Literature review

Excelent pisiological introduction in Hart, Downs, and Brown (2016b)

Population

- Around 1800 nesting pairs for PR and 2000 pairs for PL (Diamond 1971)
- I forgot to check population sizes in other places :/, depending on the focus might need to check again

Diet

- PR 50-65% flying fish 50-35% cephalopods (Fleet 1974) Flying Fish, Sardines, King Garfish, Garfish, and Scaly Mackerel
- PR diet changes seasonally and is tunned to use large dolphinfish abbundand in warmer months (Le Corre et al. 2003). they rely on predictable food sources. Maybe PL doesn't…
- However PR well adapted to changing conditions, no changes on multiple ENSOS in Christmass island (Schreiber 1994)
- Little change between the diet of PR during egg incubation and chick rearing (Christmass island) (Navarro et al. 2014)
- PL is pelagic (Bailey 1968) and solitary feeder (Feare 1981)
- The relatively long incubation times of PL and PR might be related to the difficulties of securing food in tropical offshore habitats and potentially the relative absense of predators (until recently) (Whittow 1980)
- In aldabra both species feed on flying fish Exocotiedae and squid. Lepturus more squid and smaller fish and PR very large fish and pelagic octopods (Diamond 1971)
- PL favours clear water for feeding (Haney and Stone 1988), no idea about PR but if that's the case that might be a reason for a difference.
- PL travels around 25 km of its nest to look for food while feeding the chick (Pennycuick et al. 1990)
- Dunlop, Surman, and Wooller (2001) suggests that PL might be less dependent on seasonal food sources because of the pelagic diet to explain differences in seasonality.
- PL RAMOS and PACHECO (2003) highligts the importance of food provisioning for determining the success fledging of the chick - unsuccessful are fed less often and smaller meals
- PL Adults optimise foraging to met the calorific needs of their chicks, smaller more frequent meals when small, larger less frequent meals when larger (RAMOS and PACHECO 2003)
- PL is kinda of an oportunistic feeder and has little overlap with other sea birds, and a large diversity on prey (Catry et al. 2009)
- Diet composition of PL was very similar during both moonsoons in Seychelles (Catry et al. 2009)
- Little effect of environmental variables in PL diet composition (Catry et al. 2013)

Nests

- Incubation temperature seems to be between 27-32°C for PL (Hart, Downs, and Brown 2016b), presumably similar for PR
- Sheltered nests have more stable ambient temperatyres (Hart, Downs, and Brown 2016b) and site selection offsets difficulties imposed by the weather
- Best sites are usually used by individuals in better condition and these factors cann act concurently (Kim and Monaghan, 2005; Fast et al., 2007).
- Favourable microclimates are increasingly valuable in light of global change, particularly where species are incubating at its threshold (Hart, Downs, and Brown 2016b)
- PL uses their feet to warm up the egg (Hart, Downs, and Brown 2016a)
- West islets known to be a nesting since a long time ago (Benson 1967)
- "Most islets are of type 3, composed of relatively thick champignon, occasionally with a flatter platin-like surface; the islets along the north coast of South Island tend to rise rather higher above h.w.s. than those along the Middle Island shore and are separated as type 3 b. Type 4 islets have a basal layer of champignon capped with remnants of an upper layer of poorly consolidated limestone composed largely of coral debris; the islets south of Passe Gionnet are composed entirely of this latter rock type, frequently capped by solution pans and rising to 1.5 or 1.8 m above h.w.s. (type 5). Some islets of each of the three major types (3 to 5) were visited at approximately monthly intervals to follow the progress of marked tropic bird nest-sites. Type 5 islets were found to be favoured by rubricauda, types 3 and 4 by lepturus; on type 4 the junction between the two rock types is frequently undercut and was a favourite nest site for lepturus." (Diamond 1971)
- PR places the nest under protective vegetation (Fleet 1972; Morrell et al. 2000)
- PR prefers nest sites had high periferal cover when compared to random sites (Clark et al. 1983), periferal cover sites offers shade which is important because of the thermal sensitivity (Howell and Bartholomew 1962).
- In Aldabra RT only nests during the wet season. Presumably because shade is increassed and more OK nesting sites become available (Prys-Jones and Peet 1980). Shade reaches a minimum towards the end of the dry season (Prys-Jones and Peet 1980)
- The availability of nests sites might be an important factor limiting the number of breeding pairs (Clark, Schreiber, and Schreiber 1990)
- Proximity of nests might be due to coloniality (Clark, Schreiber, and Schreiber 1990)
- Little overlap (~6%) in nest sites by both species (Prys-Jones and Peet 1980)
- PL nests shaded in rock cavities (Burger and Cochfeld 1991) (in Maurious), same in Cousin, shaded caves or rock crevices, and ocassionally on the ground or tree holes (Phillips 1987)
- PL nested in rock crevices protected from wind and sunshine (Schaffner 1991)
- PL nests in open caves and burrows in cliffs or on limestone grounds (Brazil), that are more exposed than most other colonies, that might explain low breeding success (Leal et al. 2016)

Seasonality

- PR nesting is seasonal: Egg laying peak April-June nort, June -equator and Aug-Oct in southern (Fleet 1974) (not really)
- PR in Europe same as in Aldabra if anything a bit earlier, incubation in December to January, chick rearing from february to march-june (Corre 2001)
- PL not seasonal in Europe, Madagascar (Corre 2001)
- PR seasonality might be related to food abundance but climate might be significant too
- PR Autum in Christmass island (Schreiber and Asmole 1970)
- PL nesting not seasonal: eggs layed every 5-10 months suggested to be because of nest site competition (Stonehouse 1962)
- PL nesting not seasonal [Phillips (1987); Diamond (1975); Prys-Jones and Peet (1980); Dunlop2001a]
- In tropical populations it might be related to limitations of habitat (as in Aldabra) or food () or even other pressures (Prys-Jones and Peet 1980). PL doesn't have any habitat limitation and hence breeds all year round [Prys-Jones and Peet (1980); Diamond1975]
- SST and Chlol- during an el niño affected breeding success and timing in Red billed tropicbirds in Baja California (Castillo-Guerrero, Guevara-Medina, and Mellink 2011)

Climate

- PR climate could affect the onset of the egg laying (Fleet 1972)
- Climate has been hypothesised to affect range expansions and modify nesting season in PR (Dunlop and Wooller 1986)

Success

The more esporadic the visits the higher the observed success rate

"Previous studies indicate that breeding success of colonial seabirds is mainly influenced by climatic variations (Ancona et al., 2011), food availability (Hamer et al., 1993; Dearborn et al., 2001), introduction of exotic species (Russel and Le Corre, 2009) and intra/interspecific competition (Coulson, 2001; Dobson and Madeiros, 2010). In cavity-nesting seabirds, cavity orientation can ameliorate micro-climate effects (e.g. Conner, 1975; Stauffer and Best, 1982). For WTTBs, breeding success has been observed to be affected by nest abandonment, intraspecific combats and predation by rats (Rattus rattus (Linnaeus, 1758) (Garnett and Crowley, 2000; Sarmento et al., 2014) and crabs (Gecarcinus spp. and Ocypode spp.) (Schaffner, 1991; Phillips, 1987). In this context, the unusual nest form (recorded previously only in Christmas Island – Stokes 1988) which exposes birds to both predators and adverse weather conditions may be responsible for the low hatching and fledging success observed in this study. Estimated" (Leal et al. 2016)

PR

- Nesting success: 17-38% PR Hawaii (Fleet 1972)
- 46-80% in Western Australia (Tarburton 1977)
- Maximum estimates in 1976 of 45% for PR and 46% PL in Aldabra

- Maximum estimates in 1967-68 of 4.4% for PR, in 1969 of 44.4% PR on monthly visits (Diamond 1975)
- 68 - 85% (1992-1998) in Johnston Atoll (Schreiber, Doherty, and Schenk 2001)
- 76-88% (1991) in Christmass island (Schreiber 1994), 85-82% Johnston atoll 1991 (Schreiber 1994)
- 59±4% (2006-2013) in O'Ahu, Hawaii (Vanderwerf and Young 2014)
- 2-8.5% in Europa (2008-2012) when rats where not controled and 32% when rats were controlled in an islet (Ringler, Russell, and Le Corre 2015)
- 14.3% in Fernando Norohna 2011-2012 (Leal et al. 2016)
- PR nestling mortality is highest when the bird is young for both PR (Fleet 1972) and PL (Stonehouse 1962). Most of the failures caused bt rat 53-65% or abandonement 22-39%. Possibly caused by disturbances, including people (Fleet 1972)
- Overheating might also contrbute to both egg and chick mortality (Howell and Bartholomew 1962)
- 76-88% in 1991-1992 (Schreiber 1994) Including ENSO years

PL

- Success 30% in Ascension Island (Stonehouse 1962). 50% as egg and 17.8% as chicks. Loss at the egg stages mainly due to abandonement disturbance with other birds.
- Success of 36% in Cousin in 1986 (Phillips 1987)
- Success between 21-32% (1990-2002) (Ramos et al. 2005)
- Maximum estimates in 1967-68 of 50% for PL, in 1969 46.1% PL on monthly visits (Diamond 1975)
- Success of 0.2273 ± 0.08081 (1983), 0.1534 ± 0.04604 (1984), 0.2497 ± 0.05369 (1985), and 0.2648 ± 0.05515 (1986) in Puerto Rico (Schaffner 1991)
- Success of 25% (2003-2004) in Cousin Island (Malan, Hagens, and Hagens 2010)
- 6.9% in Europa for non rats controlled habitats (Ringler, Russell, and Le Corre 2015)
- Heavier chicks also are more likely to fledge so an impact of food availability is to be expected (Phillips 1987)
- Acompained chicks are also more likely to successfuly fledge (Phillips 1987)
- Overheating also recorded as a cause for egg and chick mortaility (Phillips 1987), small degree of predation and some because of starvation (Phillips 1987), very unlikely because of competition
- Most chicks die when young (Phillips 1987)
- Starvation plays a role on nestling survival (RAMOS and PACHECO 2003)
- Most deathd caused by starvation (Ramos et al. 2005)
- Survival inversely correlated to ENSO Index (Ramos et al. 2005)

Predation

- PR rat predation starts when plant food is scarce for rats and stops when there is availability (Fleet 1972). Seasonality in PR dictaded by that?
- PL predated by rats, severely in one the islands in Puerto Rico, not in the other (Schaffner 1991)
- PR initiates nesting only after rats were exterminated (Bell 1995)
- PR returned to Kermadec Islands after the erradication of introduced rats (Veitch et al. 2011)
- Nesting pairs and nesting success responded positively to invasive predator erradication in Hawaii (Vanderwerf and Young 2014)
- Very low nest success when rats were present for both PL and PR (Ringler, Russell, and Le Corre 2015)

Check incubation and fledging period change

Possible venues

- With a focus on physiology impacting ecology :Functional Ecology
- With a focus on they rejected us and these journals aren't too bad Oecologia or MEPS

Depending on the results these could also be considered:

- With a focus on this is cool: Biology Letters
- With a management & conservation perspective Ecological Applications or Journal of Applied Ecology

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