia nightjars, but not by recordings of ostensibly the same species, *Caprimulgus rufus*, recorded elsewhere). Thus, interest in this species is partly on account of concerns over its taxonomic status and a resolution of this issue might help clarify priorities for this species on Saint Lucia. Providing DNA from Saint Lucia nightjars to incorporate into a new caprimulgid phylogeny, that includes *Caprimulgus rufus* DNA from Guyana, but not from Saint Lucia, may be of value here (M. Braun, University of Maryland pers. comm.; see Han, 2006). Regardless, Robbins & Parker (1997), who recommend reclassifying the onetime Saint Lucia endemic *C. otiosus* to the endemic subspecies *C. r. otiosus*, also advise: “Saint Lucian *otiosus* is certainly vulnerable given that its potential habitat is limited to no more than 30 sq. km on the windward, north-eastern section of the island. ... To ensure that the nightjar, the highly endangered White-breasted Thrasher (*Ramphocinclus brachyurus*), and the nearly extinct Saint Lucian subspecies of the House Wren (*Troglodytes aedon mesoleucus*) will continue to survive, we

recommend that a large tract of forest be preserved between Petite Anse [La Ti Tanse] and the Louvet River area".

At present, the Saint Lucia nightjar is found only in low, degraded deciduous seasonal in a small part of the North East Corridor. However, Cleere & Nurney (1998) describe a wider range of habitats used by other subspecies of *C. rufus*, though most are drier, more open types of forest. This may suggest this species is less limited by habitat on Saint Lucia than by other factors (such as alien invasive mammalian predators like mongooses predicted to have a particularly severe impact on ground nesting birds such as this), or it may indicate more significant differences between the Saint Lucia nightjar and other subspecies of *C. rufus*.

Fig. 16. The Saint Lucia nightjar. Photographed at Grand Anse, North East Corridor.

Photo: © B. Kern.



Other species next most highly ranked by these criteria are the **Saint Lucia black finch** and the **Saint Lucia wren**. As with the nightjar, the wren also has a very restricted range on Saint Lucia, which is largely confined to the same North East Corridor as the nightjar, although there is also an isolated sub-population on the slopes of Gros Piton in the south west of Saint Lucia (L. John, A. Toussaint, pers. obs.). In the case of this species, habitat loss is implicated as a limiting factor (Gilardi & John, 1998), though both the wren and the black finch are species that forage and nest in low vegetation (Diamond, 1973; Keith, 1997; Raffaele, 1998), presumably making both of them susceptible both to alien invasive mammalian predators such as mongooses and clearance of brush.

White (2009 and references therein) briefly discusses growing evidence for, and various hypotheses to explain, the observation that forest understorey and ground-foraging insectivorous birds worldwide are exceptionally vulnerable to forest fragmentation. It is notable these types of birds are common amongst the set of priority species, and more so amongst the most highly ranked ones (Table 10).

The five previously mentioned species – the amazon, white-breasted thrasher, nightjar, wren and black finch – are covered in more detail by Morton (2009b), along with recommendations for species conservation management. Of the other priority species, the **Saint Lucia oriole** may deserve special attention because of the unresolved matter of the level of two likely impacts on its population. Firstly, it is susceptible to brood parasitism by the shiny cowbird *Molothrus bonariensis minimus* (Keith, 1997), a species found predominantly

in cleared areas and hence likely to increase with increasing human impacts on the landscape. Keith (1997) also mentions the possibility of harassment by the bare-eyed thrush (*Turdus nudigenis nudigenis*). Secondly, it has been speculated that the oriole, as a species favouring the edges of banana gardens (Keith 1997), may also be susceptible to secondary poisoning from agrichemicals. However, there has been no empirical assessment of the impact of either brood parasitism or secondary poisoning on this species.

The remaining eight species appear, in Table 10, as being of lower priority, though four – the **rufous-throated solitaire**, **bridled quail dove** and **great blue heron** – appear to be scarce on Saint Lucia, at least in records from all the sources considered here. This would seem to demand some further attention.

5. Recommendations: Management Priorities for Forest Birds

The following recommendations do not include single species conservation efforts, such as the development of single species conservation action plans: for those recommendations, refer to Morton (2009b). A number of these recommendations draw, with permission, on those in Daltry (2009) as there seem to be numerous obvious opportunities for integrating conservation actions for Saint Lucia's birds and reptiles, and thus enhancing the value of these actions, and the reader is also referred to that report.

5.1. Forest protection and management

Secure the management and restoration of critical deciduous seasonal and semi-evergreen forest areas on Saint Lucia

5.1.1. Establish at least one new nature reserve to protect dry forest wildlife communities on the main island of Saint Lucia [TOP PRIORITY]

1. Secure core areas of deciduous seasonal forest for the management of Saint Lucian birds within the North East Corridor and/or Mandel  IBAs.
 - (a) Identify a core area or areas that can be feasibly managed, giving priority to areas that:
 - include as wide a range of native bird (and other) biodiversity as possible, with an emphasis on 'securing habitats for as many of the priority bird species as possible;
 - include ravine areas and relatively non-degraded deciduous seasonal forest;
 - can be managed to restore natural forest;
 - can also serve parallel strategic uses for SLFD without negatively impacting biodiversity conservation objectives;
 - provide fewer, larger contiguous areas of forest in preference to more, smaller fragmented areas.
 - (b) Explore mechanisms for obtaining private land or, if that is not practical, forming landscape protection agreements with landowners and other key stakeholders (see section 5.1.2).
 - (c) In parallel with designating a new protected area, develop a costed management plan that prescribes the area's objectives and how these will be achieved and monitored. It is important to consider the management of alien invasive species and what human activities can be permitted in the area (e.g., recreational uses).
2. Secure restoration areas for the management of bird diversity outside of Saint Lucia's Important Bird Areas (IBAs).
 - (a) Identify an area or areas that can be feasibly restored, giving priority to areas that:
 - are identified by habitat suitability modelling (see section 5.3.2) as having the capacity to sustain, if restored and managed, a range of native bird (and other) biodiversity as possible, with an emphasis on 'capturing' as much priority bird species diversity as possible;
 - meet the remaining criteria under 1(a) above.

5.1.2. Formulate local agreements to preserve important wildlife habitats and forest corridors

1. Encourage landowners and other stakeholders to safeguard specific sites of known importance to priority bird species.
 - (a) Map the location of sites that capture a wide range of priority species diversity and identify the owners and other stakeholders that use these areas.
 - (b) Develop a dialogue with the owners and, as applicable, other stakeholders regarding what steps to take or avoid to ensure the long term security of these sites. It may be necessary to negotiate some form of compensation to dedicate these sites to conservation purposes, such as tax relief or tourism concessions.
 - (c) Management agreements should be put in writing in the form of a contract or covenant, signed by the landowner, the government and, as applicable, authorized representatives of other stakeholder groups. These may be indefinite or cover a fixed period, e.g., 30 years.
2. Facilitate the regeneration and conservation of semi-evergreen seasonal forests on Saint Lucia.
 - (a) Identify plantations and other sites in the semi-evergreen seasonal forest zone (approximately 100 to 200 metres above sea level) where farming appears to have been abandoned and which are of low suitability for farming (e.g., steep slopes, close to ravines).
 - (b) Identify the current owners and determine their plans for these sites. Encourage or negotiate with the owners for such areas to be allowed to revert to semi-evergreen seasonal forest in order to conserve wildlife and protect the watershed.
 - (c) Semi-evergreen seasonal forests can be allowed to regenerate naturally or, resources permitting, native saplings planted and non-native trees felled.

5.2. Alien invasive species

Control the introduction and spread of alien invasive species that endanger forest birds

5.2.1. Control harmful alien invasive mammals from priority sites on the main island [TOP PRIORITY]

1. Concurrently (and recurrently) reduce the density of mongooses and other mammalian predators in core sites within the North East Corridor – i.e. Grande Anse, Caille Des and Louvet – and within the Government Forest Reserve, and monitor the impacts on bird survival compared with control sites with no predator removal, adjusting predator removal tactics as needs be.
 - (a) Using a large number of live traps baited with chicken or another appropriate bait, trap and euthanize mongooses, cats and opossums and rats, especially immediately prior to the bird breeding season (i.e. Feb-Mar). Keep careful records of the numbers of animals caught and if possible stomach contents.
 - (b) Monitor the impacts on bird survival compared with control sites with no predator removal, adjusting predator removal tactics as needs be.
2. Reduce the population of feral and free-ranging pigs on Saint Lucia (see Clarke, 2009). Approaches may include:-

- (a) Require all owners to mark their pigs and keep them in enclosures at all times.
- (b) Permit the shooting or capture of pigs outside of forest reserves. Keep careful records of the numbers of animals caught and if possible stomach contents.
- (c) Review the effectiveness, feasibility and benefits-risks of other options suitable for state forest areas, including trapping, poisoning and oral contraception.
- (d) Monitor the impacts on bird survival compared with control sites with no pig removal, adjusting pig removal tactics as needs be.

5.2.2. Minimise the probability of non-native species invading Saint Lucia

1. Prohibit the importation and keeping of alien species that present a risk to native wildlife.
 - (a) Employ the Wildlife Protection Act and relevant trade or health legislation to prevent the deliberate importation of, in particular, non-native and non-agricultural mammals.
 - (b) Do not issue permits to allow residents to keep animals perceived to be a threat to native wildlife if they escape. The long list of potentially destructive alien species includes exotic bird species, snakes, raccoons and monkeys.
 - (c) Advise the Development Control Authority on the risks of importing, and of increasing the densities of already-established alien invasive species, during large construction projects. Develop mitigation of these risks to be incorporated into planning permissions.
 - (d) Illegally imported alien wildlife should be destroyed immediately.
 - (e) Nominate at least one Forestry officer to liaise with the authorities at Vigie, Castries docks, Hewannora, Rodney Bay Marina and other important ports of entry, and provide prompt technical advice should any alien animals be detected.
 - (f) Review the current capacity of customs/ port authority staff to screen incoming baggage and cargo for wildlife, and provide training and resources as required.
 - (g) Offenders who illegally import animals should be penalized and held up as an example to others.

5.3. Applied research and adaptive management

Conduct research in the context of adaptively managing Saint Lucia's avifauna

5.3.1. Research the impacts of habitat restoration – modification and removal of alien invasive species – on survival probabilities of priority bird species [TOP PRIORITY]

This is a broad area of research that overlaps with many of the recommendations above, but the key recommendation is to conduct it *whilst* managing critical populations, *not* as a prelude to managing them. In this way the research findings can guide the development of the management strategies (see also section 5.3.1.1.e). This will involve researching the impacts of habitat restoration on priority bird species. This is essentially the same as researching the impacts of habitat degradation as it will involve comparing restored areas with unrestored ones. To narrow down suggested research topics in this area, the following are recommended:

1. Research the impacts of restoring native deciduous seasonal flora, especially trees, on bird survival and nesting success. This should be done in conjunction with 5.1.1.
 - (a) Research existing dry forest restoration projects, particularly elsewhere within the region (e.g. at USDA Forest Service's International Institute of Tropical Forestry in Puerto Rico).
 - (b) Identify multiple (replicate) restoration and control (no restoration) sites, coordinating this with recommendations 5.1.1 and 5.1.2.
 - (c) Produce a restoration plan for assessing and removing tree species and encouraging and replanting others in a way that will minimize negative impacts on native fauna during the restoration process.
 - (d) Produce a restoration plan for augmenting (e.g. Gilardi & John, 1998) and/or protecting nest sites of priority bird species.
 - (e) Monitor the impacts on priority bird species (and other fauna) – specifically survival probabilities and nesting success – before, during, and after restoration efforts at both restoration and control (no restoration) sites.
 - (f) Monitor the impacts on priority bird species – specifically survival probabilities and nesting success – of nesting site augmentation and/or protection.
 - (g) Adapt restoration practices in the light of research findings.
2. Research the impacts of controlling alien invasive species, especially predatory mammals, on bird survival and nesting success. This should be done in conjunction with 5.2.1.
 - (a) Research existing alien invasive control strategies and methodologies.
 - (b) Identify multiple (replicate) removal and control (no removal) sites, coordinating this with recommendations 5.2.1 and 5.4.1.
 - (c) Produce an alien invasive species control plan for measurably reducing alien invasive species densities in a way that will minimize negative impacts on native fauna during the restoration process.
 - (d) Monitor the impacts of control efforts on alien invasive species densities and on priority bird species (and other fauna) – specifically survival probabilities and nesting success – before, during, and after restoration efforts at both predator removal and control (no removal) sites.
 - (e) Adapt restoration in the light of research findings.

5.3.2. Research the habitat requirements of priority species

1. Develop predictive habitat suitability models for priority bird species in Saint Lucia. White (2009) has demonstrated this approach in principle for the white-breasted thrasher on Saint Lucia, but indicates it needs some refinement, particularly in the area of improving the reliability of GIS data.
 - (a) Review habitat suitability modelling methodologies, consulting technical experts as needed.
 - (b) Review, update and where necessary augment existing GIS data. Relevant datasets include vegetation cover and land use; elevation, slope and aspect; hydrology; rainfall; and various measures of human footprint (road access, human population density, etc).

- This is likely to require the geodetic rectification of most of the GIS data sets SLFD currently have; collaboration with the Surveys Department of the Ministry of Physical Planning is recommended.
- (c) Review existing distribution data for priority species (primarily the data presented in this report) to identify gaps.
 - (d) Conduct rapid field assessments to fill any important gaps.
 - (e) Conduct habitat suitability analyses.
 - (f) Assess sites identified as suitable with field surveys.
 - (g) Select one or more sites for management (see section 5.1.1.2).

5.4. Education and awareness

Strengthen local and national understanding and support for the conservation of forest birds and their habitats

5.4.1. *Research the awareness within critical stakeholders in Saint Lucia of the issues of critical habitats and alien invasive species*

1. Identify stakeholders critical to the success of recommendations 5.1. and 5.2. The following stakeholder groups should be considered:
 - (a) Developers and other owners of large estates
 - (b) Elected politicians
 - (c) The Development Control Authority and the National Development Corporation
 - (d) Current users of critical habit areas (as identified in sections 5.1.1 and 5.1.2), including local and overseas visitors
 - (e) The general Saint Lucian public
2. Identify which stakeholder behaviours need to be changed to achieve the aims of recommendations 5.1 and 5.2.
3. Use questionnaires to assess each stakeholder groups' understanding of, and investment in, the management of critical bird habitats and invasive alien species impacts.
4. Use questionnaires to measure behaviours in each stakeholder groups that will allow the aims of recommendations 5.1 and 5.2. to succeed if changed.

5.4.2. *Develop targeted sensitization campaigns for stakeholder groups*

1. Develop campaigns appropriate to the needs and interests of each stakeholder group. Options to consider could include:
 - (a) 'Social marketing': supplying storyline content to OECS' regional radio (and possibly television) soap opera on environmental issues (contact: Alleyne Regis, Population Media Center).

- (b) Presentations to small focus groups (e.g. for politicians or civil servants)
 - (c) Television documentaries
2. Develop campaigns appropriate to the needs and interests of each stakeholder group. Options to consider could include:
 3. Reviewing the successes and failures of the recent RARE pride campaign for the Saint Lucia iguana as a flagship for 'Iyanola' (the deciduous seasonal forests of the North East Corridor) may provide further insights into what strategies are currently working on Saint Lucia:
 - (a) This review could incorporate RARE's methodology for assessing the impact of awareness raising on behaviour change.
 4. Measure changes in the behaviours identified in section 5.4.1

5.4.3. *Establish a Saint Lucian NGO for local nature conservationists*

1. Identify interested stakeholders, possibly using the mechanism in section 5.4.1.
2. Establish the legal mechanisms needed to form an NGO.
3. Develop field activities focussed initially on bird watching:
 - (a) Focus on critical bird habitats and species
 - (b) Secure media coverage of field events to disseminate the information obtained on them to a wider audience.

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Annex I Bird species recorded from Saint Lucia

This checklist was compiled from Clements *et al.* (2007) and personal observations by A. Toussaint. Names in bold indicate species recorded during the 2009 inventory survey; * recorded outside of count period on survey and so not included in analyses of data. The categories under 'Resident' are R, resident; M, migrant; and V, vagrant.

Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Alpine Swift	<i>Tachymarptis melba</i>				V
American Golden Plover	<i>Pluvialis dominica</i>				M
American Kestrel	<i>Falco sparverius</i>				R
American Oystercatcher	<i>Haematopus palliatus</i>				R
American Redstart	<i>Setophaga ruticilla</i>				M
American Wigeon	<i>Anas americana</i>				M
Anhinga	<i>Anhinga anhinga</i>				V
Antillean Crested Hummingbird	<i>Orthorhyncus cristatus</i>				R
Antillean Euphonia	<i>Euphonia musica</i>				R
Audubon's Shearwater	<i>Puffinus lherminieri</i>				R
Baird's Sandpiper	<i>Calidris bairdii</i>				M
Baltimore Oriole	<i>Icterus galbula</i>				V
Bananaquit	<i>Coereba flaveola</i>				R
Bank Swallow	<i>Riparia riparia</i>				M
Bare-eyed Thrush	<i>Turdus nudigenis</i>				R
Barn Swallow	<i>Hirundo rustica</i>				M
Belted Kingfisher	<i>Megasceryle alcyon</i>				R
Black Swift	<i>Cypseloides niger</i>				M
Black-and-white Warbler	<i>Mniotilta varia</i>				M
Black-bellied Plover	<i>Pluvialis squatarola</i>				M
Black-bellied Whistling Duck	<i>Dendrocygna autumnalis</i>				V
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>				R
Black-faced Grassquit	<i>Tiaris bicolor</i>				R
Black-headed Gull	<i>Larus ridibundus</i>				V
Black-legged Kittiwake	<i>Rissa tridactyla</i>				M

Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Black-necked Stilt	<i>Himantopus mexicanus</i>				M
Blackpoll Warbler	<i>Dendroica striata</i>				M
Black-whiskered Vireo	<i>Vireo altiloquus</i>				R
Blue-winged Teal	<i>Anas discors</i>				M
Bobolink	<i>Dolichonyx oryzivorus</i>				M
Bridled Quail-dove	<i>Geotrygon mystacea</i>	■			R
Bridled Tern	<i>Onychoprion anaethetus</i>				M
Broad-winged Hawk	<i>Buteo platypterus</i>				R
Brown Booby	<i>Sula leucogaster</i>				R
Brown Noddy	<i>Anous stolidus</i>				R
Brown Pelican	<i>Pelecanus occidentalis</i>				R
Brown Trembler	<i>Cinclocerthia ruficauda</i>				V
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>				M
Canada Warbler	<i>Wilsonia canadensis</i>				V
Cape May Warbler	<i>Dendroica tigrina</i>				M
Caribbean coot	<i>Fulica caribaea</i>				M
Carib Grackle	<i>Quiscalus lugubris</i>			■	R
Caribbean Elaenia	<i>Elaenia martinica</i>				R
Caribbean Martin	<i>Progne dominicensis</i>				R
Caribbean Flamingo	<i>Phoenicopterus ruber</i>				V
Caspian Tern	<i>Hydroprogne caspia</i>				V
Cattle Egret	<i>Bubulcus ibis</i>				R
Cave Swallow	<i>Petrochelidon fulva</i>				V
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>				M
Collared Plover	<i>Charadrius collaris</i>				V
Common Black-Hawk	<i>Buteogallus anthracinus</i>				V
Common Ground-dove	<i>Columbina passerina</i>				R
Common Moorhen	<i>Gallinula chloropus</i>				R
Common Nighthawk	<i>Chordeiles minor</i>				R
Common Tern	<i>Sterna hirundo hirundo</i>				M
Eared Dove	<i>Zenaida auriculata</i>				R

Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>				R
Forest Thrush	<i>Cichlherminia lherminieri</i>	■		■	R
Fork-tailed Flycatcher	<i>Tyrannus savana</i>				V
Fulvous Whistling-Duck	<i>Dendrocygna bicolor</i>				V
Gadwall	<i>Anas strepera</i>				V
Glossy Ibis	<i>Plegadis falcinellus</i>				V
Grassland Yellow-Finch	<i>Sicalis luteola</i>				R
Great Blue Heron	<i>Ardea herodias</i>	■			M
Great Egret	<i>Casmerodius albus</i>				R
Great Egret	<i>Ardea alba egretta</i>				M
Greater Shearwater	<i>Puffinus gravis</i>				M
Greater Yellowlegs	<i>Tringa melanoleuca</i>				M
Green Heron	<i>Butorides virescens</i>				R
Green-throated Carib	<i>Eulampis holosericeus</i>				R
Green-winged Teal	<i>Anas carolinensis</i>				V
Grey Kingbird	<i>Tyrannus dominicensis</i>				R
Grey Tumbler	<i>Cinclocerthia gutturalis</i>	■		■	R
Gull-billed Tern	<i>Gelochelidon nilotica</i>				M
Hudsonian Godwit	<i>Limosa haemastica</i>				M
Killdeer	<i>Charadrius vociferous</i>				M
Laughing Gull	<i>Larus atricilla</i>				M
Least Sandpiper	<i>Calidris minutilla</i>				M
Least Tern	<i>Sternula antillarum</i>				M
Lesser Antillean Saltator	<i>Saltator albicollis</i>	■			R
Lesser Antillean Bullfinch	<i>Loxigilla noctis</i>			■	R
Lesser Antillean Flycatcher	<i>Myiarchus oberi</i>	■		■	R
Lesser Antillean Swift	<i>Chaetura martinica</i>				R
Lesser Scaup	<i>Aythya affinis</i>				M
Lesser Yellowlegs	<i>Tringa flavipes</i>				M
Little Blue Heron	<i>Egretta caerulea</i>				R
Little Egret	<i>Egretta garzetta</i>				M

Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Louisiana Waterthrush	<i>Seiurus motacilla</i>				V
Magnificent Frigatebird	<i>Fregata magnificens</i>				R
Mangrove Cuckoo	<i>Coccyzus minor</i>				R
Masked Booby	<i>Sula dactylatra</i>				R
Masked Duck	<i>Nomonyx dominicus</i>				R
Merlin	<i>Falco columbarius</i>				M
Northern Harrier	<i>Circus cyaneus</i>				V
Northern Parula	<i>Parula americana</i>				M
Northern Pintail	<i>Anas acuta</i>				M
Northern Shoveler	<i>Anas clypeata</i>				M
Northern Waterthrush	<i>Seiurus noveboracensis</i>				M
Osprey	<i>Pandion haliaetus</i>				R
Osprey *	<i>Pandion haliaetus</i>				M
Ovenbird	<i>Seiurus aurocapilla</i>				M
Palm Warbler	<i>Dendroica palmarum</i>				V
Pearly-eyed Thrasher	<i>Margarops fuscatus</i>			■	R
Pectoral Sandpiper	<i>Calidris melanotos</i>				M
Peregrine Falcon	<i>Falco peregrinus</i>				M
Pied-billed Grebe	<i>Podilymbus podiceps</i>				M
Pomarine Jaeger	<i>Stercorarius pomarinus</i>				V
Prothonotary Warbler	<i>Protonotaria citrea</i>				M
Purple Gallinule	<i>Porphyrio martinica</i>				R
Purple-throated Carib	<i>Eulampis jugularis</i>				R
Red Knot	<i>Calidris canutus</i>				V
Red-billed Tropicbird	<i>Phaethon aethereus</i>				R
Red-eyed Vireo	<i>Vireo olivaceus</i>				V
Red-footed Booby	<i>Sula sula</i>				R
Red-tailed Hawk	<i>Buteo jamaicensis</i>				V
Ring-billed Gull	<i>Larus delawarensis</i>				R
Ring-necked Duck	<i>Aythya collaris</i>				V
Rock Pigeon	<i>Columba livia</i>				R

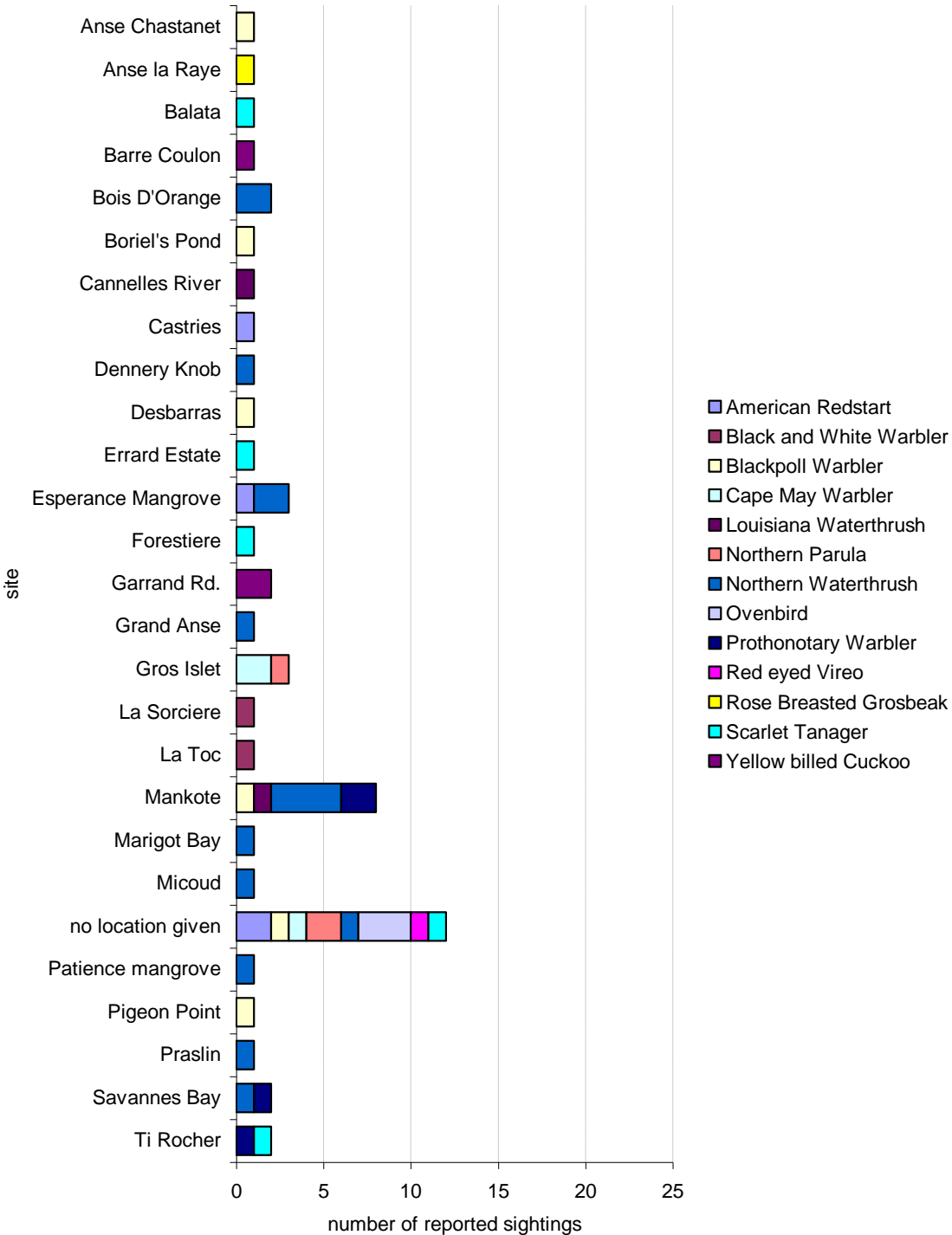
Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Roseate Spoonbill	<i>Platalea ajaja</i>				V
Roseate Tern	<i>Sterna dougallii dougallii</i>				M
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>				V
Royal Tern	<i>Thalasseus maximus</i>				M
Ruddy Duck	<i>Oxyura jamaicensis</i>				V
Ruddy Quail-dove	<i>Geotrygon montana</i>				R
Ruddy Turnstone	<i>Arenaria interpres</i>				M
Ruff	<i>Philomachus pugnax</i>				V
Rufous Nightjar	<i>Caprimulgus rufus</i>	■		■	R
Rufous-throated Solitaire	<i>Myadestes genibarbis</i>	■		■	R
Sanderling	<i>Calidris alba</i>				M
Sandwich Tern	<i>Thalasseus sandvicensis</i>				M
Scaly-breasted Thrasher	<i>Margarops fuscus</i>			■	R
Scaly-naped Pigeon	<i>Patagioenas squamosa</i>				R
Scarlet Tanager	<i>Piranga olivacea</i>				V
Semipalmated Plover	<i>Charadrius semipalmatus</i>				M
Semipalmated Sandpiper	<i>Calidris pusilla</i>				M
Semper's Warbler	<i>Leucopeza semperi</i>		■		R
Shiny Cowbird	<i>Molothrus bonariensis</i>				R
Short-billed Dowitcher	<i>Limnodromus griseus</i>				M
Smooth-billed Ani *	<i>Crotophaga ani</i>				R
Snowy Egret	<i>Egretta thula</i>				R
Solitary Sandpiper	<i>Tringa solitaria</i>				M
Sooty Shearwater	<i>Puffinus griseus</i>				M
Sooty Tern	<i>Sterna fuscata</i>				M
Sora	<i>Porzana carolina</i>				R
Spotted Sandpiper	<i>Actitis macularius</i>				M
Saint Lucia Amazon	<i>Amazona versicolor</i>	■	■		R
Saint Lucia Black Finch	<i>Melanospiza richardsoni</i>	■	■		R
Saint Lucia Oriole	<i>Icterus laudabilis</i>	■	■		R
Saint Lucia (Lesser Antillean) Pewee	<i>Contopus latirostris</i>	■		■	R

Common name	Latin name	Priority	Endemic species	Endemic subspecies	Resident
Saint Lucia Warbler	<i>Dendroica delicata</i>	■	■		R
Saint Lucia (House) Wren	<i>Troglodytes aedon</i>	■		■	R
Stilt Sandpiper	<i>Calidris himantopus</i>				M
Tricoloured Heron	<i>Egretta tricolor</i>				R
Tropical Mockingbird	<i>Mimus gilvus</i>				R
Western Reef-Heron	<i>Egretta gularis</i>				V
Western Sandpiper	<i>Calidris mauri</i>				M
Whimbrel	<i>Numenius phaeopus</i>				M
White-breasted Thrasher	<i>Ramphocinclus brachyurus</i>	■		■	R
White-crowned Pigeon	<i>Patagioenas leucocephala</i>				V
White-rumped Sandpiper	<i>Calidris fuscicollis</i>				M
White-tailed Tropicbird	<i>Phaethon lepturus</i>				R
Willet	<i>Tringa semipalmata</i>				M
Wilson's Snipe	<i>Gallinago delicata</i>				V
Yellow Warbler	<i>Dendroica petechia</i>			■	R
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>				M
Yellow-crowned Night Heron	<i>Nyctanassa violace</i>				R
Yellow-rumped Warbler (Myrtle)	<i>Dendroica coronata</i>				M
Yellow-throated Vireo	<i>Vireo flavifrons</i>				M
Zenaida Dove	<i>Zenaida aurita</i>				R

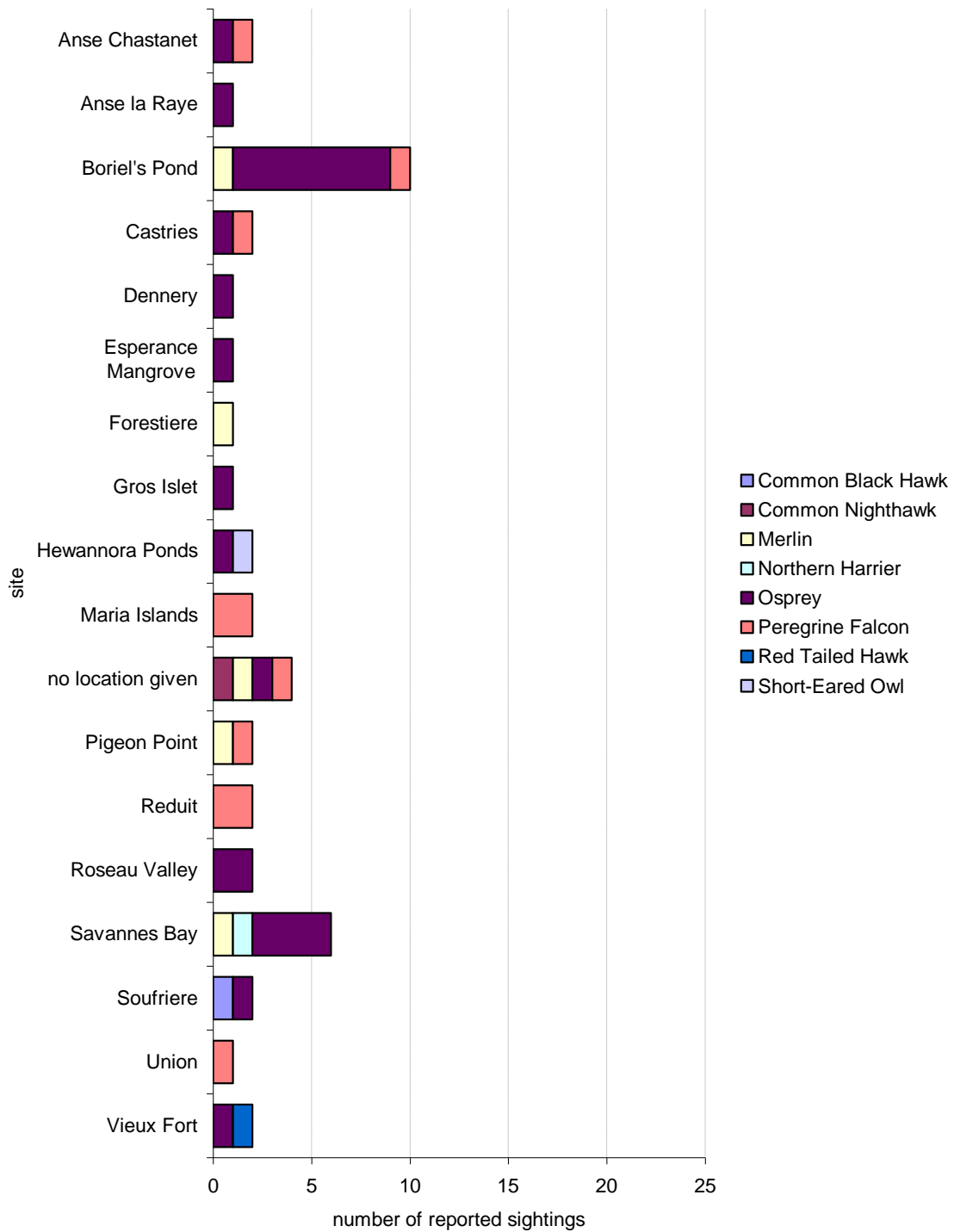
Annex II Migrant bird species reports from Saint Lucia for the period 1990-2004

Data from John (2004).

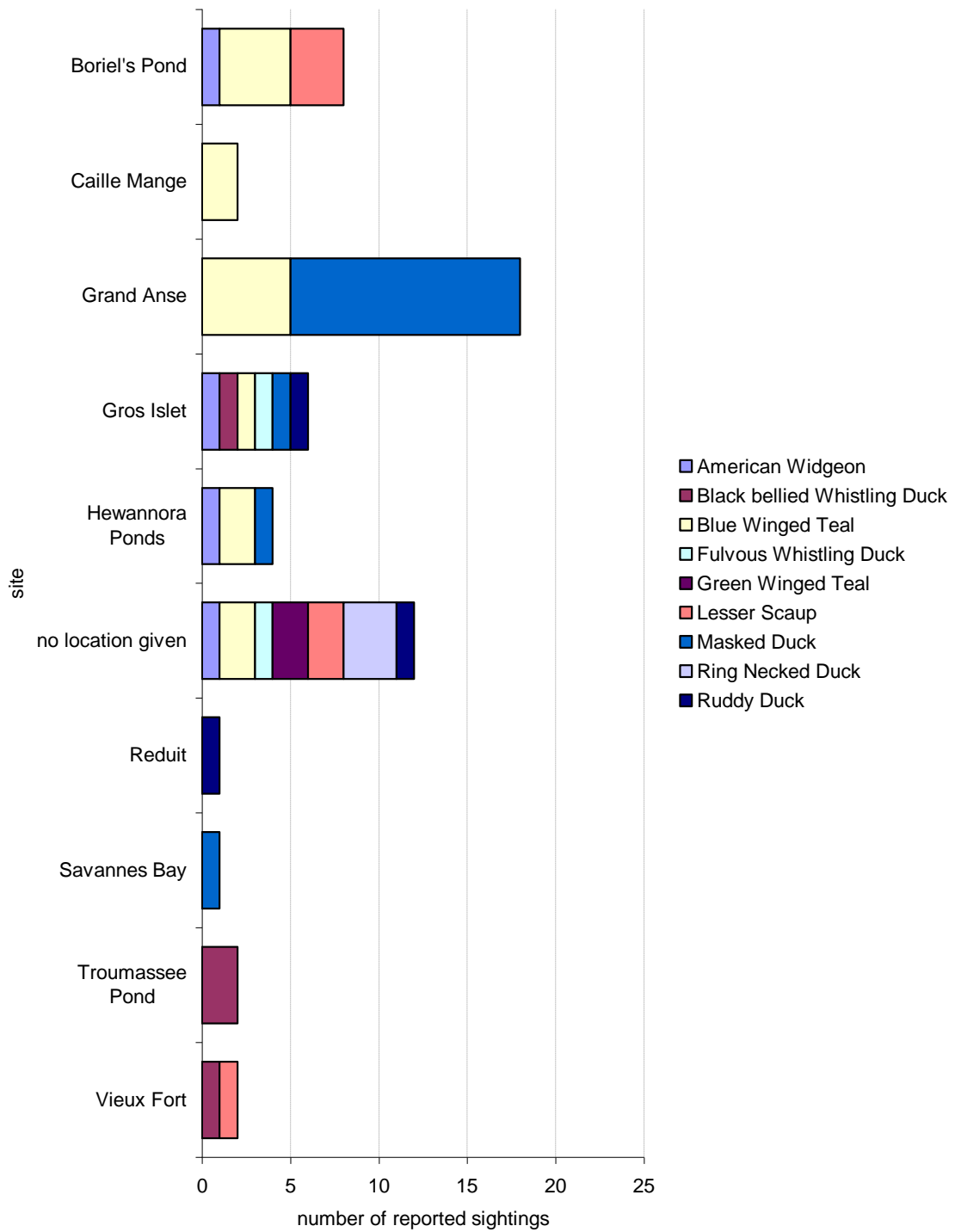
1.1 Songbirds



1.2 Hawks, Owls & Falcons

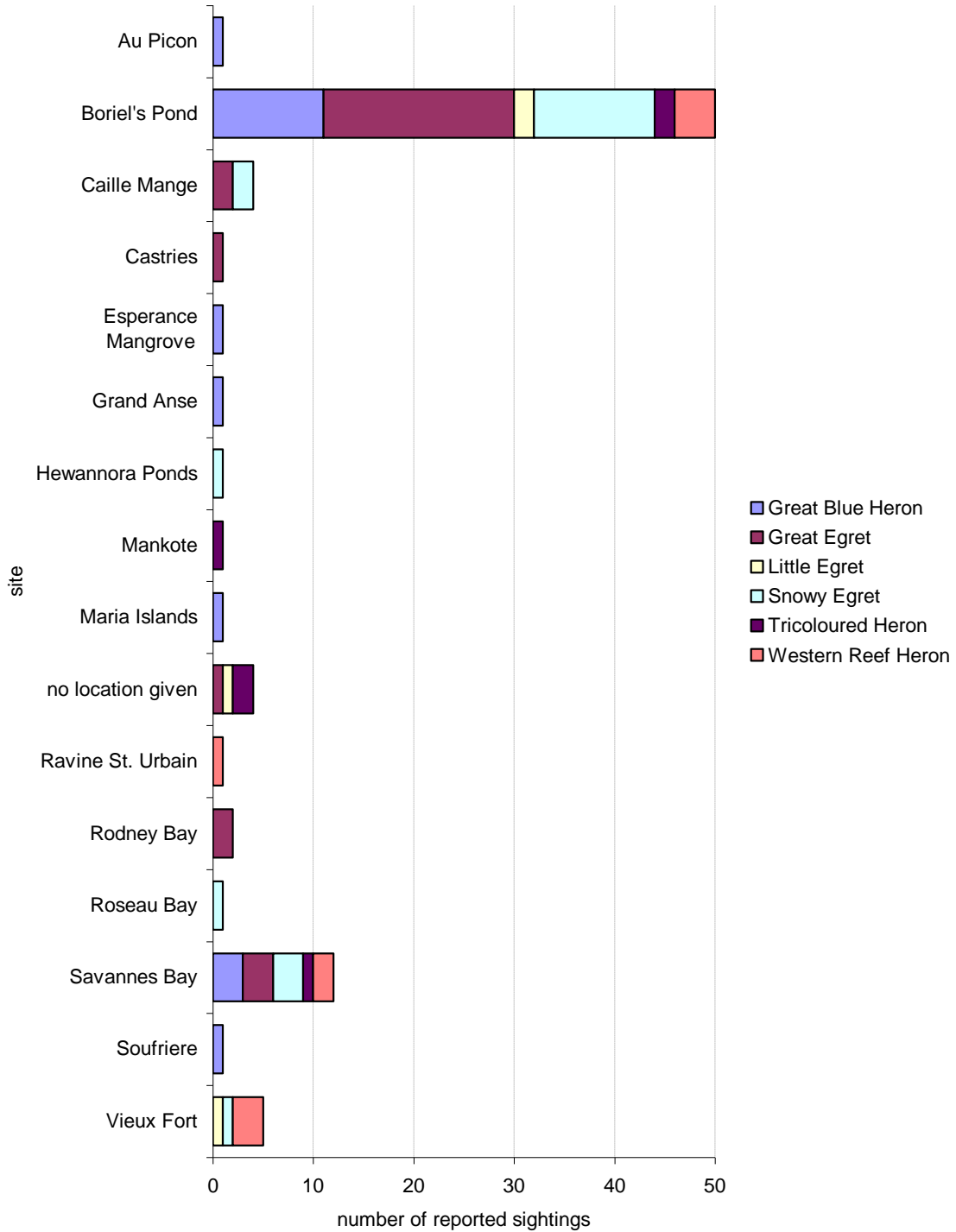


1.3 Ducks



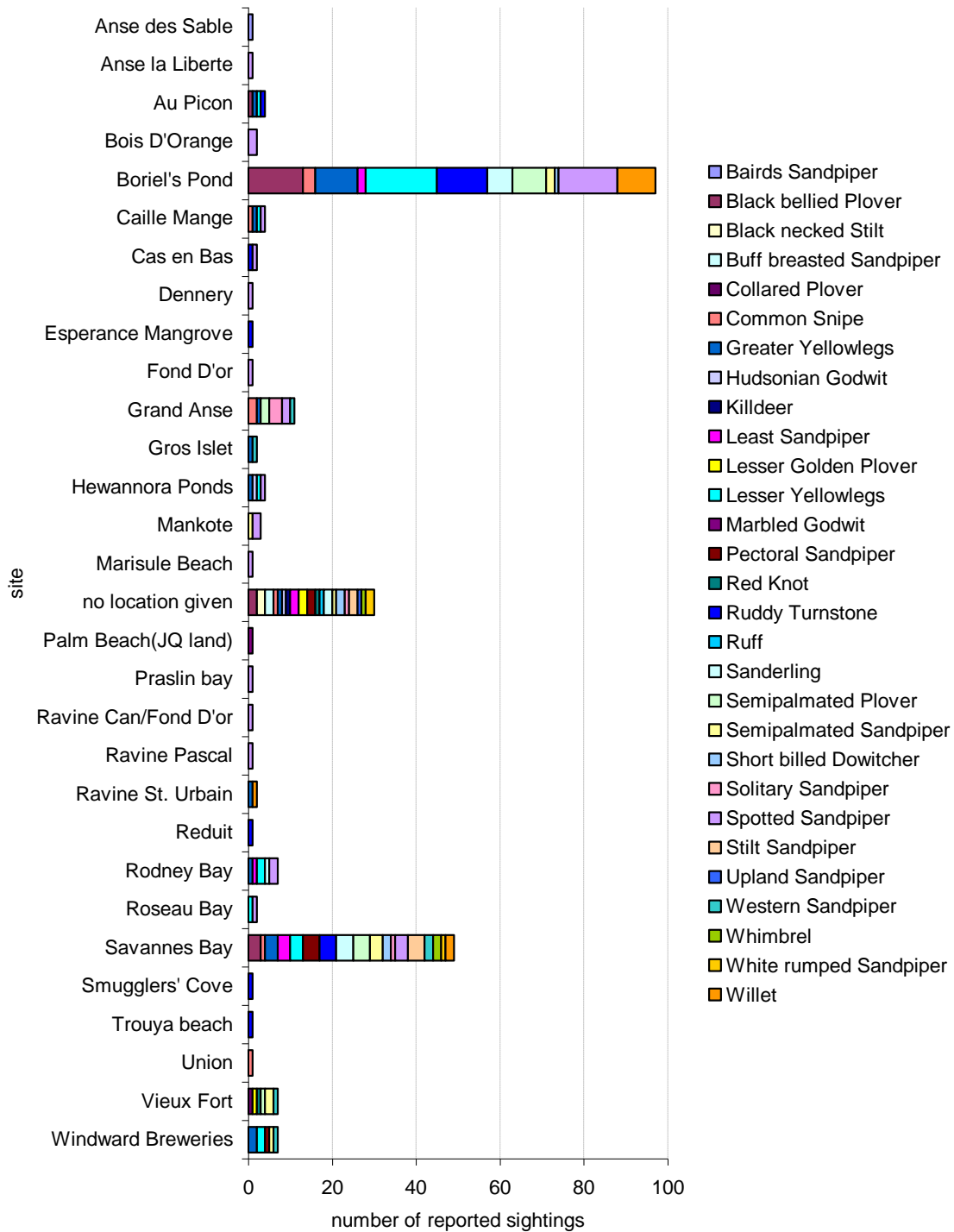
1.4 Herons & Egrets

NOTE: the scale on the x-axis (number of sighting dates) for Herons & Egrets is larger than all the other bird groups except Sandpipers & Plovers to accommodate the large numbers of sightings and species in these two groups at Boriel's Pond.

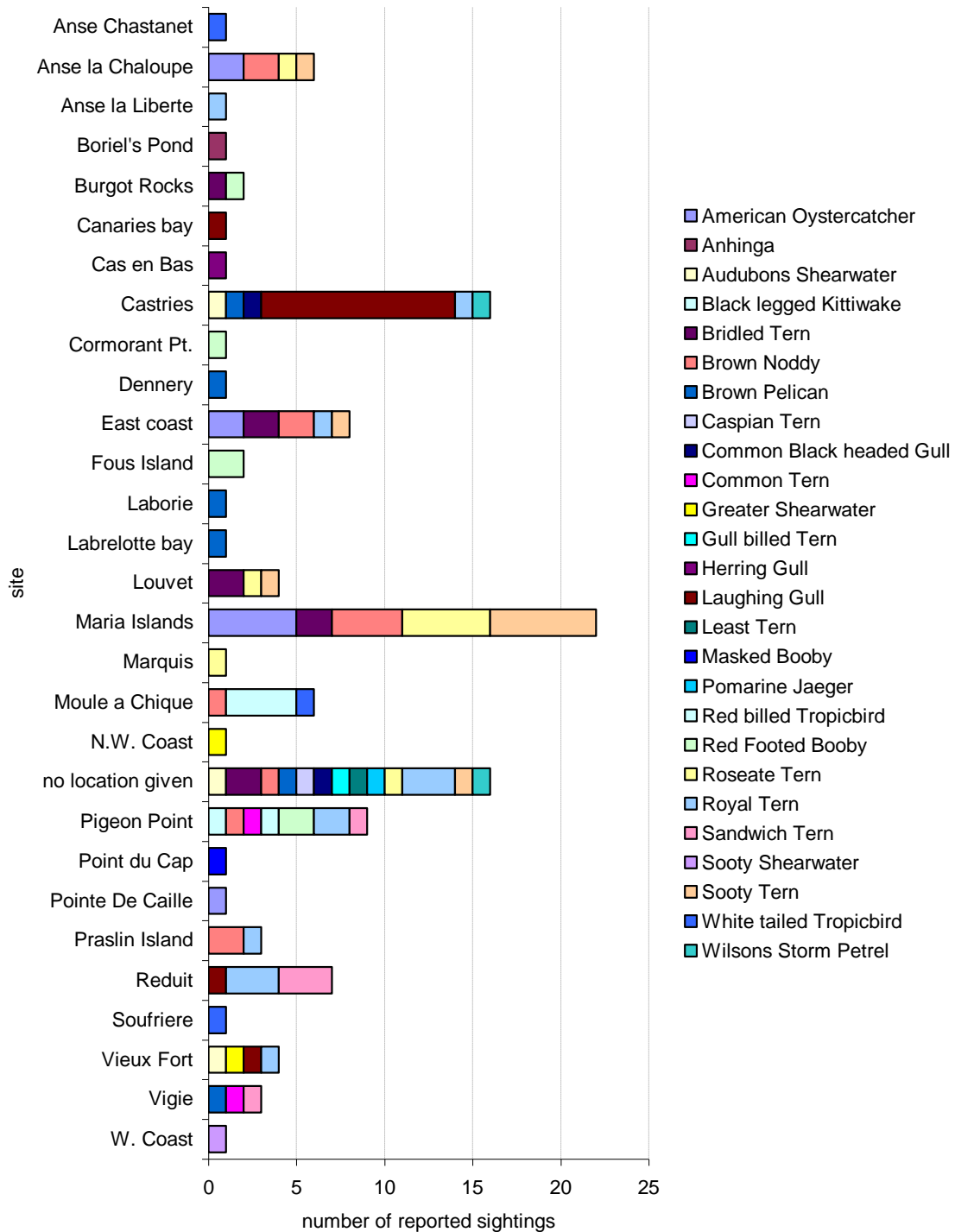


1.5 Sandpipers & Plovers

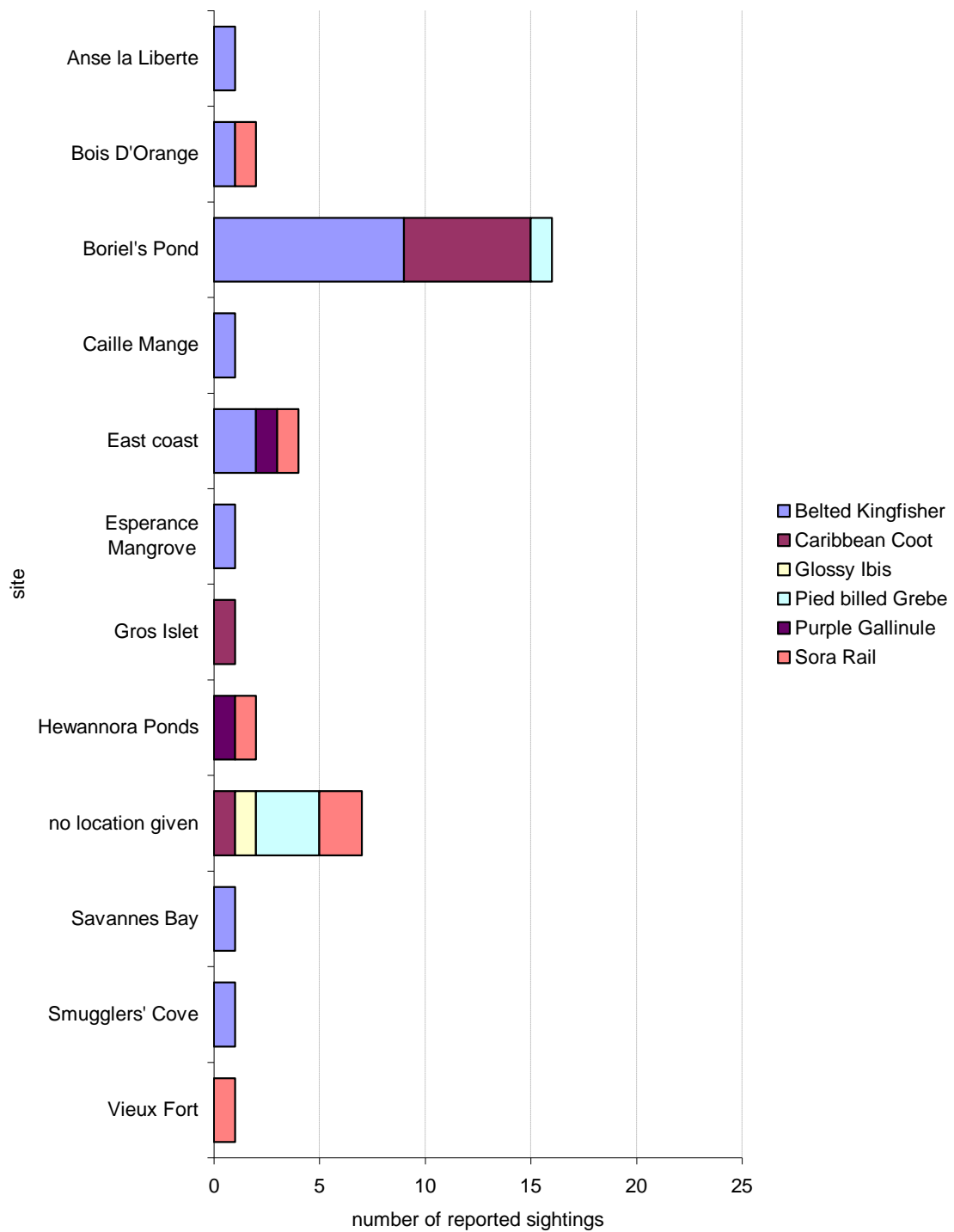
NOTE: the x-axis (number of sighting dates) for Sandpipers & Plovers is larger than all the other bird groups to accommodate the large numbers of sightings and species in these two groups at Boriel's Pond.



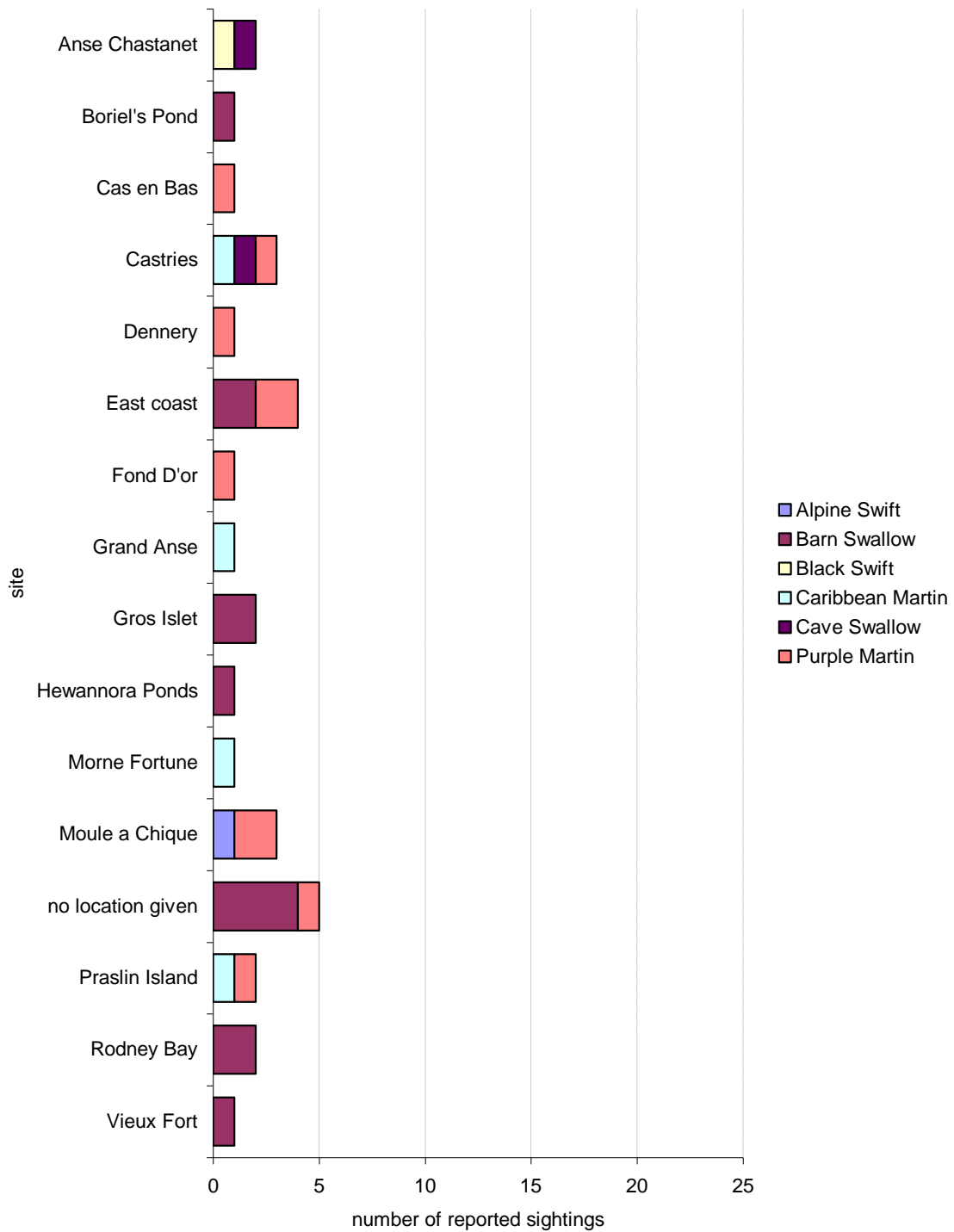
1.6 Seagulls, Terns & Other Seabirds



1.7 Coots, Rails and other Waterfowl



1.8 Swifts & Swallows



Annex III Target bird species data from 2007 Iyanola occupancy pilot study

Thirty one target species (see Table 11) of bird were selected based on endemism and global threat status (IUCN Red List category and/or BirdLife International Important Bird Area criteria). 20 sites were allocated systematically (functionally random), stratified into ravine areas (50m either side of streams) and non-ravine areas (>50m from streams) within a study area comprising the Northeast coast estates of Louvet, Grand Anse and Marquis. Each site was then surveyed 6-10 times during the second half of 2009. Morton (2007b) provides more details of the methodology.

Twenty of the 31 species were detected during this survey (see Table 1).

Table 11: Target bird species, 2007 occupancy survey.

Only species shown in bold type were detected during the survey

Antillean euphonia	Laughing gull	Sooty tern
Black-crowned night heron	Lesser Antillean bullfinch	Saint Lucia black finch
Bridled quail dove	Lesser Antillean flycatcher	Saint Lucia oriole
Bridled tern	Lesser Antillean saltator	Saint Lucia pewee
Brown noddy	Little blue heron	Saint Lucia warbler
Caribbean coot	Masked duck	Saint Lucia wren
Crested hummingbird	Pied bill grebe	Tricoloured heron
Forest thrush	Purple-throated carib	White-breasted thrasher
Great blue heron	Red-billed tropic bird	Yellow-crowned night heron
Green-throated carib	Roseate tern	
Grey trembler	Scaly-breasted thrasher	

Summary results for these 20 species are shown on the next three pages. Sizes of filled circles give an indication of detectability of different species: bigger circles show species that were detected (seen or heard) on a larger proportion of surveys (visits); smaller circles show species detected only on a smaller proportion of surveys: these latter species are more likely to be missed by surveyors if only a single survey was made of the site¹. These findings are relevant to the interpretation of surveys based on only single site visits. Note, however, that these surveys were carried out at different times of day to the inventory survey counts (08:30 to 16:30).

¹ There is a more formal method of estimating detectability, 'occupancy estimation' – and of modelling it against ('explaining it by') site and survey characteristics (covariates) – but that is beyond the scope of this document. The size of circles on the following maps gives an idea of detectability.

Fig. Number and location of sites (circles) surveyed.

Open circles: species never found during surveys of this plot; closed circles: species found, size of closed circle indicates proportion of surveys on which species was found

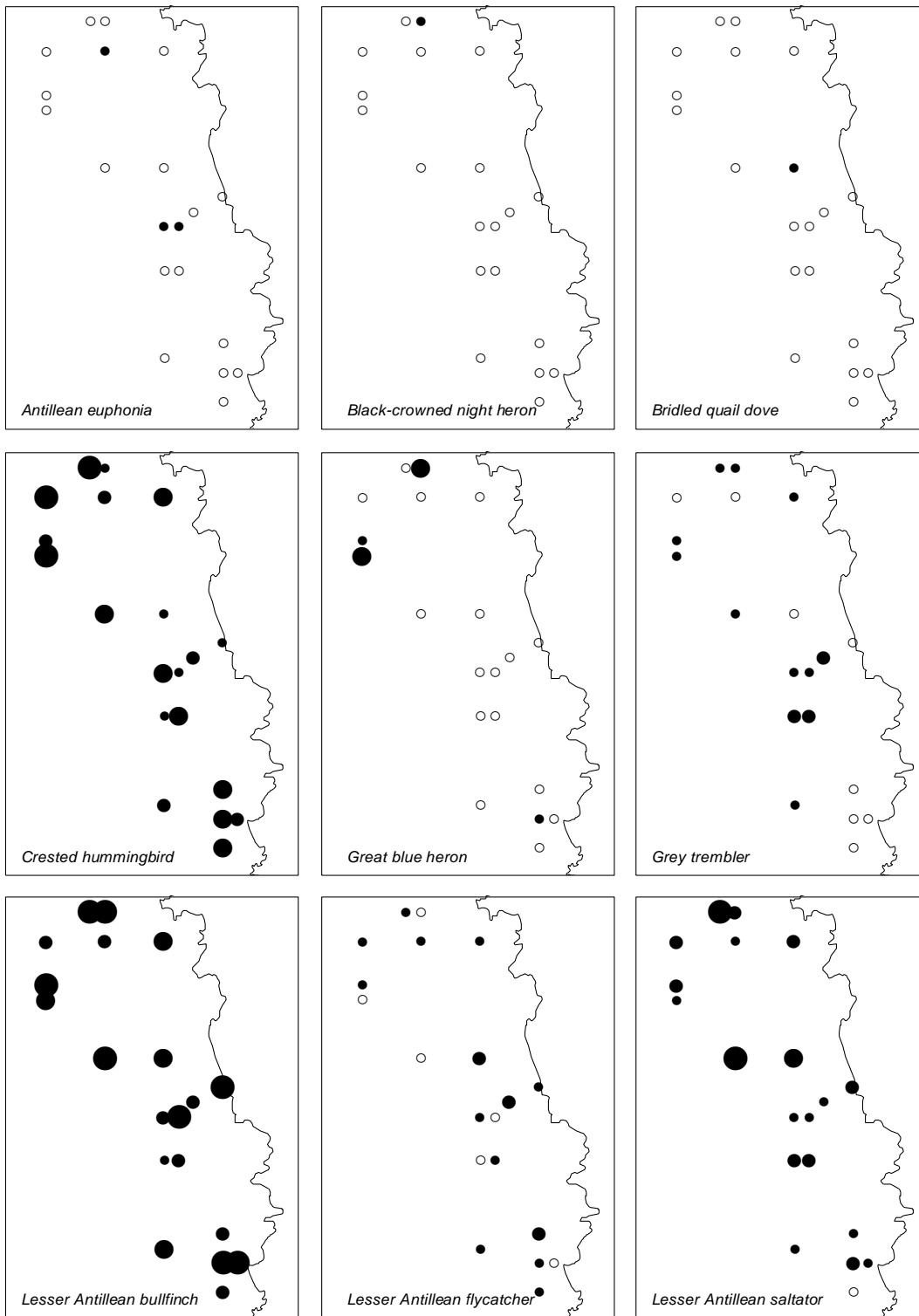


Fig. Number and location of sites (circles) surveyed. *Continued.*

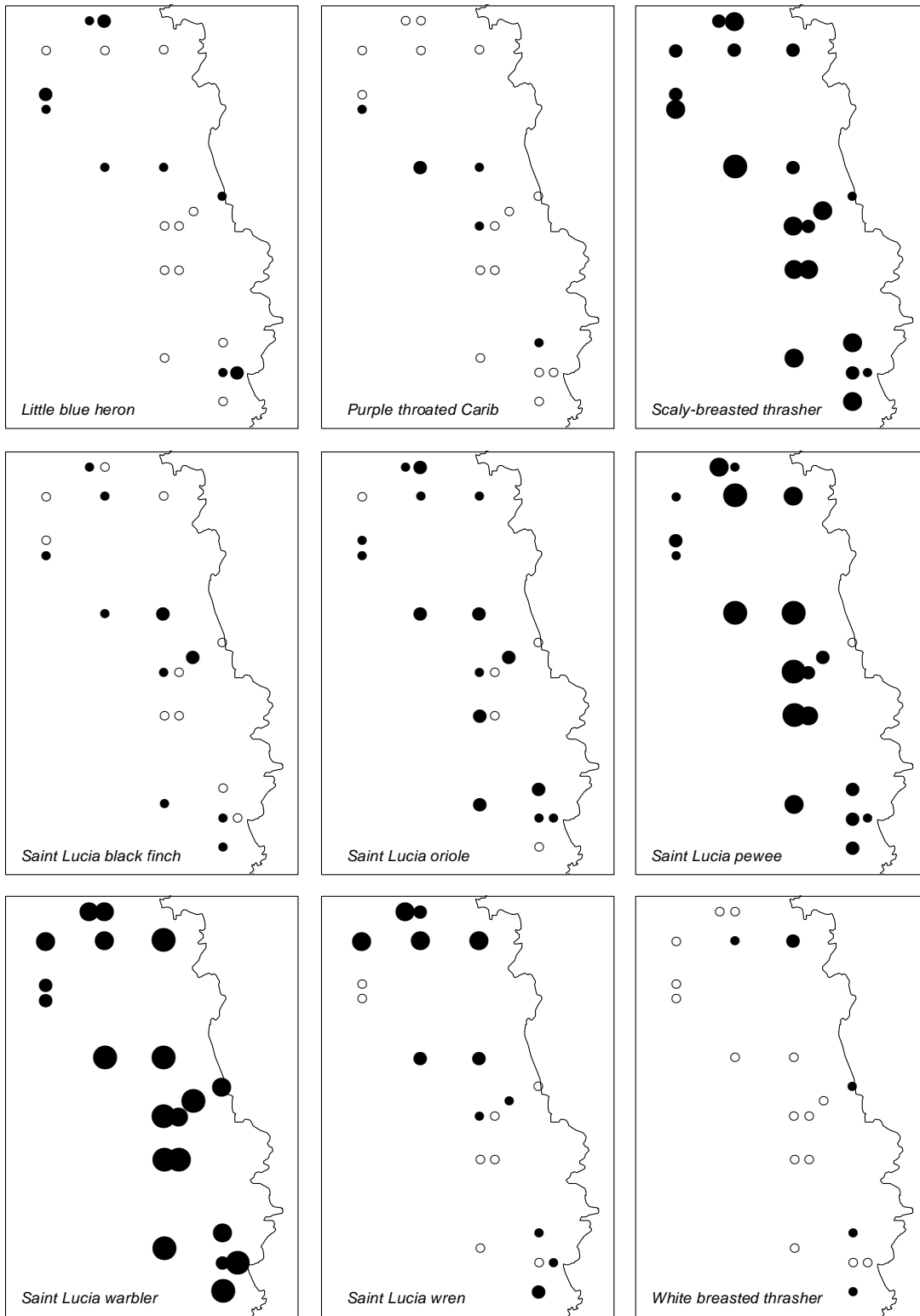
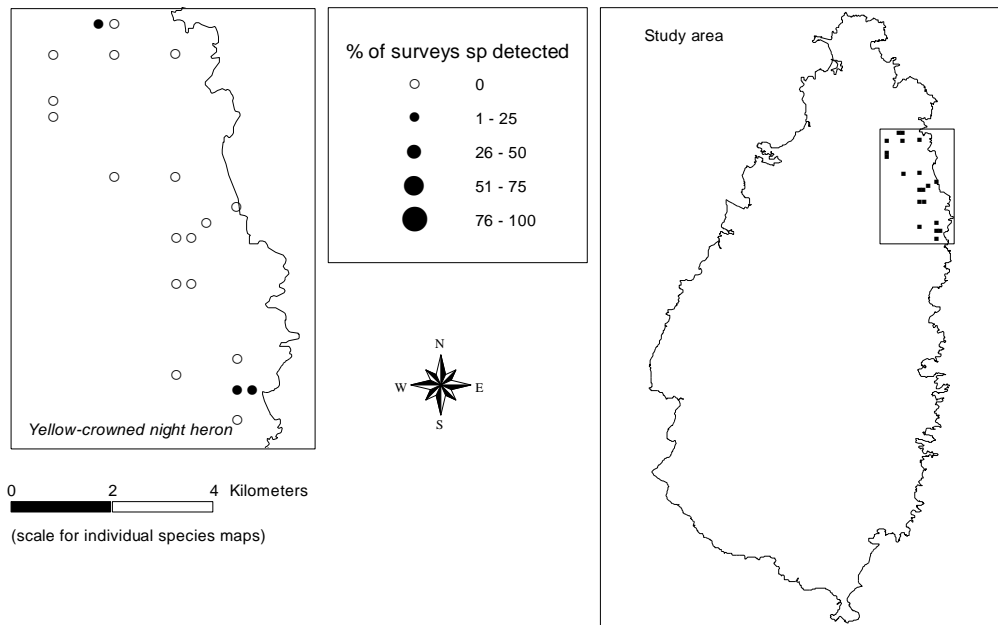


Fig. Number and location of sites (circles) surveyed. *Continued.*



Annex IV Decision Matrix for Species Recovery Planning

After Appleton & Daltry (in prep.).

Current Situation		Recovery Management Actions																
		← Mostly In Situ								→ Mostly Ex Situ								
		Baseline field surveys to identify cause(s)	Monitoring of wild population	Monitoring of known and or probable threats in the area	Targeted protection and enforcement	Habitat improvement or expansion	Artificial habitat enhancement/ supplementary feeding	Alien invasive / feral species control	Control other native species.	Horticultural/ veterinary care to treat disease or injuries	Population re-inforcement or Translocation	Re-introduction	Awareness and education to improve human behaviour	Head-starting	Fostering (for species that lay multiple clutches of eggs)	Captive breeding/ propagation	Seed banks and cryopreservation	Benign Introduction (outside natural range)
Status critical, but cause uncertain	Population locally extinct	●	n/a	○	n/a	•	•	•	•	n/a	n/a	●	○	n/a	n/a	○	•	○
	Population shows: <i>Severely reduced population size</i>	●	●	○	○	•	•	•	•	•	○	n/a	•	•	•	•	•	n/a
	<i>Slow rate of reproduction or regeneration</i>	●	●	○	○	•	•	•	•	•	○	n/a	•	•	●	•	•	n/a
	<i>High juvenile mortality</i> <i>Severely reduced genetic variation or gene flow between groups</i>	●	●	○	•	•	•	•	•	•	○	n/a	•	●	○	•	•	n/a
Threat(s) is known	'Habitat loss' (reduced area, fragmented area, degraded quality)	•	●	●	○	●	○	•	•	•	•	Identify and remove threats before re-introduction	○	•	•	•	•	Avoid introduction into areas with these threats
	Competition/ predation/ hybridization with alien species	•	●	●	•	•	•	●	•	•	•		○	•	•	○	•	
	Competition, predation, hybridization with feral or domestic animals or plants	•	●	●	●	•	•	●	•	•	•		●	•	•	○	•	
	Abnormal imbalance with other native species	•	●	●	•	•	•	○	○	•	•		•	•	•	○	•	
	Pathogenic disease (native)	•	●	●	•	•	•	•	○	●	•		•	•	•	○	•	
	Pathogenic disease (introduced)	•	●	●	•	•	•	●	•	●	•		•	•	•	○	•	
	Intentional killing/ collection by humans	•	●	●	●	•	•	•	•	•	•		●	•	•	○	•	
	Unintentional killing/ collection by humans	•	●	●	○	•	•	•	•	•	•		●	•	•	○	•	
	Direct contamination from pollutants	•	●	●	●	○	•	•	•	•	•		●	•	•	○	•	
	Inbreeding depression (small population size)	•	●	•	•	•	•	•	•	•	●		•	•	○	○	•	

● Probably essential; ○ Probably useful; • May be useful; n/a Not applicable or appropriate.