Manual for Ageing and Sexing Landbirds of American Samoa, with Notes on Molt and Breeding Seasonality

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INTRODUCTION

Molt strategies and age-determination criteria for tropical Pacific landbirds remain poorly known (Radley et al. 2011, Pyle et al. 2016). Breeding in tropical areas can occur year-round or can respond opportunistically to aseasonal climate patterns, which in turn can result in more-complex molting regimes than are found in temperate species. Such complex and stochastic regimes can include an increased incidence of molt-breeding overlap or suspension of molt for breeding (Radley et al. 2011, Freed and Cann 2012, Johnson et al. 2012, Pyle et al. 2016, Johnson and Wolfe 2017). Increased data on molt and breeding regimes in tropical areas are thus needed to fully understand molting strategies, which in turn are essential for developing criteria to age and sex landbirds in the hand.

The Institute for Bird Populations (IBP) has established the Tropical Monitoring of Avian Productivity and Survivorship (TMAPS) program to monitor population dynamics of birds in tropical regions (DeSante et al. 2005). Similar to the North American MAPS program, TMAPS utilizes data collected on captured landbirds at mist-netting stations to understand demographic parameters useful in implementing habitat conservation and management strategies (DeSante et al. 1995, 2015; Saracco et al. 2012). As part of the TMAPS program, 22 bird-capture stations have been operated in American Samoa during August 2012 to March 2017, 10 stations on the island of Tutuila, six stations on the island of Ta'u, and six stations on the near-connected islands of Ofu and Olosega (Pyle et al. 2017; Fig. 1). Data collected to date have allowed calculation of productivity and survival for up to seven native landbird species and have helped define breeding seasons, molting seasons, and the extent in which these seasons overlap at both the population and the individual levels (Pyle et al. 2016, 2017).

In order to effectively monitor the population dynamics of landbirds captured at TMAPS stations, age and sex of resident species must be determined as accurately as possible. In this manual we provide detailed molt information and criteria for ageing and sexing American Samoan landbirds, developed based on examination of specimens and capture data during 2012-2017. It represents an expansion of the information presented in Pyle et al. (2016) as updated with two additional years of data and the inclusion of 96 figures illustrating molt patterns and different age and sex groups for 16 landbird species (including 12 indigenous, 3 non-native, and one migratory species; Table 1). New information is presented here on molt and age/sex criteria for the Federally Endangered population of Tongan (or Friendly) Ground Dove *Alopecoenas* (formerly *Gallocolumba*) *stairi*, residing on Ofu and Olosega Islands. We present molt and plumage classification according to cycle-based terminology, providing a template for the use of this terminology at capture stations in tropical Pacific regions. The manual is formatted such that it will enable field referencing at the TMAPS stations in American Samoa and, as many of these species and closely related species are found throughout islands of the tropical Pacific basin, we anticipate that it will be useful for future studies beyond American Samoa.

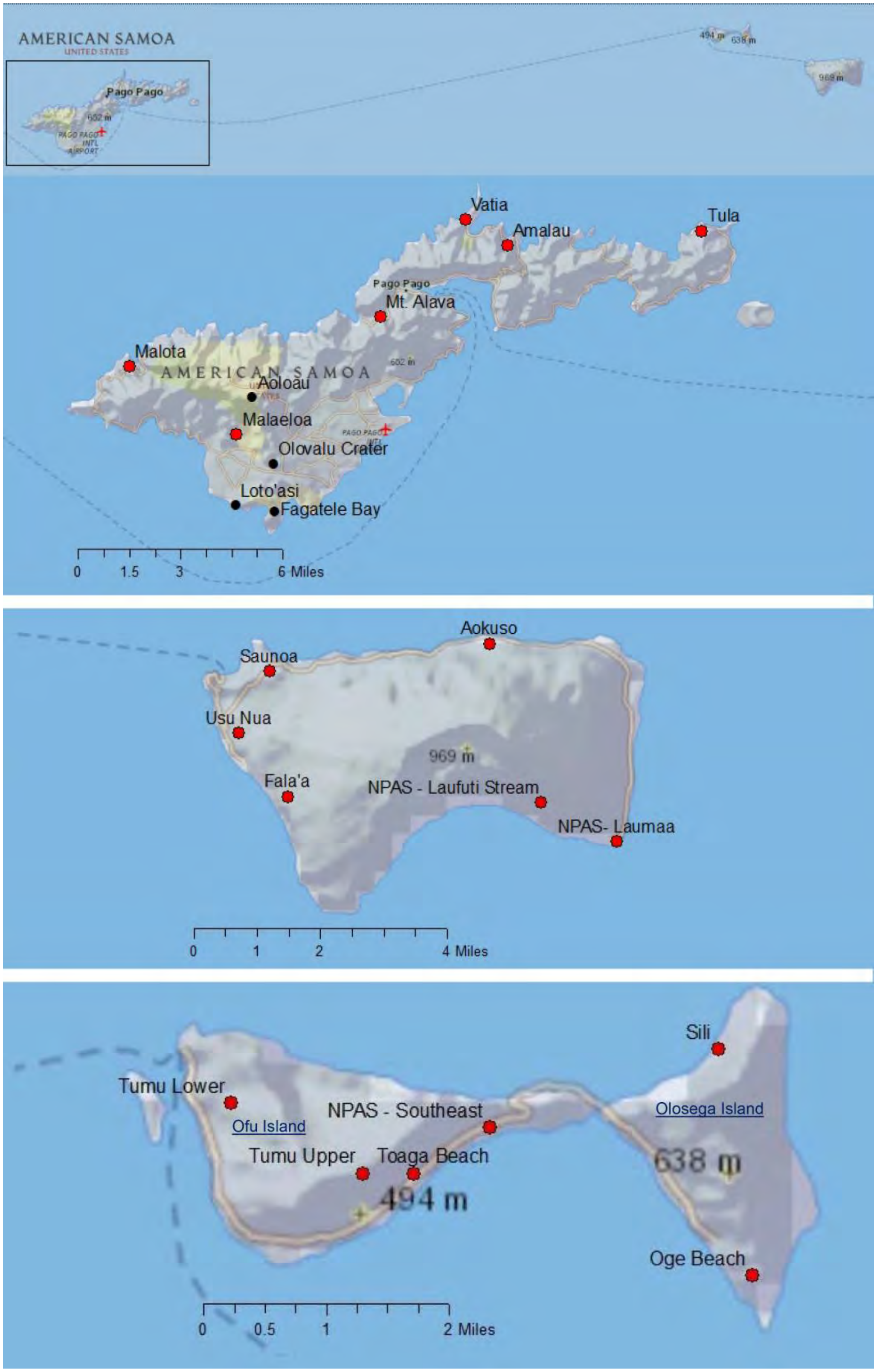

Figure 1. Locations of TMAPS stations on Tutuila (top), Ta'u (center), and Ofu-Olosega (bottom) islands.

METHODS

Specimen examination

The 16 species of landbirds covered in this report are listed in Table 1. Pyle examined 172 specimens of 13 indigenous and two introduced bird species collected in American Samoa and (of conspecific or congeneric species) elsewhere in the southwestern Pacific. These included 66 specimens housed at the Museum of Vertebrate Zoology (MVZ), Berkeley, California; 37 specimens at the Western Foundation of Vertebrate Zoology (WFVZ), Camarillo, California; 31 specimens at the Museum of Comparative Zoology (MCZ), Cambridge, Massachusetts; 29 specimens at the California Academy of Sciences (CAS), San Francisco; 5 specimens at the Louisiana State University Museum of Natural Science (LSUMNS), Baton Rouge; 2 specimens at the Museum of Wildlife and Fish Biology (MWFB), Davis, California; 1 specimen at the Field Museum of Natural History, Chicago, Illinois; and 1 specimen at the Yale-Peabody Museum (YPM), New Haven, Connecticut. Specimens were generally collected year-round, although fewer were collected in June-September. Some specimens were labeled as "adult" or "immature" but the method of age determination was usually not recorded. Sex was indicated on the labels of most specimens, presumably as determined by gonadal examination, although a small proportion of apparent errors in sexing were encountered. Each specimen was carefully examined for active molt, state of feather wear indicating timing and extent of previous molts, and plumage and feather-shape criteria that could relate to age and/or sex. Measurements of wing, tail, and bill were obtained from specimens examined at MVZ, WFVZ, and CAS. Further information for specimens used in this manual (including collection dates) is available from the research institutions or from on-line databases such as Ornis (http://www.ornisnet.org/) or Vertnet (http://vertnet.org/).

TMAPS stations

A total of 22 TMAPS stations were established and operated on Tutuila (14.3º S, 170.7º W), Ta’u (14.2º S, 169.5º W), and Ofu-Olosega (14.2º S, 169.6º W) islands (Fig. 1) during all or parts of August 2012–August 2013 (Tutuila), December 2013–March 2014 and December 2014–March 2015 (Tutuila and Ta'u), and November 2015–March 2016 and November 2016–March 2017 (all three island groups). On Tutuila, six stations were operated during most of the above months, whereas four stations had to be discontinued and replaced by other stations in 2012 or early 2013 because of poor capture rates or logistical considerations. Twelve stations (six on Tutuila and six on Ta’u) were then operated monthly during November or December–March, 2013-2014, 2014-2015, 2015-2016, and 2016-2017, while six more stations were established and operated on Ofu-Olosega islands during November or December–March in 2015-2016 (Pyle et al. 2017) and 2016-2017. Information from the initial 13 months of continuous operation on Tutuila (August 2012–August 2013) formed the basis to establish an optimal TMAPS season of November/ December–March, in order to capture a majority of the breeding season for most species in American Samoa (Pyle et al. 2016).

Each station consisted of 10 mist nets operated for 6 hrs per day, for up to 3 consecutive days (a “pulse”), once per month, following IBP protocols for stations in tropical regions (DeSante et al. 2005). For each captured or recaptured bird, complete data were obtained according to MAPS and TMAPS protocols (DeSante et al. 2016).

TABLE 1. Molt extents and cycle-based groupings for 16 species of American Samoan landbirds treated in this manual.[1]`

Common Name (Alpha code[1])	Scientific Name	Molt Extent[1] Preformative	Molt Extent[1] Prebasic	Molt Group[2]
Tongan Ground Dove (TGDO)	*Alopecoenas stairi*	Incomplete to Complete	Incomplete to Complete	1
Many-colored Fruit Dove (MCFD)	*Ptilinopus perousii*	Incomplete to Complete	Incomplete to Complete	1
Crimson-capped Fruit Dove (CCFD)	*Ptilinopus porphyraceus*	Incomplete to Complete	Incomplete to Complete	1
Pacific Imperial Pigeon (PIPI)	*Ducula pacifica*	Incomplete to Complete	Incomplete to Complete	1
Pacific Long-tailed Cuckoo (PLTC)	*Urodynamis taitensis*	Limited to Partial	Complete	2
White-rumped Swiftlet (WRSW)	*Aerodramus spodiopygia*	Partial	Incomplete to Complete	3
Pacific Kingfisher (PAKI)	*Todiramphus sacer*	Absent	Complete	4
Blue-crowned Lorikeet (BCLO)	*Vini australis*	Partial	Complete	3
Cardinal Myzomela (CAMY)	*Myzomela cardinalis*	Incomplete	Incomplete to Complete	3
Polynesian Wattled-Honeyeater (POWH)	*Foulehaio carunculata*	Partial to Incomplete	Incomplete to Complete	3
Red-vented Bulbul (RVBU)	*Pyconotus cafer*	Complete	Complete	5
Samoan Shrikebill (SASH)[1]	*Clytorhynchus powelli*[1]	Partial	Incomplete to Complete	3
Polynesian Starling (POST)	*Aplonis tabuensis*	Partial to Incomplete	Incomplete to Complete	3
Samoan Starling (SAST)	*Aplonis atrifusca*	Partial to Incomplete	Incomplete to Complete	3
Jungle Myna (JUMY)	*Acridotheres fuscus*	Complete	Complete	5
Common Myna (COMY)	*Acridotheres tristis*	Complete	Complete	5

[1]Taxonomy, sequence, and names follow Gill and Donsker (2017) except that Samoan Shrikebill is split from Fiji Shrikebill (*C. vitensis*) following Pratt (2010). Four-letter alpha codes (in parentheses), used for data entry, follow protocols developed by Pyle and DeSante (2003, 2017). See text for definitions of molt extents.

[2]Molt Groups have specific combinations of acceptable molt-cycle age codes (see Table 2 and text)

Molt status and degree of skull pneumatization and reproductive condition (see below) were recorded and wing chord, tail, and bill measures were obtained following the methods of Pyle (1997). Most captured birds were photographed, including images of body, spread-wing, and spread-tail, to help determine age and molting status. Approximately 10,000 images were obtained during TMAPS station operation in 2012-2017.

Molts and plumages

Wing-feather terminology and primary and secondary numbering in landbirds is shown in Figure 2 and the number of flight feathers for each species are given in the species accounts. All American Samoan landbird species have 10 primaries (the outermost, p10, reduced in some species), numbered from the innermost (p1) to the outermost (p10). The number of secondaries in American Samoan species varies from 7 to 13, with White-rumped Swiftlet having only seven secondaries, all passerines having nine secondaries, and the other non-passerines having 10-13 secondaries. Secondaries are numbered from the outermost (s1) proximally to the innermost (s7, s9, s10, s11, or s13 among American Samoan species), with the inner three secondaries in all but one species (the White-rumped Swiftlet) regarded as the tertials. The tertials are technically part of the secondary tract but differ in form and in molting behavior. Secondary coverts cover the bulk of the wing surface and are divided into the lesser, median, and greater coverts, and the primary coverts, covering the primary bases, are located distal to the greater coverts, along with two alula feathers and the alula covert (Fig. 2). American Samoan landbirds have either 10 (two species), 12 (11 species), 12-14 (one species), or 14-16 (two species) rectrices, numbered from the innermost (r1) pair to the outermost (r5, r6, r7, or r8) pair on each side of the tail.

Following the terminology of Humphrey and Parkes (1959) as modified by Howell et al. (2003), adult landbirds in American Samoa and elsewhere essentially undergo one complete or near-complete molt of all body and most or all flight feathers once per year, known as the **definitive prebasic molt**, which results in the **definitive basic plumage**. The period between commencement of one definitive prebasic molt to commencement of the following definitive prebasic molt is known as a **definitive molt cycle**. The first growth of pennaceous feathers in the nest is considered the **first prebasic molt** (or prejuvenile molt), resulting in **juvenile plumage**, and the period between this first molt and the ensuing **second prebasic molt** is known as the **first molt cycle**, followed by the **second molt cycle**, and so on. Once a mature (definitive) plumage appearance is reached, a bird enters the definitive molt cycle, although the term 'definitive' can be imprecise (Wolfe et al. 2014, Howell and Pyle 2015). Most Samoan landbird species can reach a definitive plumage appearance following the second prebasic molt, with a few individuals of certain species not obtaining definitive appearance until after the third prebasic molt. Thus, the second molt cycle is considered the definitive molt cycle in most species; however, birds with complete preformative molts (see below) can essentially reach a definitive plumage appearance within the first cycle.

Within a molt cycle, inserted molts occur that can vary from limited to complete but are usually less than complete. Inserted molts are defined by feathers being replaced twice within a cycle, as distinct from protracted or suspended prebasic molts, which can

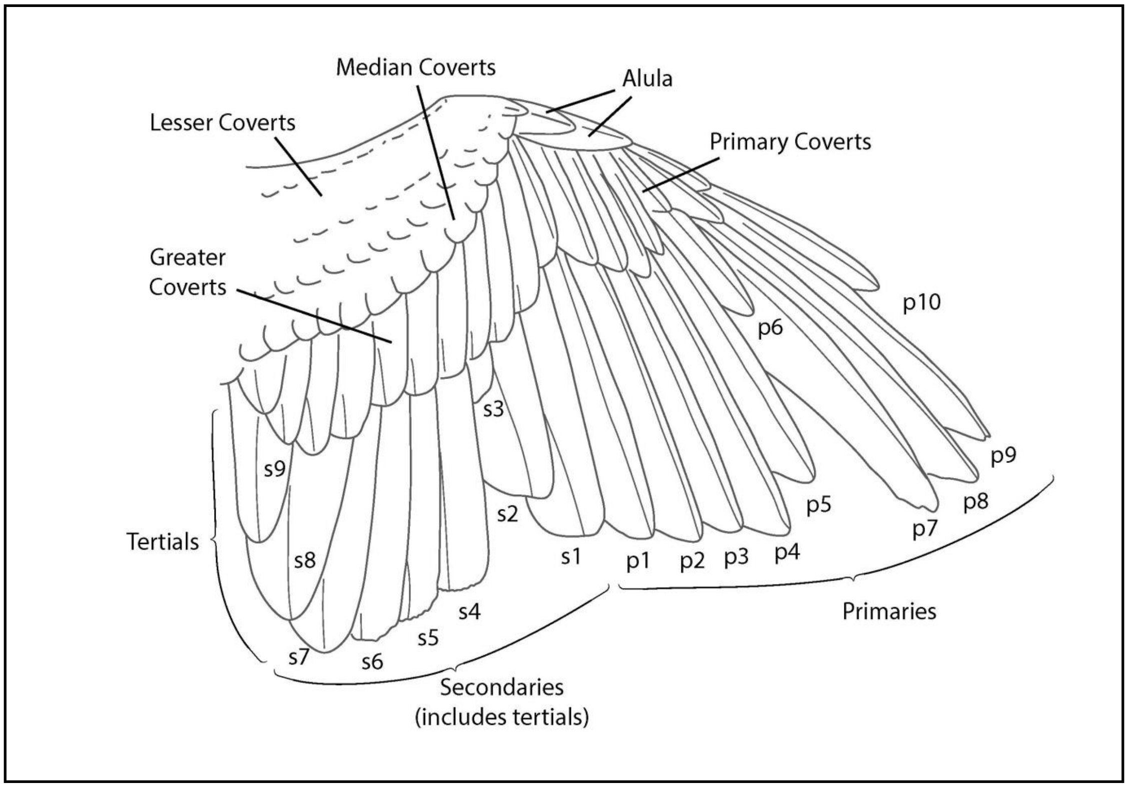

Figure 2. Wing feather topology, numbering, and typical molt sequence among remiges of a passerine. See text for other secondary-replacement sequences among non-passerines. Redrawn from Pyle (1997) for Pyle et al. (2015).

occur in episodes but only involve a single replacement of each individual feather. North American and other temperate bird species can show inserted molts in the definitive cycle, known as prealternate molts (Pyle 1997, Howell et al. 2003), but there is no evidence for the occurrence of prealternate molts in American Samoan species (Pyle et al. 2016). Within the first cycle, most birds have an inserted molt that is unique to this cycle and is referred to as the **preformative molt** (Howell et al. 2003), which results in the **formative plumage**. Among landbirds worldwide, this molt can occasionally be absent but typically is limited (a few body feathers replaced), partial (most to all body feathers and some secondary coverts and/or tertials replaced), or incomplete (all body feathers and secondary coverts and some but not all flight feathers replaced), and it can occasionally be complete (all feathers replaced). Most American Samoan landbirds show partial or incomplete preformative molts, while in one species it is absent and in four species it can be incomplete or complete (Pyle et al. 2016; Table 2).

The sequence of feather replacement during preformative and definitive prebasic molts is generally very fixed within families of birds (Pyle 1997, 2008, 2013). Most American Samoan landbirds replace primaries and corresponding primary coverts distally from p1 to p10 and replace secondaries proximally from s1 and bilaterally from the central tertial (Fig. 2); exceptions to these sequences among primaries and secondaries are found in two American Samoan species (see species accounts). Rectrices are often replaced distally (r1 to r6) on each side of tail, with some variation in sequence noted. Because molt can be protracted through the non-breeding season in American Samoan landbirds, it is often possible to see a gradation between more-worn and fresher feathers in sequence among these feather tracts. These progressions are referred to as **molt clines**, and these clines are often most discernable in the secondaries, from the more-worn outmost (s1) toward the fresher secondary adjacent to the tertial (s6 in passerines). Detecting molt clines can confirm that a bird has previously molted remiges, which in many cases allows determination of second cycle or later, in species for which the preformative molt is absent, limited, or partial. Juvenile remiges and rectrices, besides lacking molt clines, are also usually narrower, more pointed, and more worn than definitive basic feathers, and in some species the shape to the outer primary (e.g., notched or blunt) can further help identify feather generation useful in age determination.

Prebasic molts in temperate birds often take place just after a well-defined breeding season; however, in tropical species breeding can be protracted or occur year-round, leading to speculation that molt and breeding frequently overlap (Johnson et al. 2012). In American Samoan landbirds there can be overlap between breeding and molting at the population level but there appears to be little overlap at the individual level (Pyle 2016). The molting season may be better defined than the breeding season, and when conditions favor breeding during active molt, the molt can be **suspended**, to be resumed following the breeding attempt. Evidence of suspended molts are found in all but one American Samoan landbird and can be used to determine age and breeding status. In temperate species such suspensions can also occur between cycles, for which molt is referred to as **arrested** rather than suspended, and prebasic molts are considered incomplete. Replacement of primaries and secondaries appears to resume in sequence after both suspended and arrested molts; for example, several Samoan passerines can suspend molt retaining the last 1-2 secondaries (s5-s6), to resume molt with these feathers during the ensuing molt cycle (Pyle et al. 2016). In some species a new sequence can also begin following suspension or arresting of molt, resulting in multiple replacement waves in a process known as **staffelmauser** (Pyle 2006, 2008). Among American Samoan landbirds, two waves of staffelmauser molt among primaries regularly occurs in the four species of pigeons and doves, and has also been observed in swifts and, for the first time in a passerine, the Samoan Starling (Pyle et al. 2016).

Age coding using the cycle molt and plumage system

Most researchers from north-temperate regions use a calendar-based classification system to age birds (Pyle 1997, 2008) but this is impractical in tropical or Southern Hemisphere regions where breeding and fledging can occur across calendar years. Therefore, this manual adopts the molt-cycle-based system (also known as the "WRP" system) developed by Wolfe et al. (2010), refined by Johnson et al (2011), and based on the molt terminology of Humphrey and Parkes (1959) as revised by Howell et al. (2003). We encourage the reader to be familiar with the age-coding of this molt-cycle-based system so as to understand their use in this manual. Good summaries of the use of the molt-cycle based coding system for given avifaunas are provided by Pyle et al. (2015, 2016) and Johnson and Wolfe (2017).

To age birds with molt-cycle based terminology, the plumage sequences and extents of preformative and prebasic molts must be understood for the species at hand, to correctly determine acceptable coding. Species showing absent, limited-to-incomplete, and complete preformative molts each have an acceptable set of codes that can be used, and coding choices also vary depending on whether or not definitive prebasic molts are typically complete, less than complete, or both within a species. The 16 species treated in this guide can be divided among 5 groups showing different sets of acceptable molt-cycle based age codes, as shown in Tables 1 and 2. For each species in each group, monthly acceptability codes can also be applied and used for verification of age-coding choices in data (see Appendix 1). In addition, it must be ascertained whether or not the bird is actively undergoing molt, as molting birds receive a separate set of codes than non-molting birds. Active molt is best determined in the hand by examining birds for ongoing feather growth or pin feathers on the body, head, wings, and tail.

The following molt-cycle based codes, in chronological order according to a bird's age, are used for American Samoan landbirds and in this manual. Notes on which species can receive each code, tips for identifying birds of that age, the general seasonal timing in which they are encountered in American Samoa, and other notes on applying the codes are also included. The list of acceptable codes is reduced over most other continental avifaunas, e.g., those in Chile (Pyle et al. 2015) or Brazil (Johnson and Wolfe 2017), due to the lack of prealternate molts in American Samoan landbirds.

FCJ – A first-cycle bird in full juvenile plumage. This plumage is found in all five species Groups (Table 2), is usually a distinctive and recognizable plumage, and is often held for a short period of time (as short as one month), although it is retained through the first cycle in the one Group-4 species, Pacific Kingfisher (Table 1). FCJs are usually identified by fresh and often lax plumage, along with incomplete skull pneumatization in passerines and duller eye color than adults in some species; FCJ Pacific Kingfishers are identified throughout the first cycle by retained juvenile wing and tail feathers, and some additional plumage characters. FCJs are most common in Dec-Feb, corresponding to the latter stages of peak breeding season in American Samoa, although they are found year-round in Pacific Kingfisher and (less-commonly) in most other species that undergo aseasonal or year-round breeding (Appendix 1). For Pacific Kingfisher it is important to estimate whether or not FCJs are < or > 6 months old (see FCF, below).

FPF – Birds undergoing the preformative molt, transitioning from an FCJ to an FCF (below). This code is acceptable for all species except Pacific Kingfisher (Group 4), which lacks a preformative molt (Tables 1-2). FPFs are identified in the same manner as FCJs, except that active molt of body feathers, wing coverts, or flight feathers, is in progress. When molt can include primaries, as is the case for the eight species that can undergo incomplete or complete primary replacement during preformative molts, the code FPF is only applied to birds actively replacing primaries or outer (non-tertial) secondaries. For the remaining eight species that have partial-to-incomplete preformative molts not including primaries, the code is applied for birds with at least a moderate amount of active body-feather molt. FPF should not be applied to birds with a few body feathers in pin or growing, as this may represent accidental feather replacement or the beginning of the Second Prebasic Molt (see below). FPFs are most common in Jan-Mar, corresponding to the end of breeding season in American Samoa, although in most species they can be encountered less commonly year-round (Appendix 1).

TABLE 2. Cycle-based age-coding species groups, and acceptable age codes for each group, for 16 species of American Samoan landbirds.`

	Molt Extent[1]			
Group	Preformative	Prebasic	Species[1]	Acceptable Cycle-based Codes[1]
1	Incomplete to Complete or Suspended	Incomplete to Complete or Suspended	TGDO, MCFD, CCDO, PIPI	FCJ, FPF, FCF, SPB, SCB, FAJ, UPB, DCB, DPB, SAB; UCU, UPU, UUU
2	Partial	Complete	PLTC	FCJ, FPF, FCF, SPB, UPB, DCB, DPB; UCU, UUU
3	Limited to Incomplete	Incomplete to Complete or Suspended	WRSW, BLCO, CAMY, POWH, SAST, POST, SAST	FCJ, FPF, FCF, SPB, SCB, UPB, DCB, DPB, SAB; UCU, UUU
4	Absent	Complete	PAKI	FCJ, SPB, UPB, DCB, DPB; UCU, UUU
5	Complete	Complete	RVBU, JUMY, COMY	FCJ, FPF, FAJ, UPB; UCU, UPU, UUU

[1]See text and Table 1 for categorization of molt extents, definition of cycle-based age codes, and four-letter species alpha codes.

FCF – First-cycle birds in formative plumage. This code is acceptable for all species except Pacific Kingfisher (Group 4) and the three non-native species (Group 5) in which the preformative molt is invariably complete (Tables 1-2). For Group-5 species, the code FAJ (below) is used instead of FCF or DCB for birds that had undergone a complete feather replacement, as it cannot be determined if these birds are in formative or definitive basic plumage. For other individuals (of most species) that undergo less-than-complete preformative molts, FCFs are best identified by molt limits between retained juvenile and replaced formative feathers along with shapes and condition of juvenile outer primaries and rectrices. FCFs are found in fairly consistent proportions year-round in American Samoa, with lower proportions in peak molting periods of Dec-Mar (Appendix 1). In addition, it is important to separate all FCF birds into fresh or worn plumage, as these can represent "young" or "adult" birds, respectively, in productivity analyses. In the American Samoan TMAPS program FCFs with fresh to moderate outer primary wear and estimated to be <6 months old are designated as "young" birds and those with moderate to heavy outer primary wear and estimated to be >6 months old as "adult" birds.

FAJ – After first-cycle juveniles. This code is acceptable only with Groups 1 and 5 of our target species, which can have complete preformative molts resulting in an inability to distinguish FCFs and DCBs (see FCF). FAJ should not be used for species of Groups 2-4 in which age (e.g., between FCF and DCB) is not determined due to intermediate characters; these should be coded UCU (below). FAJs are found at fairly consistent proportions year-round in those American Samoan species that can undergo complete preformative molts, with lower proportions during peak molting periods in Dec-Mar (Appendix 1).

SPB – Birds undergoing the second prebasic molt. This code is acceptable for all except Group-5 species (Tables 1-2) in which it is unknown whether or not a worn molting adult is undergoing its second or later prebasic molt; for these, as well as some Group 1 species that had undergone a complete previous molt (birds coded FAJ), the code UPB (instead of SPB or DPB) should be used for birds undergoing prebasic molts. SPB and all other prebasic-molt codes should be applied only to birds that are undergoing active molt of primaries or outer (non-tertial) secondaries (see FPF). SPBs are most common in Dec-Mar, corresponding to peak molting season in American Samoa, although in most species they can be encountered less commonly year-round (Appendix 1).

SCB – Second-cycle birds in second basic plumage. This code is acceptable for 11 species of Groups 1 and 3, in which the second prebasic molt can be suspended or incomplete; in Samoan Columbiformes (Group 1) this code rarely is applied to birds with two waves of remigial molt including retained juvenile feathers, and has only been observed thus far in Many-colored Fruit Dove. In Group-3 species, SCBs are identified by a mixture of juvenile and basic feathers on non-molting birds. Birds of these groups with a single generation of basic feathers or with multiple generations that are not distinguished between SCB and SAB should be coded FAJ (Group 1) or DCB (Group 3).

SCBs are found at fairly consistent but low proportions year-round in American Samoa, with fewer found during peak molting periods in Dec-Mar (Appendix 1).

TPB – Birds undergoing the third prebasic molt. TPB is acceptable with the same species that can be coded SCB (above) and can be identified by the same criteria among un-molted feathers but with newer basic feathers also actively molting in. Only birds undergoing active molt of primaries or outer (non-tertial) secondaries should be coded TPB (see FPF). This code is uncommon in American Samoa, and may be found most often in Dec-Mar, corresponding to peak molting season (Appendix 1).

UPB – Birds of unknown (second or later) cycle undergoing a prebasic molt. This code can be used for all species of American Samoan landbirds and generally denotes a bird that cannot be determined to either SPB or DPB. For some birds of Group 1 and all birds of Group 5 it can be used for birds molting remiges showing only a single generation of older non-juvenile feathers; e.g., FAJs that have commenced the next molt. For other species of Groups 2-4 this code is most often used for birds completing molt, in which the last feathers in sequence (usually p10, s5, or s6) are growing in, preventing assessment of age (SPB or DPB) based on criteria among the previous feather generation. Only birds undergoing active molt of primaries or outer (non-tertial) secondaries should be coded UPB (see FPF), and this code is most common in American Samoa in Feb-Mar, corresponding to the end of peak molting season (Appendix 1).

DCB – Definitive-cycle birds in basic plumage ("adults") that have undergone at least one complete prebasic molt; this plumage is then repeated annually. DCB can be assigned to all species except those in Group 5, in which all birds are coded FAJ after complete molts (see above). Otherwise, DCBs are identified by uniform basic feathering in species of Groups 2-4 or mixed old and new basic-like feathers in species of Group 1 (Group-1 species with uniform non-juvenile feathering should be coded FAJ). DCBs are found at consistent proportions year-round in American Samoa, with lower proportions found during peak molting periods in Dec-Mar (Appendix 1).

DPB – Birds undergoing the definitive prebasic molt. DPB is acceptable for all species of Groups 1-4 that can be coded DCB or SAB (see below). UPB should be used for all birds of Group 5 and those birds of Group 1 in which all unmolted feathers are uniformly non-juvenile. DPBs are identified in the same manner as DCBs or SABs for birds that have commenced or are undergoing the ensuing active molt. Only birds undergoing active molt of primaries or outer (non-tertial) secondaries should be coded DPB (see FPF), and this code is most common in American Samoa in Jan-Mar, corresponding to the peak molting season of breeding birds (Appendix 1).

SAB – After second-cycle birds in definitive basic plumage. This code is only acceptable for species of Groups 1 and 3, in which the prebasic molt can be suspended or incomplete resulting in three (Group 1) or two (Group 3) generations of basic feathers. SABs are identified by staffelmauser or stepwise molt patterns (Pyle 2006, 2008) in the wings of Group-1 species (see species accounts for doves and pigeons) or two generations of basic feathers following a suspended or incomplete prebasic molt in Group-3 species. Birds of these groups with a single generation of basic feathers or with multiple generations that are not distinguished between SCB and SAB should be coded DCB. Note that SABs that are molting receive code DPB, even though they may still be identifiable as SAB. SABs are found at consistent proportions year-round in American Samoa, with lower proportions found during peak molting periods in Dec-Mar (Appendix 1).

UCU – Unknown cycle and plumage. This code is acceptable for all Groups, for non-molting birds for which neither cycle nor plumage was distinguished; for example, either FCF or DCB. UCU can be used in all months for American Samoan landbirds. but should be avoided unless birds escape before being examined for age criteria.

UPU – Birds of unknown cycle undergoing molt. This code is acceptable only for Groups 1 and 5, in which the preformative molt can be complete, for actively molting birds for which cycle was not distinguished; for example, either FPF or DPB. It may most commonly be used for birds completing molt, in which the last feathers in sequence are growing in, preventing assessment of age (FPF or DPB) based on criteria among the previous feather generation. For birds of groups 2-4, UPB should be used instead of UPU for birds of unknown cycle molting primaries. UPU can be used in all months for American Samoan landbirds. but should be avoided unless birds escape before being examined for molt and age criteria.

UUU – Unknown cycle and plumage, and unknown whether molting or not. This code is acceptable for all species Groups and all months in American Samoa, for birds that escape before both molt and plumage status are recorded.

Code-acceptance table for data verification
In order to ensure that unacceptable codes are not used for a given species (see Tables 1-2), we have derived a table indicating whether or not a code is acceptable, unacceptable, or should be manually checked within a given month (Appendix 1). All birds coded UCU, UPU, or UUU are designated for manual checking as well as some codes of molting or non-molting birds found during seasons where molting is not expected or expected, respectively.

Species Accounts
The following accounts include information on numbers of specimens examined and birds captured, and number of flight feathers, measurements, information on timing and extents of molts, and age/sex criteria based on both specimen and banding data. Taxonomy, species sequence, and species names follow those of Gill and Donsker (2017), except for one species (Samoan Shrikebill) in which the species taxonomy of Pratt (2010) is followed (Table 1). We have derived four-letter alpha codes for each species, based on the common (English) name of the species (Table 1), for use on banding or other data sheets, following the coding rules established by Pyle and DeSante (2003, 2017). All measurements are given in mm and, where enough data or information is available, metric ranges are presented as ~95% confidence intervals, as calculated as the mean $\pm$ 2*S.D (see Pyle 1997).

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SPECIES ACCOUNTS

Tongan Ground Dove (TGDO) *Alopecoenas stairi*

Range and Taxonomy: Tongan Ground Doves are found among scattered islands in central Polynesia, from Fiji to Tonga and Western Samoa (Pratt et al. 1987, Rosa 2007). In American Samoa the Tongan Ground-Dove is restricted to the islands of Ofu and Olosega, where a small and little-known population exists and was designated as an Endangered Species in September 2016 (Rosa 2007; USFWS 2015, 2016). This species is also known as "Shy Ground Dove" or "Friendly Ground Dove" and was formerly placed in the widespread southwestern Pacific genus *Gallicolumba*, before the genus *Alopecoenas* was recognized for species of the central Pacific (Gill and Donsker 2017). The nominate subspecies *A. s. stairi*, smaller and less-marked, is restricted to American and Western Samoa (Amadon 1943a).

Individuals Examined: 2 specimens from Samoa (MVZ 1, MCZ 1); 18 captures at TMAPS stations in 2015-2016 on Ofu and Olosega islands; one wing measure from Banks (1984) and six tail measures from Amadon (1943a).

Structure and Measurements: Ten primaries, 10 secondaries, 12-14 rectrices; p10 full-length (Figs 3-11). Capture data indicate that ♀♀ may more-frequently have 12 rectrices and ♂♂ more frequently have 14 rectrices but at least one exception each has been noted among 5 ♀♀ and 10 ♂♂ with full sets of rectrices. Wing chord: ♀ (n7) 134-147, ♂ (n15) 147-157; Tail: ♀ (n4) 81-89, ♂ (n18) 85-97; Exposed culmen ♀ (n4) 10.1-12.7, ♂ (n10) 10.8-13.3; Tarsus ♀ (n4) 29-32, ♂ (n10) 31-35. Longest primaries are p7-p8.

Breeding Seasonality: No previously published information on breeding of Tongan Ground Dove for American Samoa. None of 14 captures of adults (SPB or older) between 11 Dec and 7 Mar were in breeding condition, and 11 of these 14 birds were in moderate to heavy body molt and/or flight-feather molt. No FCJs but four FPFs were captured during this period. These data suggest that breeding may occur primarily during Apr-Nov, but confirmation is needed.

Molt: Group 1, with incomplete-to-complete preformative and prebasic molts (Table 1). One unknown-age ♀ collected 3 Jun on Ofu was not in molt (Banks 1984). Of 18 captures between 11 Dec 2015 and 7 Mar 2016, 15 were in active molt, perhaps indicating a peak molting period in Dec-Mar, but timing could be protracted and year-round as in other Pacific island doves (Pyle et al. 2008). Molt appears to be similar to that of other *Alopecoenas* ground-doves, for example *A. xanthonurus* of the Marianas Islands (Pyle et al. 2008, Radley et al. 2011) and most other Columbiformes (Pyle 1997), in that both the preformative and definitive prebasic molts appear to be incomplete to complete, with flight-feather molt often suspended or arrested, some secondaries often retained, and staffelmauser patterns evident in some older birds (see Figs. 3-11). Flight-feather molt sequence appears typical of diastataxic species (including *Alopecoenas* doves; Bostwick and Brady 2002), with primaries being replaced distally (from p1 to p10), secondaries being replaced bilaterally from the second tertial (s9) and proximally from s1 and s5, and rectrices generally being replaced distally on each side of the tail, except that the outermost rectrix (r6 or r7) often can be replaced before the adjacent 2-3 feathers (r3-r5 or r4-r6, respectively). Among the remiges, the last juvenile flight feathers replaced are among p10, s3-s4, and s7-s8 (see Figs. 3-5 and 8-11).

Age Determination: Age-code Group 1 (Tables 1-2). **FCJ**s appear like older birds but are duller and have greener or more bronze-colored upperparts with thin buff fringes to many or all feathers (beware some older ♀♀ may also show buff fringes to some feathers), and have uniformly narrow remiges and rectrices (cf. Figs. 3-4). **FPF**s are variable and can resemble FCJs when molt has just commenced (Figs. 3-4) or resemble FCFs when molt is nearly complete (Fig. 5). **FCF**s resemble older age groups in plumage but can be identified by retained juvenile outer primaries (typically p10 or p9-p10) and/or middle secondaries (typically among s4 and s7-s8) being thin, brownish, and relatively abraded, and by the remiges otherwise showing even molt clines rather than multiple generations or indications of suspended or protracted molts (Fig. 6; see also Fig. 5). **SPB**s are FCFs that have begun the next molt cycle; these are probably uncommon and may be difficult to separate from FPFs but the molting of p1 before all juvenile secondaries have been dropped would indicate SPB. Because the preformative molt can be complete, age-codes SCB and TPB are not acceptable. Birds that had undergone a complete molt, without suspension or retained feathers, are assigned code **FAJ** (Fig. 7), and such birds that have commenced the next molt cycle are **UPB**s (Fig. 8). Non-molting birds with two generations of basic feathers (either due to molt suspension or arrest) are coded **DCB** (Fig. 9), and these birds which have commenced the following molt can be coded **DPB** (Fig. 10). Non-molting birds with three sets of basic feathers in staffelmauser patterns or two sets along with a suspension limit can be aged **SAB** (Fig. 11); note that both DCBs and SABs that have commenced the following molt are coded DPB (cf. Fig. 9). Age codes **UCU**, **UPU**, and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction).

Should breeding occur primarily during Apr-Nov and molting primarily in Dec-Mar (see above), we might expect to see more FCJs in May-Dec; more FPFs in Jul-Mar; more FCJs, FCFs, FAJs, DCBs, and SABs in Mar-Nov; and more FPFs, SPBs, UPBs, and DPBs in Nov-Mar (see Appendix 1) but both molting and non-molting birds, as well as juveniles, could well occur year-round; further data on potential interannual variation in breeding and molting seasons are needed to assess this.

Sex Determination: FCJs of other Pacific ground-doves show ♀-like plumages (Amadon 1943a, Radley et al. 2011) and the same appears to be the case for of Tongan Ground Dove. Once the preformative molt begins and through all subsequent plumages, sexes are easily separated, ♂♂ most easily by the bright purple formative or basic wing coverts and white feathering to the lower breast, but also by a brighter pink face and grayer or bluish-gray crown (Figs. 3, 6, and 8), and ♀♀ by brown wing coverts, lack white in the lower breast, and dull (FPF) to bright (FAJ) brown faces and crowns (Figs. 4-5 and 7). FCJs may not be separable by plumage but can likely be sexed by wing chord as perhaps assisted by the number of rectrices (see below). Differences in measurements, especially wing chord, are consistent with plumage differences and appear to separate most individuals, with FCJs and FPFs (with juvenile p7-p8) expected in the bottom half of the ranges and older birds (with formative or basic p7-p8) expected in the upper half of the range for each sex. The number of rectrices, 12 in most ♀♀ and 14 in most ♂♂, could also be useful as a supporting character for sexing FCJs. although beware that exceptions to this can be found in both sexes. No TMAPS captures from Dec to Mar showed brood patches or cloacal protuberances; in most other Columbiformes both sexes develop brood patches (♀♀ > ♂♂), and the cloacal protuberance is only partially developed in ♂♂, and the same is expected in Tongan Ground Dove. Note that Amadon (1943a) reported that some ♀ Tongan Ground Doves may resemble ♂♂ in plumage but we have found little evidence of overlap between the sexes among any of size, appearance, and number of rectrices, and we suspect that Amadon's reasoning may have been based on mis-sexed specimens or that it does not apply to populations in American Samoa.

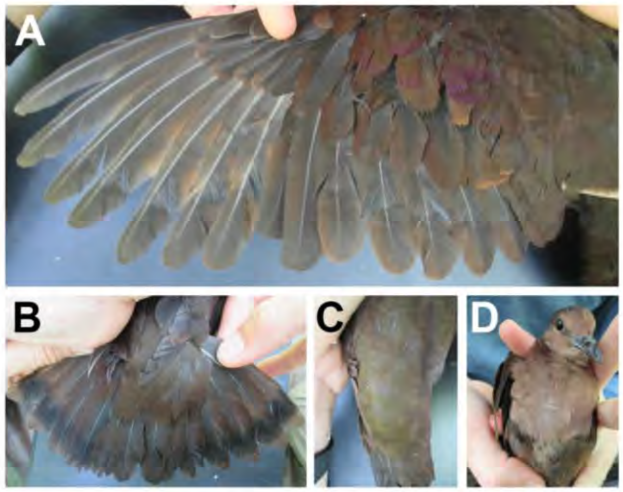

Figure 3. FPF ♂ Tongan Ground Dove, Ofu Island, 9 Feb 2016. P1 is new, p2-p3 are growing, and the remainder of the primaries, outer secondaries, and rectrices are juvenile (A-B); note the thin shapes and fault bars to all unmolted flight feathers. Back, wing coverts, and rump (A, C) include bronze or greenish juvenile feathers with indistinct buff fringes and incoming purplish formative feathers; the bright purple formative wing coverts (A) are diagnostic of ♂, as also may be the count of 14 rectrices (B). Breast and head are brownish (juvenile) with gray (crown), pinkish (face), and whitish (lower breast) formative feathers coming in (D), further indicating ♂.

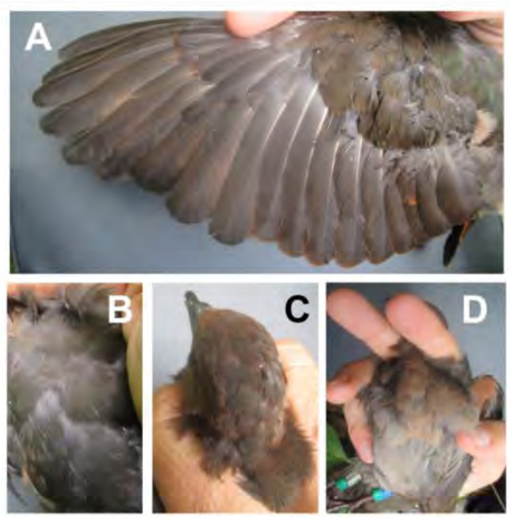

Figure 4. FPF ♀ Tongan Ground Dove, Olosega Island, 29 Feb 2016. P1-p2 are new, p3-p4 are growing, and the remainder of the primaries and outer secondaries are juvenile (A); note the even wear to the juvenile primaries and secondaries, without molt clines. Back, wing coverts, and rump (A-B) include bronze or greenish juvenile feathers and incoming pinkish to brownish formative feathers, the newer brown (rather than purple) formative wing coverts indicating ♀. New formative head and breast feathers (C-D) are browner (less brighter pink, gray, purple, or whitish) than in FPF ♂ (see Fig. 3).

Figure 5. FPF ♀ Tongan Ground Dove, Ofu Island, 20 Jan 2016. All remiges have been replaced during the preformative molt except p9 and s3 which are growing, and p10, s4, and s7-s8 which are retained juvenile (A). Body feather and wing covert molt appears to be complete resulting in an appearance resembling FCF, FAJ, DCB, and SAB ♀♀. The lack of purple in the wing coverts (A) and brownish coloration to the head breast, without brightish pink, gray, or white (B), confirms this as a ♀.

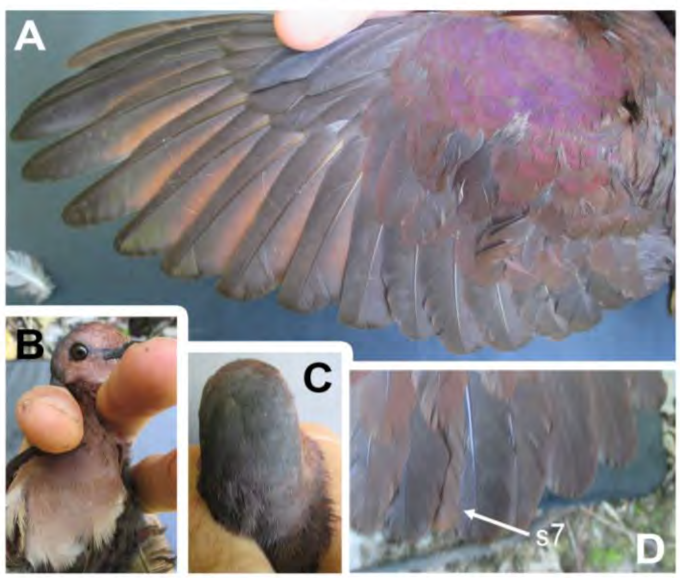

Figure 6. FCF ♂ Tongan Ground Dove, Olosega Island, 4 Jan 2016. All remiges have been replaced except p10 (A; both wings) and the left s7 (D); the thin brown condition of these feathers indicate that they are juvenile, and note also the even molt clines to the rest of the remiges, indicating a single incomplete preformative molt of these feathers. The purple wing coverts, pinkish face, gray crown, and white feathers in the lower breast (A-C) indicate ♂; body plumage appears to be similar in FCF, FAJ, DCB, and SAB ♂♂, without an increase in the amount of white as found in other Alopecoenas ground-doves (Radley et al. 2011).

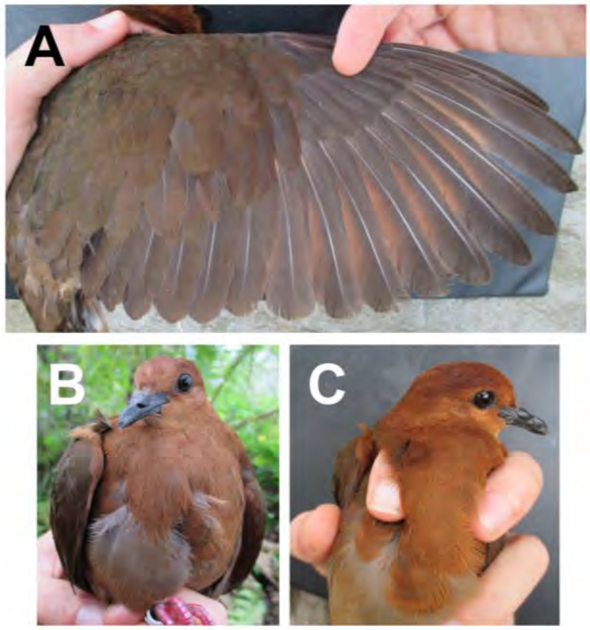

Figure 7. FAJ ♀ Tongan Ground Dove, Ofu Island, 16 Feb 2016. All remiges have been replaced during the previous molt (A) and there is no way to ascertain if this an FCF that had undergone a complete preformative molt or a DCB that had undergone a complete definitive prebasic molt, so we assign code FAJ to this bird. The brown wing coverts, head, and breast in an FAJ confirms this as a ♀.

Figure 8. UPB ♂ Tongan Ground Dove, Ofu Island, 11 Feb 2016. P5 is growing on both wings and the older generation of feathers (including p7-p10 and all secondaries) are uniformly basic and show molt clines (the left p9 is being replaced adventitiously). Without retained feathers or molt suspension among the older generation we cannot ascertain if this bird is undergoing the second prebasic molt or a later definitive prebasic molt, so it receives code UPB. The purple coloration to the wing coverts indicates ♂.

Figure 9. DCB Tongan Ground Doves, Ofu Island, 11 Dec 2015 (A-C) and 17 Dec 2015 (D-F). Both of these DCBs show two generations of basic feathers, with a suspension or arrest of molt between p8 and p9 in A, and s2 and s8 newer than s3-s7 in D. The plumages are typical of definitive ♂ (A-C), with pinkish head with gray crown, purple wing coverts and sides to the breast, and white to the lower breast; and ♀ (D-F), with lack of purple, pinkish, or white and a brown head and breast.

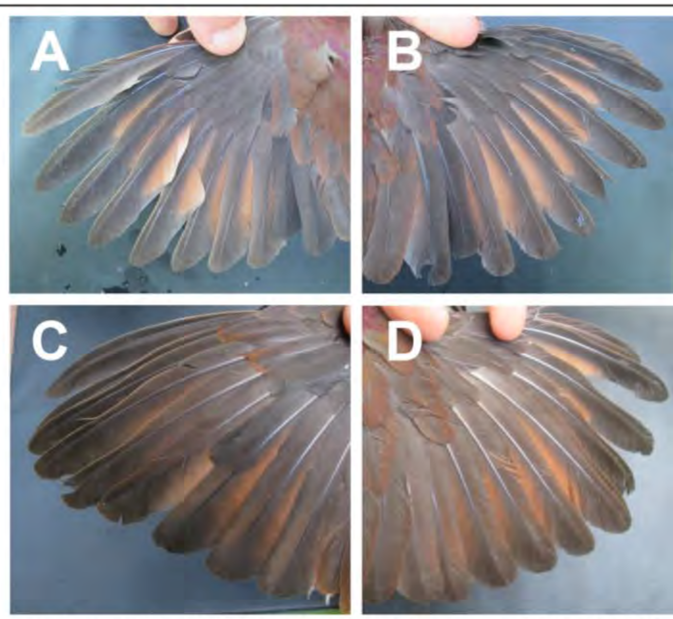

Figure 10. DPB Tongan Ground Doves, Ofu (A-C) and Olosega (D) Islands, 5 Feb 2016 (A-B), 22 Dec 2015 (C), and 3 Feb 2016 (D). All three of these DPBs show two generations of basic feathers and are undergoing a subsequent molt. Both wings of the DPB in A-B show an older basic p10, p3-p9 as a staffelmauser set (note the molt cline from p3 to p9), and p1-p2 as a newer set, with p2 growing. Similarly, the DPB in C shows a set among p1-p4 (p4 growing), a set among p5-p8, and a third set among p9-p10. The DPB in D shows p10 as older basic and a single set among p1-p9 (p9 dropped and not visible) but with an obvious suspension limit between p5 and p6; the bird likely bred during this molt suspension and allows us to code this DPB rather than UPB. These include two ♂♂ (A-B and D) and a ♀ (C) by plumage features and measurements.

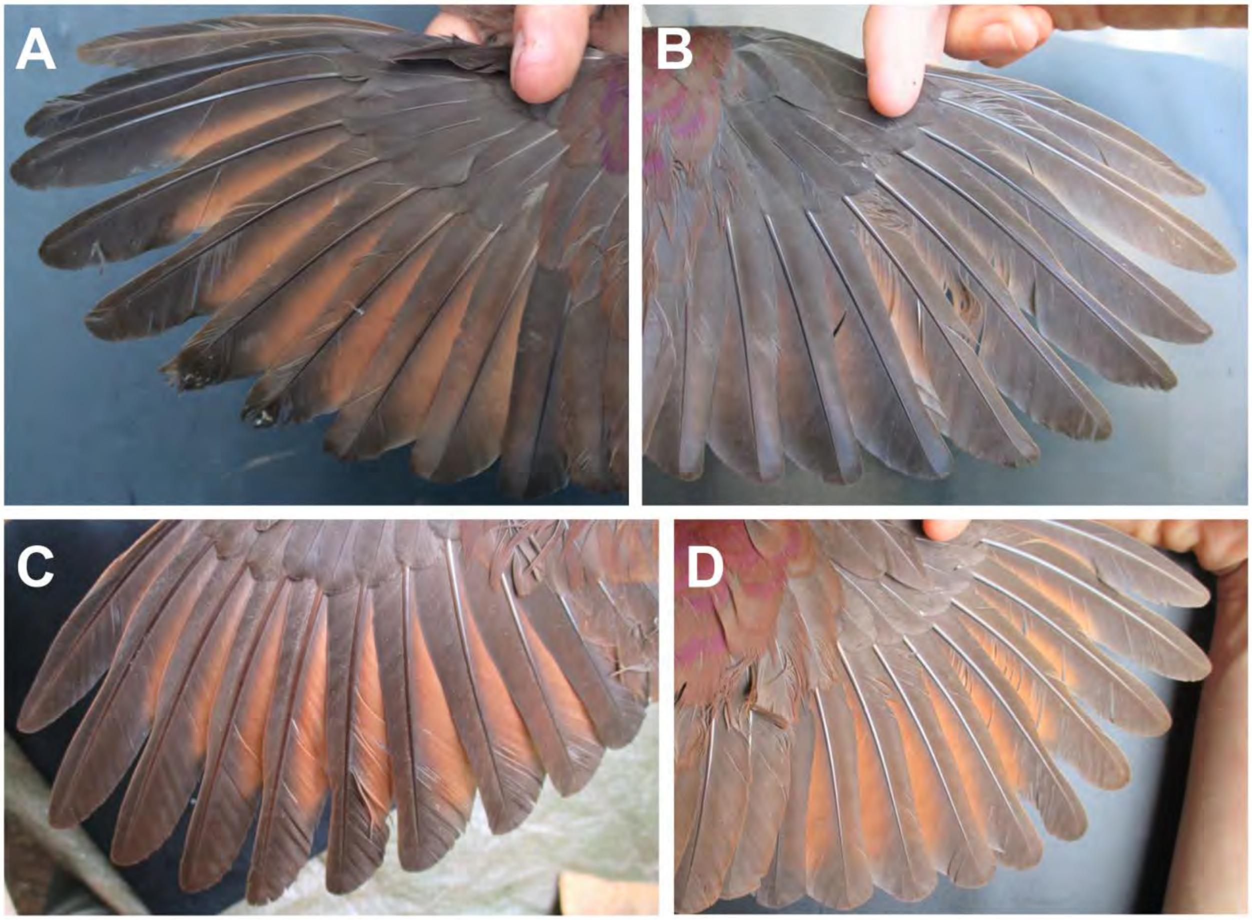

Figure 11. SAB ♂ Tongan Ground Doves, Olosega (A) and Ofu (B-D) Islands, 5 Jan 2016 (A), 20 Jan 2016 (B), and 7 Mar 2016 (C-D). All three of these SABs show three sets of basic feathers in staffelmauser patterns: p1, p2-p9, and p10 (A); p1-p4, p5-p8, and p9-p10 (B); p1, p2-p5, and p6-p10 (C), and p1, p2-p6, and p7-p10 (D). Although the wings in C and D are on the same bird, it is not unusual for there to be asymmetrical staffelmauser patterns in molt, as is the case by one feather (p6 replaced on right wing but not on left wing) in this case. All three of these SABs are ♂♂ by plumage features and measurements.

Many-colored Fruit Dove (MCFD) *Ptilinopus perousii*

Range and Taxonomy: Many-colored Fruit Dove is found in central Polynesia in Fiji, Tonga, and Samoa. In American Samoa it is found among all island groups. The nominate subspecies (*perousii*) is found in American and Western Samoa whereas subspecies *mariae* is found in Tonga and Fiji (Gill and Donsker 2017).

Individuals Examined: 21 specimens (MVZ 6, WFVZ 1, CAS 4, MCZ 10); Samoa -12, Fiji - 9; 1 capture at a TMAPS station on Tutuila.

Structure and Measurements: Ten primaries, 11 secondaries, 12-14 rectrices; most individuals have 12 rectrices but both ♀♀ and ♂♂ can show 14. The longest primaries are p6-p7 and the outermost primary (p10) is highly modified (Figs. 12-17). Specimens from American and Western Samoa and captures from American Samoa had wing chord: FCJ/FPF ♀ (n2) 117-120, FAJ/DCB/SAB ♀ (n14) 123-133; FCJ/FPF ♂ (n1) 129; FAJ/DCB/SAB ♂ (n15) 129-138.

Breeding Seasonality: Banks (1984) examined 74 specimens from American Samoa including half-grown juveniles collected Nov-May and birds with enlarged gonads, indicating breeding individuals, collected primarily in Nov, with a few others taken in Dec-Jun. Twenty birds captured on Tutuila 23-27 Sep 2016 were largely completing molt or in fresh plumage. This suggests year-round breeding but with a peak in the austral spring and summer (Sep-Feb), followed at the individual level by a peak molting season of Feb-Sep, a strategy typical of subtropical Columbiformes (see Crimson-crowned Fruit Dove, below).

Molt: Group 1, with incomplete-to-complete preformative and prebasic molts (Table 1). Banks (1984) found that 60% of 74 specimens were in active molt and these were collected in nearly every month. Five specimens of older birds (older than FCF) on Samoa in Nov-Mar were in active primary molt whereas four taken in Mar-Nov were not molting, and eight of 18 captured on Tutuila 23-27 Sep 2016 were undergoing molt while the remaining ten appeared to have recently completed molt. This suggests peak molt in non-breeding birds, probably commencing shortly after the breeding season (Feb-Mar in most) and completing in Sep, but that both breeding and molting may also occur year round (Pyle et al. 2016). Flight-feather molt sequence is typical of diastataxic Columbiformes (see Tongan Ground Dove), with the outermost rectrix being replaced before adjacent feathers in at least one specimen (cf. Fig. 15**D**). SCBs, DCBs, DPBs, and SABs showing molt suspensions and multiple waves appeared to be more common in Many-colored Fruit Doves than in other Samoan doves (Figs. 16-17), suggesting a slower remigial molt rate in general. Banks (1984) also recorded one individual with p2 and p7 growing, indicating staffelmauser (and DPB).

Age Determination: Age-code Group 1 (Tables 1-2). **FCJ**s have entirely green and grayish heads, distinct pale fringes to the back and other feathers, a broader tip to the notched p10 (Radley et al. 2011, Pyle et al. 2016), and a duller tail pattern among juvenile rectrices (Figs.12-14). **FPF**s in molt can be identified by the juvenile characters mentioned above and by the blunter-tipped p10 until it is dropped (Fig. 13). **FCF**s have arrested the preformative molt before it has completed and show more worn outer primaries with juvenile p10 (Fig. 15**A**), retained secondaries typically among s3-s4 and s6-s8, and/or retained outer rectrices. **SPB**s are FCFs that have begun the next molt cycle with the molting of p1 before all juvenile secondaries have been dropped (Fig. 17**A**); these are typically only occasionally encountered. Because the preformative molt can be complete, age-codes SCB and TPB are not acceptable. Birds with definitive body plumage and that had undergone a complete molt, without suspension or retained feathers, are assigned code **FAJ** (Fig. 15**B**), and such birds that have commenced the next molt cycle are **UPB**s (Fig. 15**D**). Non-molting birds with two generations of basic feathers (either due to molt suspension or arrest) are coded **DCB** (Fig. 16), and these birds which have commenced the following molt can be coded **DPB** (Fig. 17**B**). Non-molting birds with three sets of basic feathers in staffelmauser patterns or two sets along with a suspension limit can be aged **SAB** (Fig 17**C-D**); note that both DCBs and SABs that have commenced the following molt are coded DPB. Age codes **UCU**, **UPU**, and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction).

Should breeding occur primarily during Sep-Feb and molting primarily in Feb-Oct for the preformative molt or Mar-Sep for the definitive prebasic molt (see above), we might expect to see more FCJs in Nov-Mar; more FPFs in Jan-Oct; more FCFs, FAJs, DCBs, and SABs in Sep-Mar; and more SPBs, UPBs, and DPBs in Dec-Apr (see Appendix 1) but both molting and non-molting birds, as well as juveniles, could well occur year-round; further data on variation in breeding and molting seasons are needed to assess this.

Sex Determination: FCFs, DCBs, and SABs are highly dichromatic in plumage and easily sexed (Figs. 12-17). The notch of p10 in DCBs may also average shorter in ♂♂ than ♀♀ (Fig. 12). FCJ ♀♀ and ♂♂ may not be separable, as in other fruit doves, although check for differences in the shape of the juvenile p10 (cf. Fig. 12) and the color and pattern to the juvenile flight-feathers (cf. Figs. 13-14), as compared to wing length (once it is fully grown), which can be used to separate about 50% of older birds and may separate most or all FCJs (see above). FPFs can be sexed once preformative molt of body feathers has commenced (Fig. 14), and FCF ♂♂ acquire distinctive bright plumage which appears to be duller and/or have more green markings in the wing and tail than older birds (Fig. 15). Both sexes may develop brood patches so the reliability of this and cloacal protuberance for sexing needs to be determined.

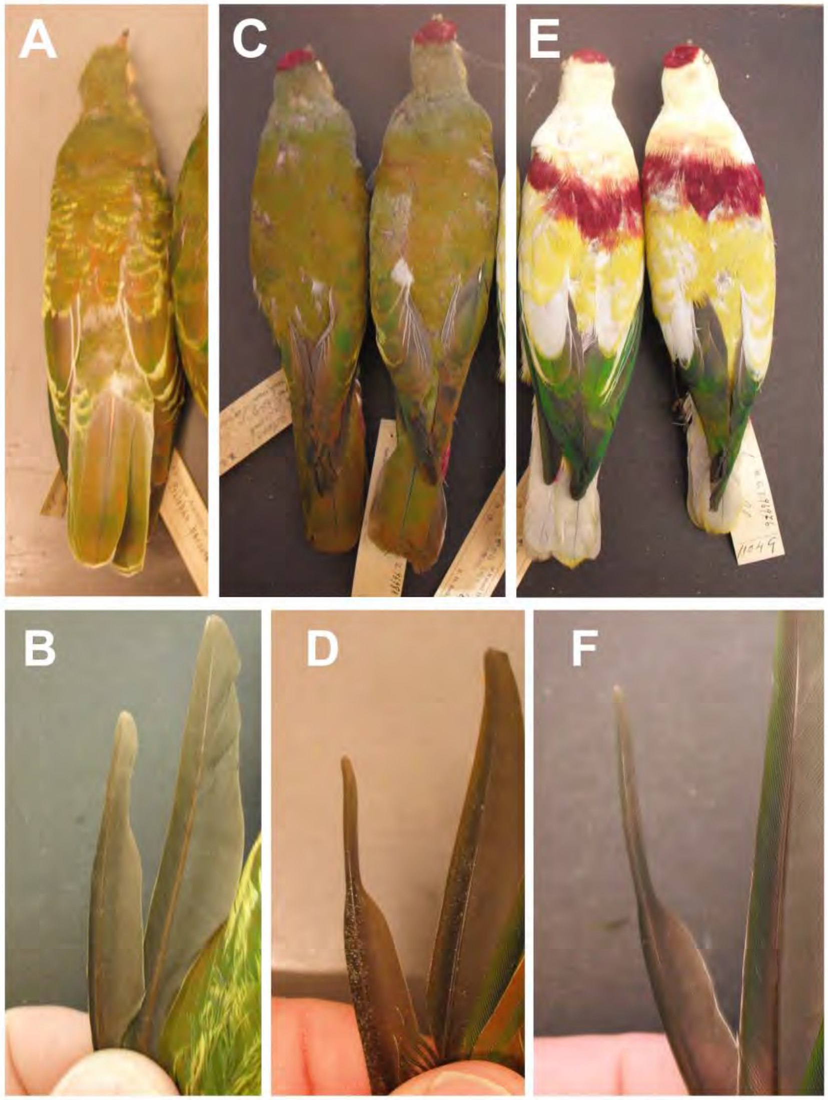

Figure 12. Variation in plumage and shape of the outer primary among Many-colored Fruit Dove specimens by age and sex: FCJ ♀♀ (A-B), FAJ/DCB ♀♀ (C-D), and DCB/SAB ♂♂ (E-F). Note the green plumage with extensive yellow fringing to the back feathers and the blunt-tipped p10 in the FCJ. FCJ ♂♂ may be similar to FCJ ♀♀ in plumage though look for differences in the coloration to the rectrices (cf. Figs. 13-14). Dramatic sex-specific plumages of older birds begin with FCFs and FAJs, which appear to be similar in plumage to DCBs and SABs, sex for sex, although body plumage in ♂♂ may average duller (Fig. 15). Similar differences in the shape of the outer primary appear to occur throughout the genus Ptilonopus (e.g., Radley et. al 2011 and see Figs. 23-24). Specimens are from CAS (A-B) and MCZ (C-F).

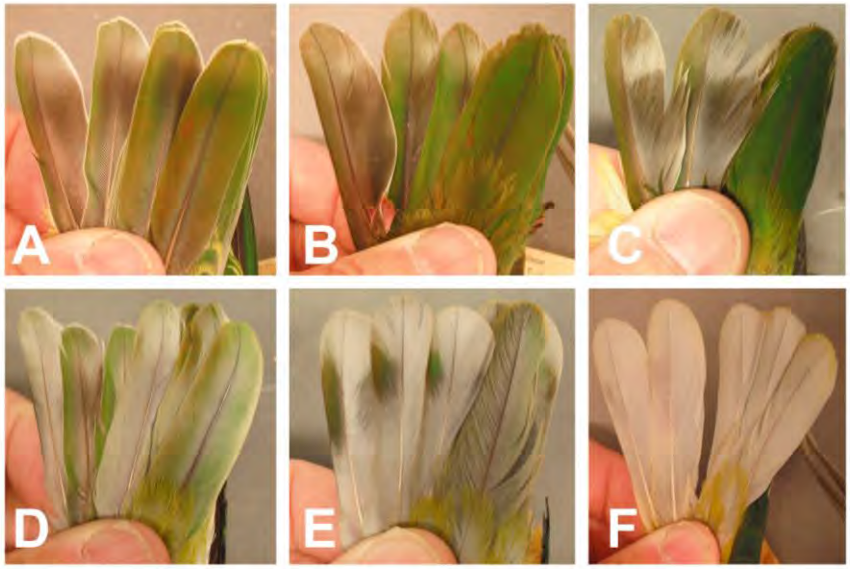

Figure 13. Variation in the pattern to the rectrices in Many-colored Fruit Dove specimens: FCJ ♀ (A), FAJ ♀ (B), DCB ♀ (C), FCF ♂ (D), FAJ ♂ (E), and DCB ♂ (F). In the FCF ♂ (D) note the mixture of greener juvenile (r4-r5) and whiter formative (r3 and r6) rectrices. Study is needed on whether intermediate patterns to the rectrices (as in B, D, and E) are exclusive to formative rectrices or can also be found in basic rectrices. See also Figure 14 for images and discussion of juvenile rectrix patterns by sex. Specimens are from CAS (A-B and F) and MVZ (C-D).

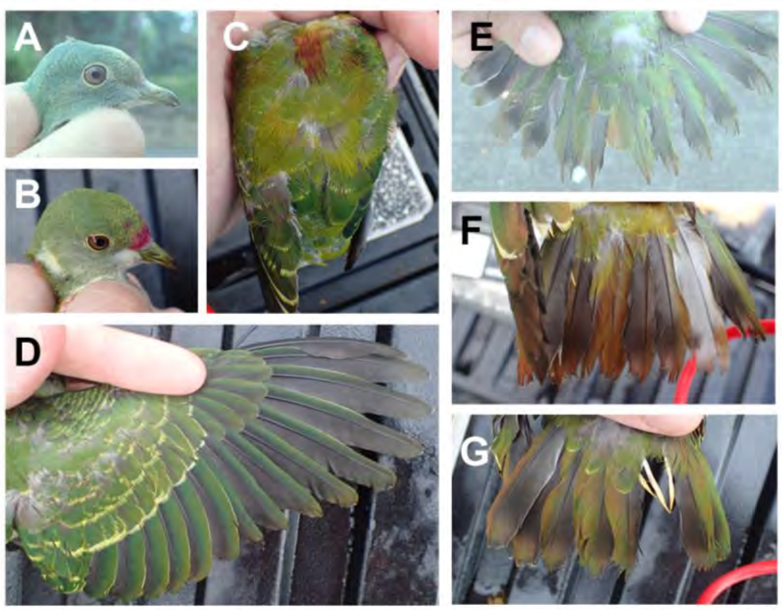

Figure 14. FPF ♀ (A, D-E, G), ♂ (B-C, F) Many-colored Fruit-Doves captured on Tutuila Island, 23-24 Sep 2016. In all three cases p1 had dropped (as in D), commencing the preformative molt. Note that by this time the incoming body feathers, green in ♀♀ (A, D) and with characteristic colorful plumage in ♂♂ (B-C), along with wing chord, can be used to sex FPFs. Rectrix pattern, mostly green with a dark subterminal band in ♀♀ (E), and variably dusky, rusty, and greenish in ♂♂ (F) may also be used to sex at least some FCJs and FPFs. The bird in G had no incoming body feathers to determine sex and the tail pattern may be intermediate, but the wing chord (117 mm) confirms it is a ♀.

Figure 15. FCF ♂ specimen (A, D; MVZ, from Fiji) and FAJ ♂ (B), and UPB ♂ (D, E-F) Many-colored Fruit-Doves captured on Tutuila Island, 23-27 Sep 2016. The FCF (A) shows suspended molt after p6 had been replaced; note that p10 (barely visible) is blunt, indicating a juvenile feather (see Fig. 12), and the difference in color between replaced formative and retained juv primaries. FAJs (B) show uniformly replaced primaries and secondaries, which could either be formative or definitive basic. FAJs that are undergoing the following primary molt are coded UPB (C) because this could be undergoing either the second or later prebasic molt. The FCF ♂ (A) and UPB ♂ (C) both had duller head and body plumage and more green markings in the outer greater coverts and tail (D-F; see also Fig. 13B and D-E) suggesting that FCF ♂♂ show pre-definitive plumage and that the UPB may have been an SPB, but confirmation is needed.

Figure 16. DCB ♀ (A-D) and DCB ♂ (E-H) Many-colored Fruit-Doves captured on Tutuila Island, 23-27 Sep 2016. Both birds have suspended primary molt (the ♀ at p7 and the ♂ at p5) and show attenuated basic outer primaries (see Fig. 12), allowing age-coding to DCB. Note also the distinctive sex-specific upperpart, underpart, and head plumages (♀ B-D, ♂ F-H).

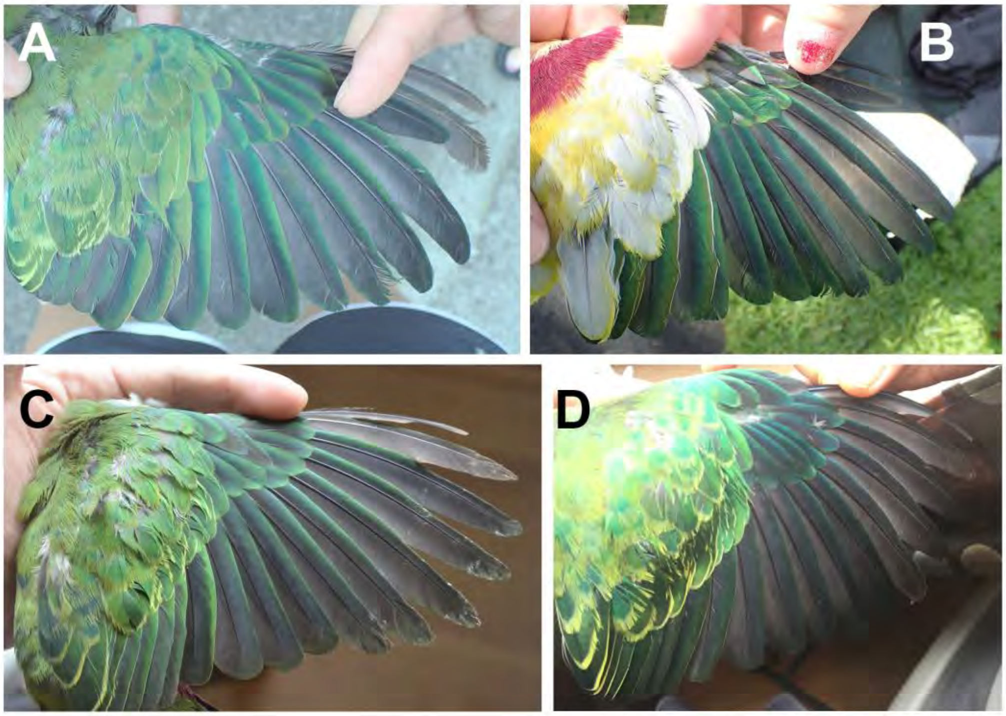

Figure 17. SPB ♀ (A), DPB ♂ (B), and two SAB ♀ (C-D) Many-colored Fruit-Doves captured on Tutuila Island, 23-27 Sep 2016. In the SPB (C), note that the two juvenile outer primaries (p9-p10) have been retained, with p10 being blunt-tipped (see Fig. 12), and that the inner three primaries (p1-p3) have been replaced during the following second prebasic molt. This is an uncommon pattern and age code in Samoan doves. In the DPB ♂ (B), p9-p10 are growing and p1-p4 are newer than p5-p8, indicating two waves of molt and age code DPB (as opposed to UPBs showing just one wave of molt; Fig. 15D). The two SAB ♀♀ each have three sets of primaries, p1-p3, p4-p8, and p9-p10 in C, and p1-p5, p6-p8, and p9-10 in D, allowing age coding to SAB. Molt appears to be slower in Many-colored Fruit-doves, allowing more coding of SCB and SAB than in other Samoan doves. .

Crimson-crowned Fruit Dove (CCFD) *Ptilinopus porphyraceus*

Range and Taxonomy: Crimson-crowned Fruit Dove is found in Fiji, Niue, Tonga, Samoa (Gill and Donsker 2017), and possibly the Marshall Islands where now extirpated. In American Samoa it is found among all island groups. Both taxonomy and use of common names are complex and confused, with many current treatments. Purple-capped Fruit Dove (*P. ponapensis*) of Micronesia has sometimes been considered conspecific and/or this common name has been also used for Samoan populations. The subspecies of Crimson-crowned Fruit Dove in Western and American Samoa is *P. p. fasciatus*, which by some treatments is considered a separate species from *P. p. porphyraceus* (Tongan Fruit Dove) to the south of Samoa.

Individuals Examined: 19 specimens from Samoa (MVZ 2, WFVZ 7, MCZ 6, CAS 4); 44 captures at TMAPS stations on Tutuila (34), Ta'u (7), and Ofu-Olosega (3).

Structure and Measurements: Ten primaries, 10 secondaries, 12-16 rectrices (cf, Fig. 26). The longest primary is p7 and the outermost primary (p10) is highly modified (Figs. 18-27). Specimens and captures from Samoa had wing chord: ♀ (n44) 124-137, ♂ (n30) 132-145, with no discernable differences among the three island groups of American Samoa. FCFs and FPFs (with juvenile p7) had measures in the bottom third of the range whereas older birds (with formative or basic p7) generally had measures in the upper two-thirds of this range.

Breeding Seasonality: Based on an unreported number of specimens, Banks (1984) concluded that breeding in American Samoa took place largely in Jun-Jan, with juveniles present Aug-Feb. TMAPS banding data show reproductive condition in Dec-Feb, one fresh juvenile captured in Jan, birds undergoing the preformative molt in Mar-Jul, and birds undergoing prebasic molts primarily in Dec-Apr. The few captures of breeding-aged birds (FAJ, DCB, or SAB) in May-Jul (n =5) showed no reproductive conditions or molt. These data perhaps indicate a peak breeding season in Sep-Feb, followed at the individual level by a peak molting season of Dec-Apr; however, some evidence from captures of this species suggests limited year-round breeding as typical of subtropical Columbiformes.

Molt: Group 1, with incomplete-to-complete preformative and prebasic molts (Table 1; Pyle et al. 2016). Banks (1984) concluded that the definitive prebasic molt took place primarily in Sep-Jan following breeding. Specimens and TMAPS captures undergoing prebasic primary replacement or heavy body molt were in Oct (2), Nov (1), Dec (1), Jan (5), Feb (2), Mar (2), and Apr (1) and those undergoing primary molt during the preformative molt were in Jan (1), Mar (1), Jun (1) and Jul (2), suggesting later and perhaps more year-round molting than indicated by Banks. Flight-feather molt sequence is typical of diastataxic Columbiformes (see Tongan Ground Dove). Banks (1984) also concluded that no older birds showed juvenile p10s; e.g., that the FCF was complete, at least with respect to primaries. Among specimens and TMAPS captures DCBs with mixed basic or formative and basic remiges were encountered (Figs 22-23) as well as staffelmauser patterns and primary molt suspension (Figs. 23-24), but no FCFs with mixed juvenile and basic flight-feathers (as in Many-colored Fruit Dove; Figs. 14-16), supporting Banks' conclusion that the preformative molt is typically complete.

Age Determination: Age-code Group 1 (Tables 1-2). **FCJ**s have entirely green and grayish heads, distinct pale fringes to the back and other feathers, a broader tip to the notched p10 (Radley et al. 2011, Pyle et al. 2016), and a duller tail pattern, with less distinct yellow tips to the rectrices (Figs. 18-20). **FPF**s in molt can be identified by the juvenile characters mentioned above and by the blunter-tipped p10 until it is dropped (Figs. 19-20). **FCF**s appear to be rare in this species but expect occasional birds to arrest the FPB before it has completed (cf. Figs. 14-16), retained secondaries among s4 and s7-s8 most likely, which are thinner, duller, and relatively abraded compared to retained basic secondaries of DCBs and SABs (cf. Fig. 14). **SPB**s are FCFs that have begun the next molt cycle with the molting of p1 before all juvenile secondaries have been dropped; these will be rarely encountered if at all. Because the preformative molt can be complete, age-codes SCB and TPB are not acceptable. Birds with definitive body plumage and that had undergone a complete molt, without suspension or retained feathers, are assigned code **FAJ** (Fig. 21), and such birds that have commenced the next molt cycle are **UPB**s (Fig. 22). Non-molting birds with two generations of basic feathers (either due to molt suspension or arrest) are coded **DCB** (Fig. 23), and these birds which have commenced the following molt can be coded **DPB** (Fig. 24). Non-molting birds with three sets of basic feathers in staffelmauser patterns or two sets along with a suspension limit can be aged **SAB** (Fig. 24); note that both DCBs and SABs that have commenced the following molt are coded DPB (cf. Fig. 23). Age codes **UCU**, **UPU**, and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction).

Should breeding occur primarily during Nov-Mar and molting primarily in Feb-Jul for the preformative molt or Dec-Apr for the definitive prebasic molt (see above), we might expect to see more FCJs in Nov-Feb, more FPFs in Nov-Jun, more FAJs, DCBs, and SABs in Apr-Jan, and more UPBs and DPBs in Dec-Apr (see Appendix 1) but both molting and non-molting birds, as well as juveniles, could well occur year-round; further data on variation in breeding and molting seasons are needed to assess this.

Sex Determination: Most individuals can be sexed by the combination of wing chord (see above) and plumage, once age is determined. FCJs are probably not separable to sex by plumage but some may be sexed by wing chord (falling in the bottom third of the full ranges for each sex). FAJ, DCB, and SAB ♀♀ average duller and grayer or more-olive napes than in ♂♂, but some overlap might be expected between SAB ♀♀ and FPF or FAJ ♂♂ (Fig. 25). Back color and tail pattern also average slightly duller in ♀♀ than ♂♂, with ♀♀ showing more green to the outer rectrices (Fig. 26). Both sexes may develop brood patches so the reliability of this and cloacal protuberances for sexing needs to be further determined; it appears that full brood patches are developed by ♀♀ only (cf. Pyle 1997).

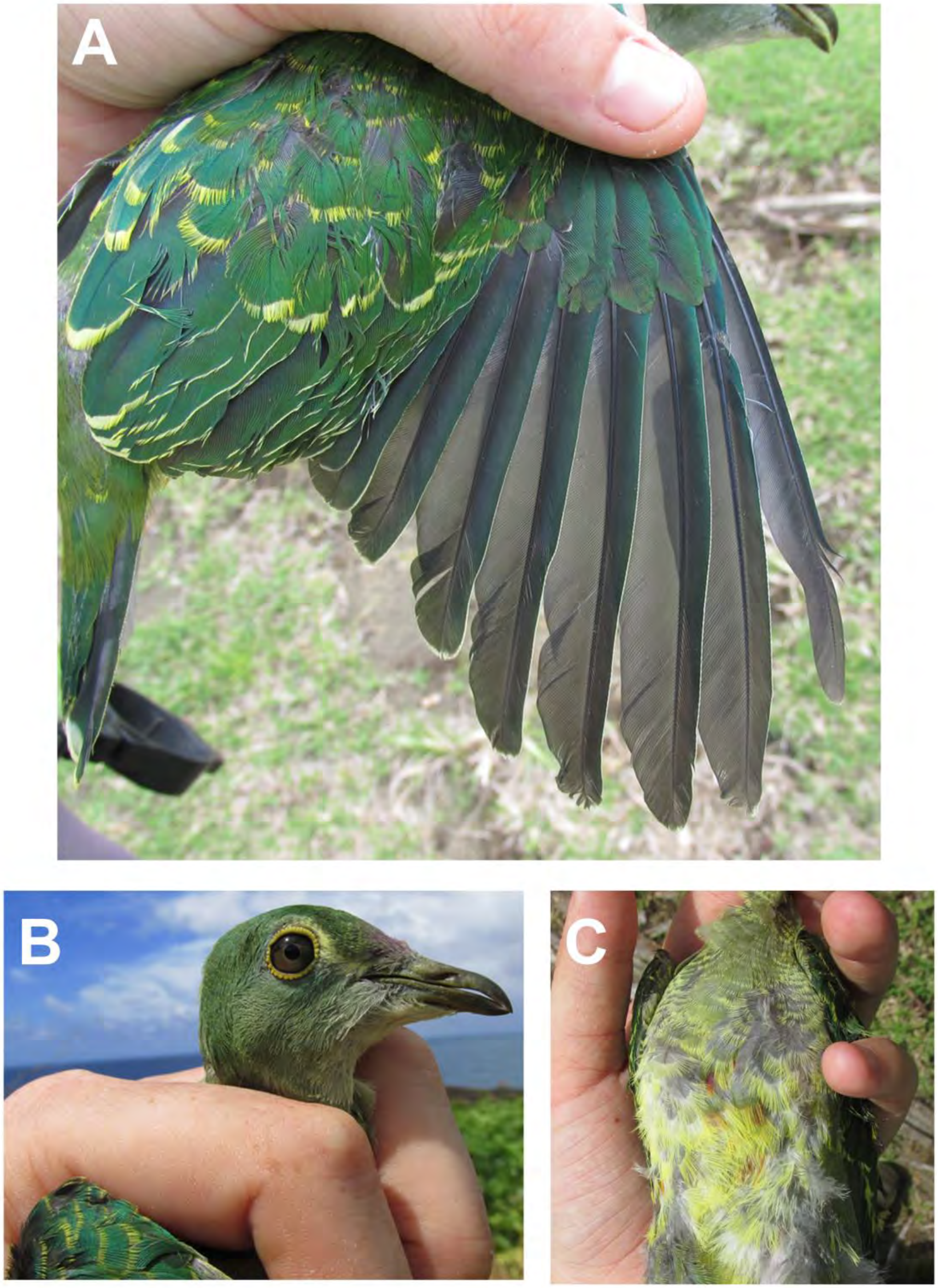

Figure 18. FCJ ♀ Crimson-crowned Fruit Dove, Tutuila Island, 5 Jan 2013. Note the pale-fringed wing coverts (A), blunt-tipped p10 (A), unmarked head (B), and largely gray-and-yellow unmarked abdomen (C); the orange and black feathers in the abdomen may be formative but since no primary molt has commenced this bird is coded FCJ (see text). The wing chord of this FCJ was 126 mm, in the bottom third of the range for ♀♀ and outside of the range for ♂♂.

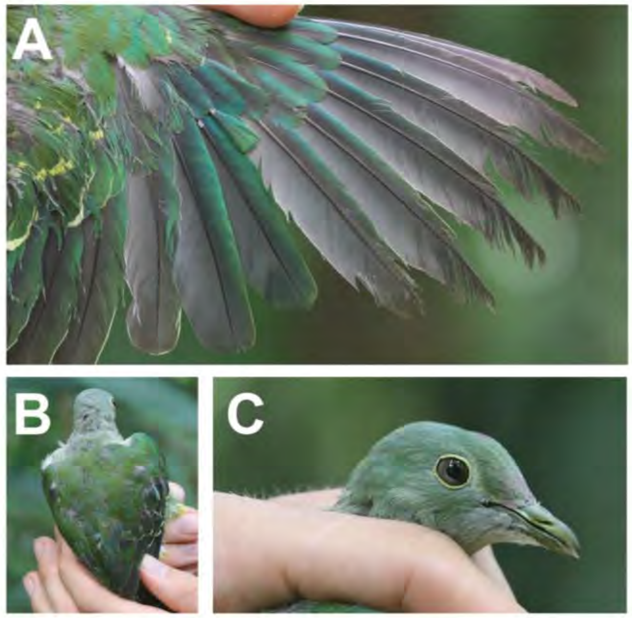

Figure 19. FPF ♀ Crimson-crowned Fruit Dove, Tutuila Island, 19 Mar 2014. The preformative molt has progressed to p4 (growing), with p1-p3 new formative and p5-p10 worn juvenile; note the relatively broad tip to p10 (A). The pale-fringed wing coverts (A) and unmarked head and crown (B-C) indicate that body feathering is still primarily juvenile. The wing chord of this FPF was 124 mm, in the bottom third of the range for ♀♀ (despite being shortened by primary wear) and outside of the range for ♂♂.

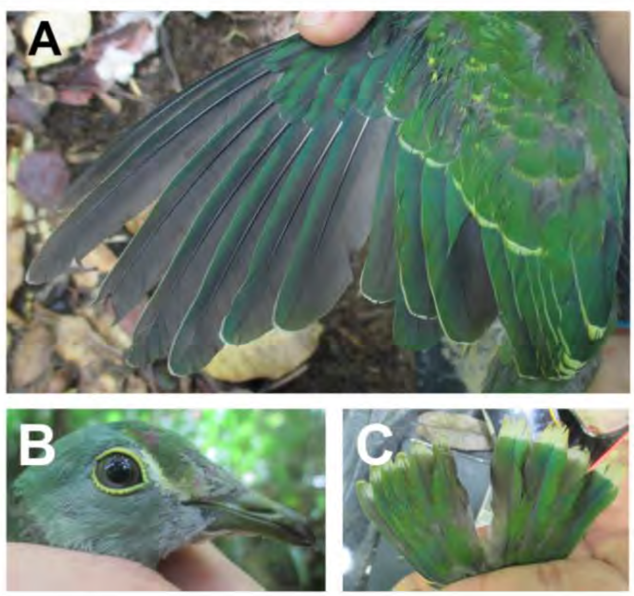

Figure 20. FPF ♀ Crimson-crowned Fruit Dove, Tutuila Island, 16 Dec 2014. The preformative molt has progressed to p5 (dropped and out of view), with p1-p4 new formative and p6-p10 worn juvenile; note the relatively broad tip to p10 (A). Among the secondaries, s1 (displaced) appears new and s5 dropped. The pale--fringed wing coverts (A) remain as juvenile and note the incoming perple and yellow formative feathers in the crown (B). The rectrices are in molt, with r1 or r1-r2 dropped, the right outer rectrices juvenile, and the left outer rectrices replaced adventitiously, providing a good comparison of the shape and pattern of juvenile vs. later rectrices (C). The wing chord of this FPF was 128 mm, near the bottom third of the range for ♀♀ and outside of the range for ♂♂.

Figure 21. FAJ ♀ Crimson-crowned Fruit Dove, Tutuila Island, 25 Mar 2013. All remiges have been replaced during the previous molt (A), the outer primary (p10) is attenuated (B), and there is thus no way to ascertain if this an FCF that had undergone a complete preformative molt or a DCB that had undergone a complete definitive prebasic molt, so we assign code FAJ. Note the relatively bright (see Fig. 26) head and abdomen feathering (C-D) as compared to FCJs and FPFs (Figs. 18-20); this body plumage is typical of all age groups of both sexes following the preformative molt. The dull greenish wash to the nape (C) along with slightly duller upperparts and tail, and a wing chord of 136 mm for an FAJ indicate that this as a ♀ (see Figs 26-27).

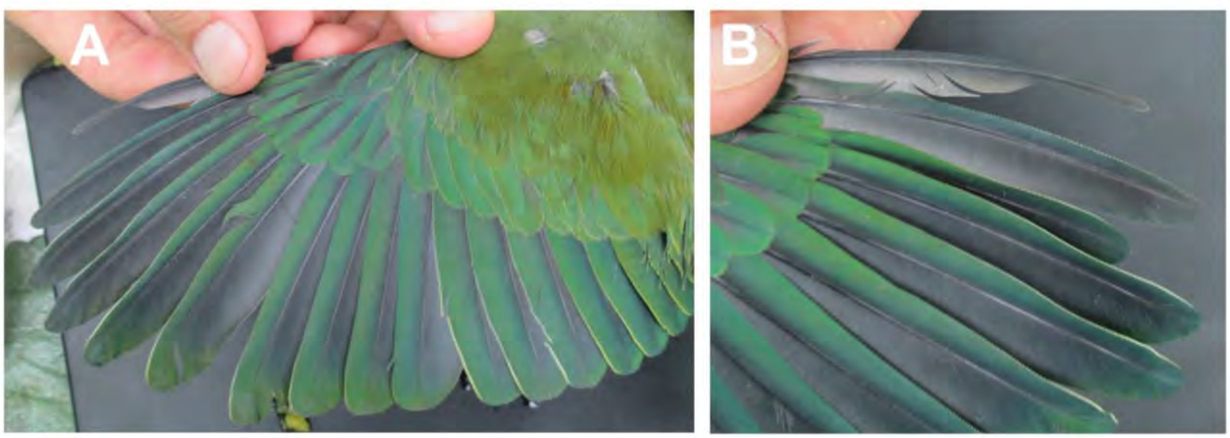

Figure 22. UPB ♂ Crimson-crowned Fruit Dove, Ofu Island, 3 Mar 2016. This UPB has dropped p9 on the left wing (A) and has p8 growing on the right wing (B). Otherwise, all remiges are of a single non-juvenile generation (note the attenuated unmolted p10s), indicating that it could either be SPB or DPB, typical of an FAJ undergoing the following molt, and thus coded UPB. Plumage and wing chord indicated this to be a UPB ♂.

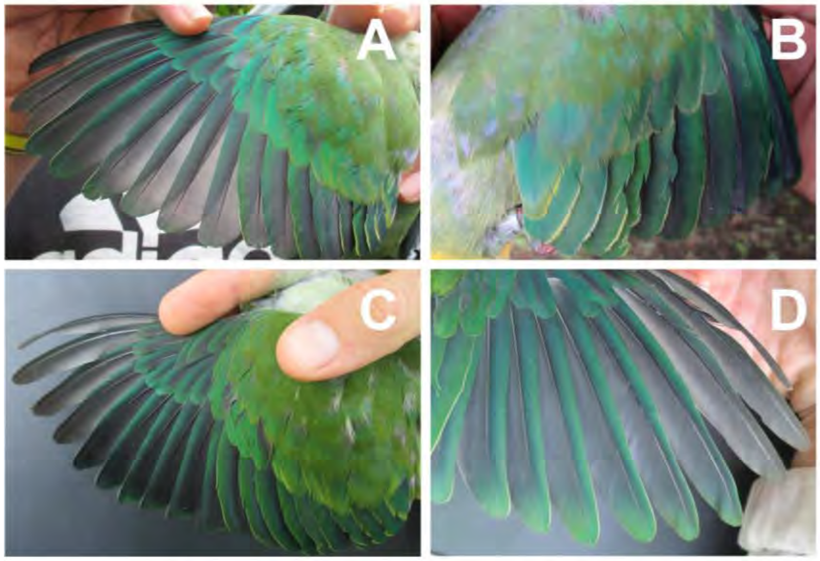

Figure 23. DCB ♂♂ Crimson-crowned Fruit Doves, Tutuila Island, 10 Feb 2015 (A-B); and Ofu Island, 8 Feb 2016 (C-D). In the upper DCB, p1-p6 have been replaced followed by suspension or arrest, with p7-p10 older (A), and the secondaries are also of multiple generations, with the inner two tertials (s9-s10) newer than the third tertial (s8) and s5 older than surrounding secondaries (B). Similarly, in the lower DCB, p1-p6 have been replaced on the left wing (C) and p1-p7 on the right wing (D), and the secondaries also appear to show multiple generations or contrasts in wear due to suspensions (C). Two generations of basic feathers (with older attenuated p10s, not visible in the upper bird, and older non-juvenile secondaries), along with the lack of active molt, result in age codes of DCB. Plumage and wing chord indicated both to be DCB ♂♂.

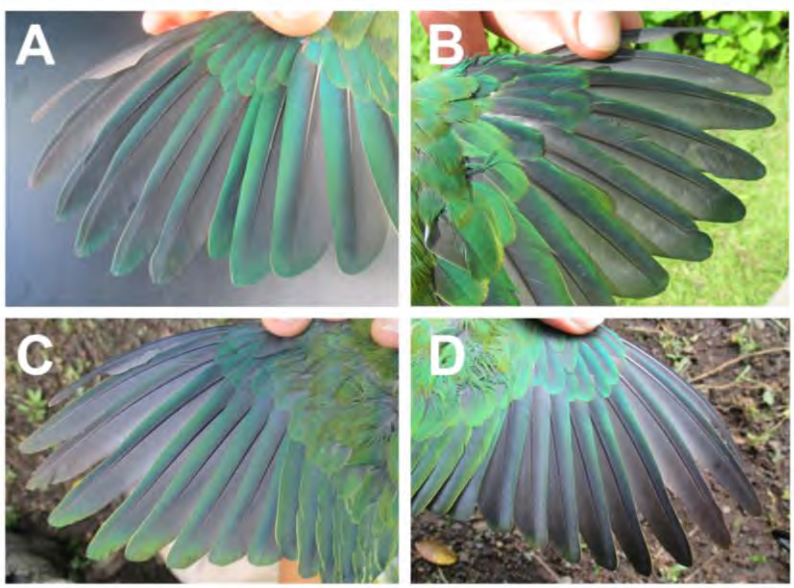

Figure 24. DPB ♀♀ Crimson-crowned Fruit Doves, Ta'u Island, 11 Jan 2016 (A); and Tutuila Island, 7 Jan 2013 (B) and 10 Feb 2015 (C-D). DPBs have multiple generations of non-juvenile remiges (note the attenuated tips to the p10s), as in DCBs or SABs (Figs. 23, 25), but are undergoing the following prebasic molt. All three of these DPBs show staffelmauser molting patterns indicating SAB prior to molt: the DPB in A has p4 growing and two sets of basic outer primaries (p5-p8 and p9-p10); the DPB in B shows p3 and p8 growing and sets at p1-p2, p4-p7, and p9-p10; and the DPB in C-D has p1 new, p7 dropped (not visible), and sets at p2-p6 and p8-p10 on both wings. Note that molting birds with two generations or suspensions among older feathers, following DCB (cf. Fig. 23), are also coded DPB. Plumage and wing chord indicated all three of these DPBs to be ♀♀.

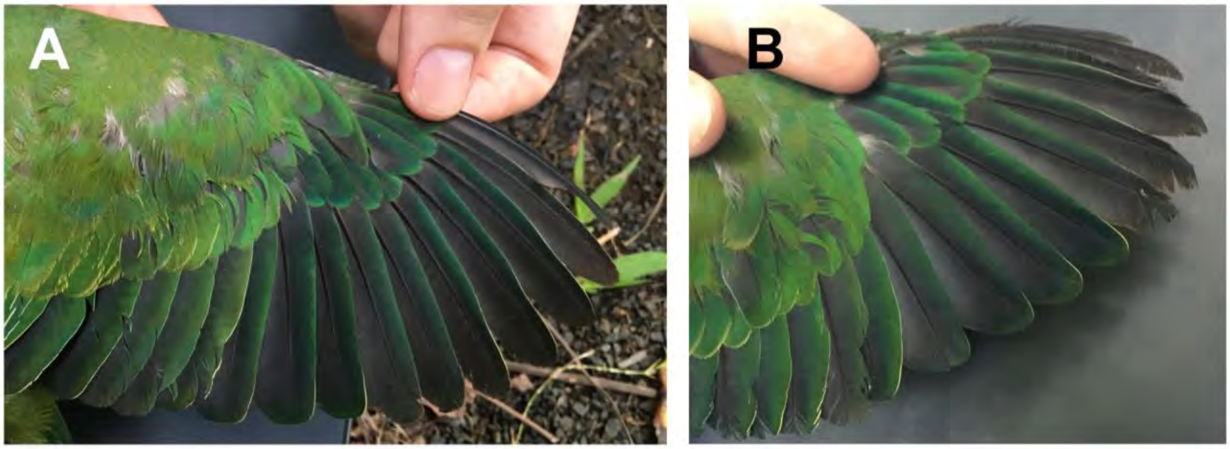

Figure 25. SAB ♀♀ Crimson-crowned Fruit Doves, Tutuila Island, 10 Feb 2015 (A) and 1 Mar 2016 (B). Both of these birds show three sets of basic feathers in staffelmauser patterns: p1-p3, p4-p8, and p9-p10 (A); and p1-p4, p5-p7, and p8-p10 (B), and thus can be age-coded SAB. Both are SAB ♀♀ by plumage features and measurements.

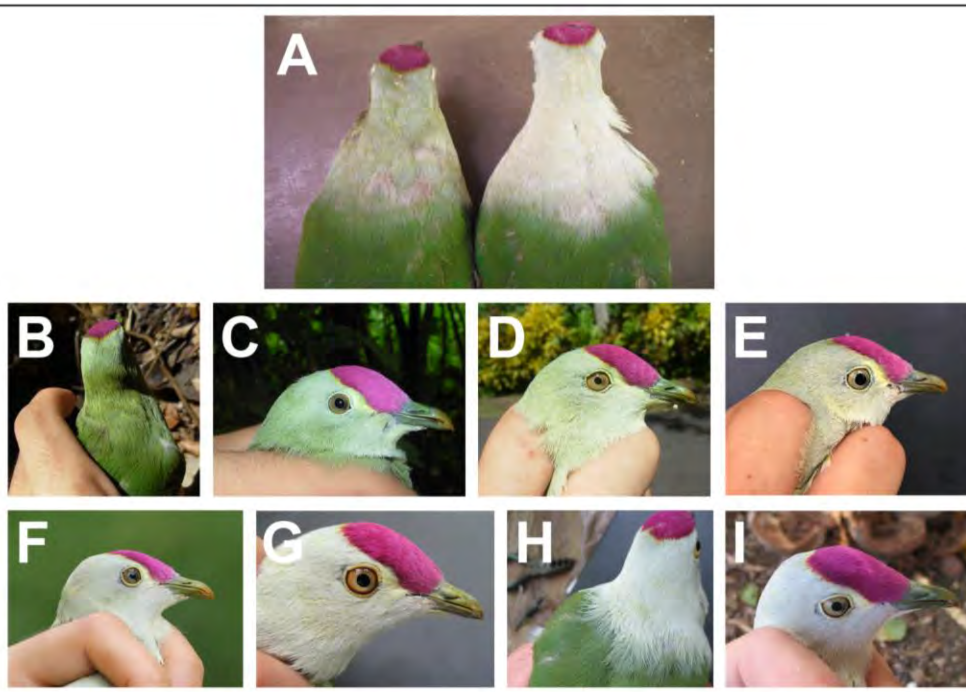

Figure 26. Variation in head plumage in adult (FAJ, DCB, and SAB) Crimson-crowned Fruit Doves: a comparison of specimens at WFVZ (A; ♀ left, ♂ right), ♀♀ (B-E), and ♂♂ (F-I). Note that some older ♀♀ may come close to overlapping with younger ♂♂; e.g., compare E (SAB ♀) with F (FAJ and possibly an SCB ♂). Photos of captured birds taken in Dec-Mar on Tutuila (B-F), Ta'u (G, I), and Ofu (H).

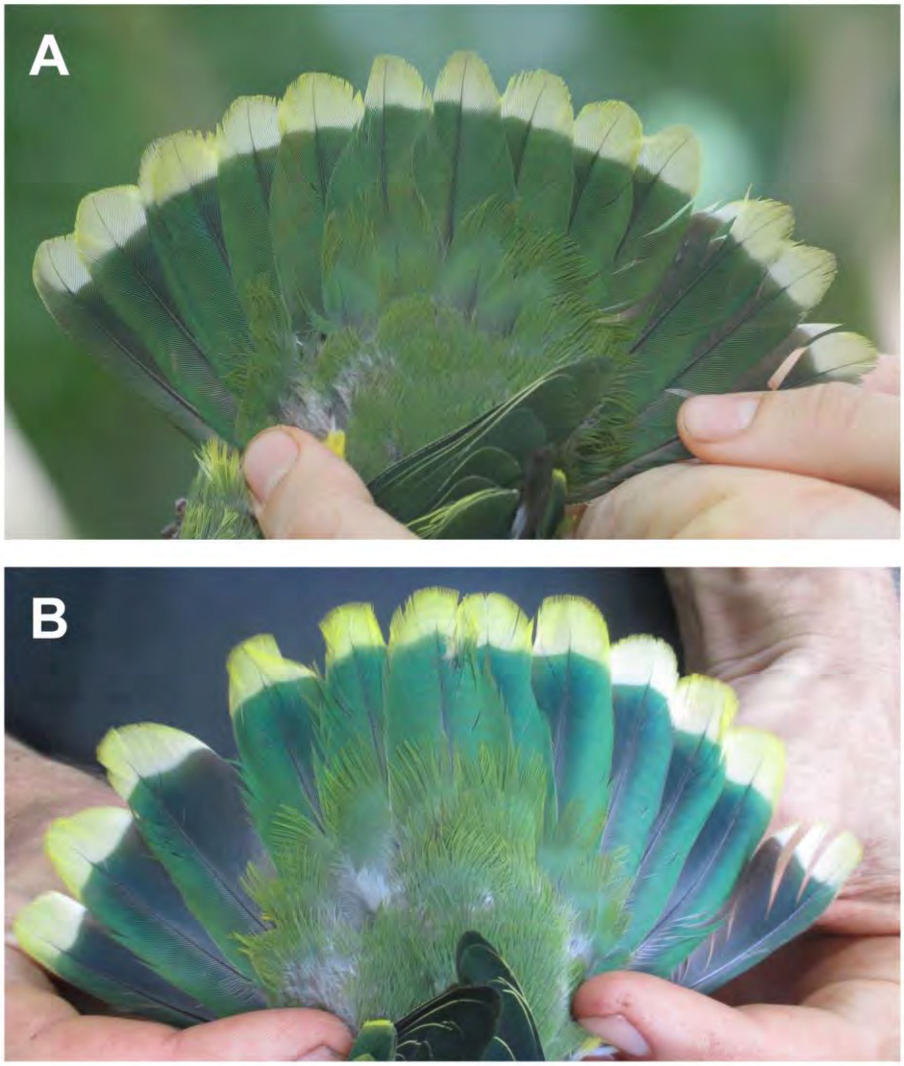

Figure 27. Variation in upperpart and tail plumage in SAB ♀ (A) and ♂ (B) Crimson-crowned Fruit Doves. ♂♂ tend to have duller olive backs and rumps as well as duller and less-distinct yellow tips to the rectrices; note especially the greater extent of green on the outer rectrix of the ♀, which appears to be a fairly consistent sex-specific character. Note also the variation in rectrix counts, 13 in the ♀ (possibly one of 14 missing) and 12 in the ♂; Crimson-crowned Fruit Doves vary from having 12 to 16 rectrices, with no apparent differences by age and sex. Photos from Tutuila 8 Mar 2014 (A) and Ofu 21 Jan 2016 (B).

Pacific Imperial Pigeon (PIPI) *Ducula pacifica*

Range and Taxonomy: Pacific Imperial Pigeons are found throughout the central and southwestern Pacific basin, from the Bismark Archipelago off New Guinea to the Cook and Samoan islands. The subspecies *D. p .pacifica* is also widespread throughout the central and southwestern Pacific Basin, including American and Western Samoa, with one other subspecies (*sejuncta*) recognized from the Bismark Archipelago

Individuals Examined: 24 specimens (MVZ 12, WFVZ 6, MCZ 3, CAS 1, MWFB 2); 15 from Samoa and 9 from elsewhere in sw. Pacific; 4 captures at TMAPS stations and 3 live or dead birds photographed apart from TMAPS stations on all three island groups.

Structure and Measurements: Ten primaries, 13 secondaries, 12 rectrices; the longest primaries are p7-p8 (Figs. 28-34). Amadon (1943a) records mean flattened wing lengths from Samoa as follows: wing chord: ♀ (n12) 237.6, DCB ♂ (n10) 251.5; tail ♀ (n8) 147.9, ♂ (n10) 153.5. Specimens from American Samoa had wing chord: DCB ♀ (n1) 215, DCB ♂ (n3) 233-240; tail DCB ♀ (n1) 135, DCB ♂ (n3) 144-176. Two unsexed FCJs captures from American Samoa had wing chords of 212 and 229 mm; it is likely that the first bird and probable that the second bird were ♀♀, and that a good proportion of individuals in American Samoa can be sexed, but study is needed on the complete range of variation among all four age/sex groups (with juvenile and formative/basic p7-p8). Tentatively, ♀♀ may have wing chords of about 212-250 and ♂♂ may have wing chords of about 232-270, with FCJs, etc. (birds with juvenile p7-p8), falling in the lower two-thirds and DCBs, etc. (with basic p7-p8), falling in the upper two thirds of these ranges.

Breeding Seasonality: Banks (1984) noted a ♀ specimen from Tutuila with ovaries "approaching readiness" in Apr and one in Oct with minute ovaries; this and molt data suggested to Banks that peak breeding may occur in Mar-Sep. Two FCJs that had just commenced body but not flight-feather molt were observed in American Samoa in late Feb and early Mar (cf. Fig. 29). The status of molting and non-molting birds (see below) perhaps suggests peak breeding in Jan-May, but it appears to be variable and probably can occur year-round as in other Pacific Columbiformes.

Molt: Group 1, with presumably incomplete-to-complete preformative and prebasic molts (Table 1). Banks (1984) found most of 21 Pacific Pigeons collected in American Samoa in Oct-Jan showed body molt and that 8 of 21 showed primary molt. Specimens, TMAPS captures, and other non-FCJ birds examined from American Samoa were in primary molt Apr (completing), Jun (commencing), and Oct (completing) while those not molting primaries or secondaries were in Jan (3), Feb (2), Mar (1), Apr (3), May (2), Jun (1), Nov (1), and Dec (1). This might suggest more molting in Jun-Nov following breeding in Mar-Sep but both breeding and molting probably occur year round to some extent. Flight-feather molt sequence is typical of diastataxic Columbiformes (see Tongan Ground Dove). It is possible that the FPF is partial (cf. Fig. 29) but, if it is interpreted to include flight-feathers as largely the case for Columbiformes, this molt is frequently if not always suspended or arrested; FCFs examined had suspended or arrested molt after p2, p6, p7, and p8 had been replaced (specimens at MVZ and cf. Figs. 31-32) and these birds also showed incomplete replacement of both secondaries and rectrices. Two FAJ specimens had undergone complete preformative or prebasic molts; otherwise, most specimens and observations of FCF, DCB, and SAB birds (n = 18) showed retained formative or basic remiges in staffelmauser patterns and often retained rectrices (Figs. 31-34); three sets of primaries indicating SAB were observed in at least six of these birds (e.g., Fig. 34).

Age Determination: Age-code Group 1 (Tables 1-2). **FCJ**s have buff fringes to back feathers and wing coverts when fresh, as in other *Duculus* pigeons (Fig. 28), but these may be variable and can wear off within a few months (Fig. 29); FCJs are otherwise easy to distinguish by duller upperparts and underparts, uniform juvenile flight feathers, smaller ornamental bill knobs, and duller pink legs and feet (Figs. 29-30). **FPF**s (FCJs that have commenced molt) and **FCF**s after suspended or arrested molt can be identified by some of the juvenile characters mentioned above (although note head and body plumage is definite-like in FCFs); by the worn, thin, brown, retained juvenile outer primaries, middle secondaries (often among s3-s4 and s7-s9), and outer rectrices (Figs. 31-32); by the dull pink legs and feet (Fig. 29), which appear to take about a year to become fuller red; and by smaller ornamental bill knobs (Figs. 29 and 31). **SPB**s are FCFs that have begun the next molt cycle, often with the molting of p1 before all juvenile secondaries have been dropped. Some birds may suspend the SPB (with two or three generations of primaries) before all juvenile secondaries have been replaced, and these birds could be aged SCB and TPB, but thus far no examples of this have been encountered, and we consider these unacceptable codes at this time. Birds with definitive body plumage and that had undergone a complete molt, without suspension or retained feathers, are assigned code **FAJ**, and such birds that have commenced the next molt cycle are **UPB**s. Non-molting birds with two generations of basic feathers (either due to molt suspension or arrest) are coded **DCB** (Fig. 32), and these birds also show definitive head and body plumage, bright red feet, and more developed ornamental bill knobs (Figs. 30, 33). DCBs which have commenced the following molt can be coded **DPB**. Non-molting birds with three sets of basic feathers in staffelmauser patterns or two sets along with a suspension limit can be aged **SAB** (Fig. 34); note that both DCBs and SABs that have commenced the following molt are coded DPB. Age codes **UCU**, **UPU**, and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction).

Should breeding occur primarily during Mar-Sep and molting primarily in Jun-Dec, but with year-round breeding at least at low rates likely (see above), we might expect to see more FCJs in Apr-Nov, FPFs year-round, more FAJs, DCBs, and SABs in Oct-Jun, and more UPBs, and DPBs in Jun-Dec (see Appendix 1) but both molting and non-molting birds, as well as juveniles, could well occur year-round; further data on variation in breeding and molting seasons are needed to assess this.

Sex Determination: DCB and SAB ♀♀ appear to average slightly duller green upperparts and duller gray head and breast than same-aged ♂♂ but plumage appears unreliable for separating individuals. Measurements (see above) are probably useful for sexing, ♀♀ being smaller, but more samples are needed to determine full ranges for each age and sex. Both sexes may develop brood patches so the reliability of this and cloacal protuberances for sexing needs to be determined. The bill knob (cf. Fig. 33) may average larger on DCB and SAB ♂♂ than ♀♀ but this may also vary by age and season; study needed.

Figure 28. Specimen of fresh FCJ of Micronesian Imperial Pigeon (Ducula oceanicus) showing buff fringes to juvenile upperpart feathers, wing coverts, and remiges. The closely related Pacific Imperial Pigeon likely shows similar fringes when fresh (though perhaps thinner or individually variable), that can wear off within a few months (cf. Fig. 29). Specimen from MVZ.

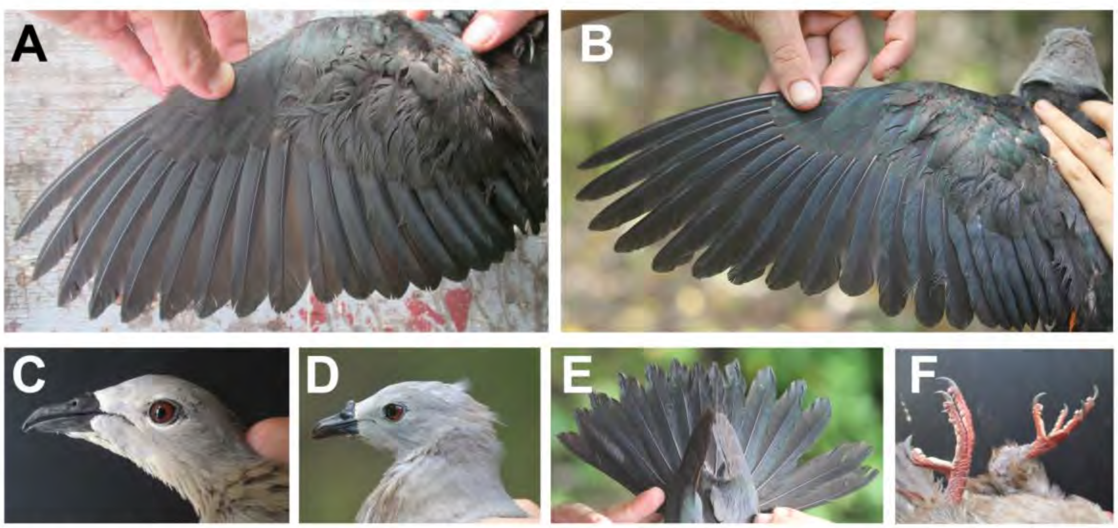

Figure 29. Worn FCJ Pacific Imperial Pigeons captured at TMAPS stations on Olosega Island, 29 Feb 2016 (A, C, F); and Tutuila Island, 8 Mar 2014 (B, D). The FCJ from Olosega Island appears fresher and may be 3-4 months old whereas the FCJ from Tutuila appears rather worn and may be 5-7 months old. Note that some back feathers and secondary coverts have been replaced (A-B) but since no juvenile remiges or rectrices have dropped we presume age-code FCJ for this bird (although, if we consider the preformative molt to be partial, we would code these FCF). Thin buff fringes are visible on some of the wing feathers of the Olosega FCJ (A), suggesting broader buff fringes in fresh FCJs (cf. Fig. 28) that wear off within a few months. Other characters indicating FCJ over FAJ include uniformly thin and pointed remiges and duller (less greenish) juvenile upperpart feathers or mixed with formative feathers (A-B), duller brown-washed heads and napes and less-developed bill knobs (C-D), uniformly narrow, pointed, and dull brownish-slate rectrices (E), and duller pink legs and feet (F).

Figure 30. Specimens of FCJ (A) and SAB (B) Pacific Imperial Pigeons showing duller upperparts and underparts in the FCJ. Specimens from WFVZ.

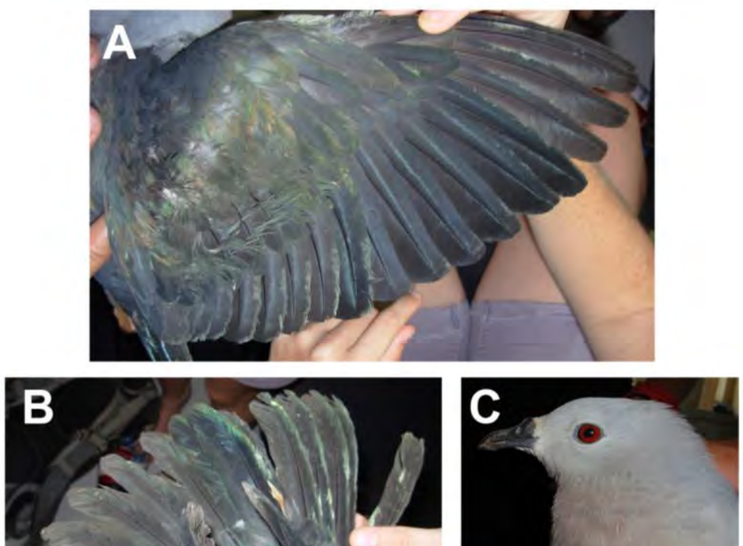

Figure 31. FCF Pacific Imperial Pigeon captured on Tutuila Island, 11 Jan 2013. This FCF has suspended the preformative molt after p1-p6, s1, s12-s13, and the central rectrices (r1) have been replaced (A-B). Note that the older unmolted flight feathers are paler, less glossy, narrower, and show even wear rather than a molt cline or suspension limits. Note also that definitive-like body plumage has been assumed (compare Figs. 29-30) but that the bill knob is still reduced in height (C).

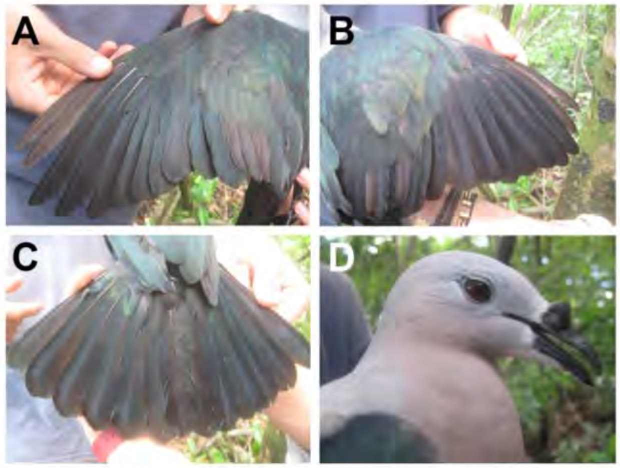

Figure 32. FCF Pacific Imperial Pigeon captured on Tutuila Island, 24 Mar 2014. This FCF has suspended the preformative molt at a later stage than that of Figure 31, with p9-p10 on both wings, s3-s4 and s6-s7 on the left wing, and s3-s4 and s7 on the right wing retained as juvenile feathers (A-B). Note that the left formative s5 appears more like a juvenile than a basic feather (having being replaced early in sequence), and that the s5 on the right wing is new and may have been molted for a second time, if not replaced adventitiously. The right p1 may also have been replaced again as part of molt or adventitiously. Should the right p1 and s5 have been replaced as part of the next molt we would consider this an SCB, a possibility since other large species of birds exhibiting staffelmauser can begin the following molt in sequence (with p1, s1, and/or s5) before all juvenile remiges are replaced (Pyle 2006). Alternatively, if the preformative molt is considered partial (see text), we would call this an SCB or TPB. Study needed. Note also that all rectrices have been replaced and are formative (C); they are possibly weaker than basic feathers and intermediate between juvenile and basic in shape, and that the body plumage appears definitive and bill knob larger than in FCJs (D; cf. Fig. 29).

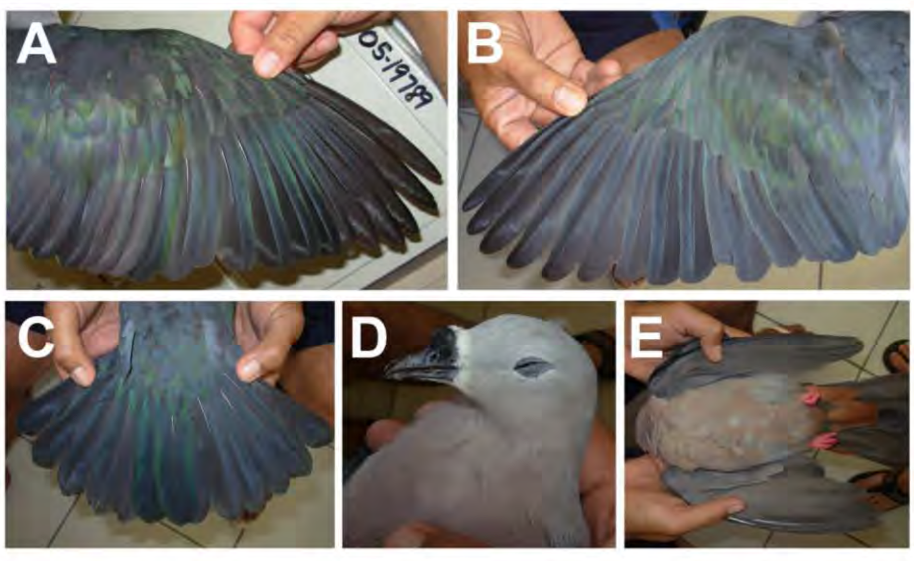

Figure 33. DCB Pacific Imperial Pigeons brought in by hunters on Tutuila Island, 4 Apr 2014 (A) and 22 Feb 2013 (B-E). There are only two sets of non-juvenile remiges in the first bird (A; p1-p4, s1, and s5 new; p5-p10 and the remaining secondaries old) and also in the second bird (B; p1-p2 and p3-p10) along with the rectrices (C; r1 and r2-r7), indicating DCBs (as the older feathers could be either formative or basic); had there only been one set we would age these birds FAJ. In comparison with FCJ (Fig. 29), note that the bill knob is full (B), the head and breast plumage are definitive (B-C), and the feet are bright red (C); a bill knob this full might indicate a ♂ but study is needed on variation in bill knob size within each sex by age and season.

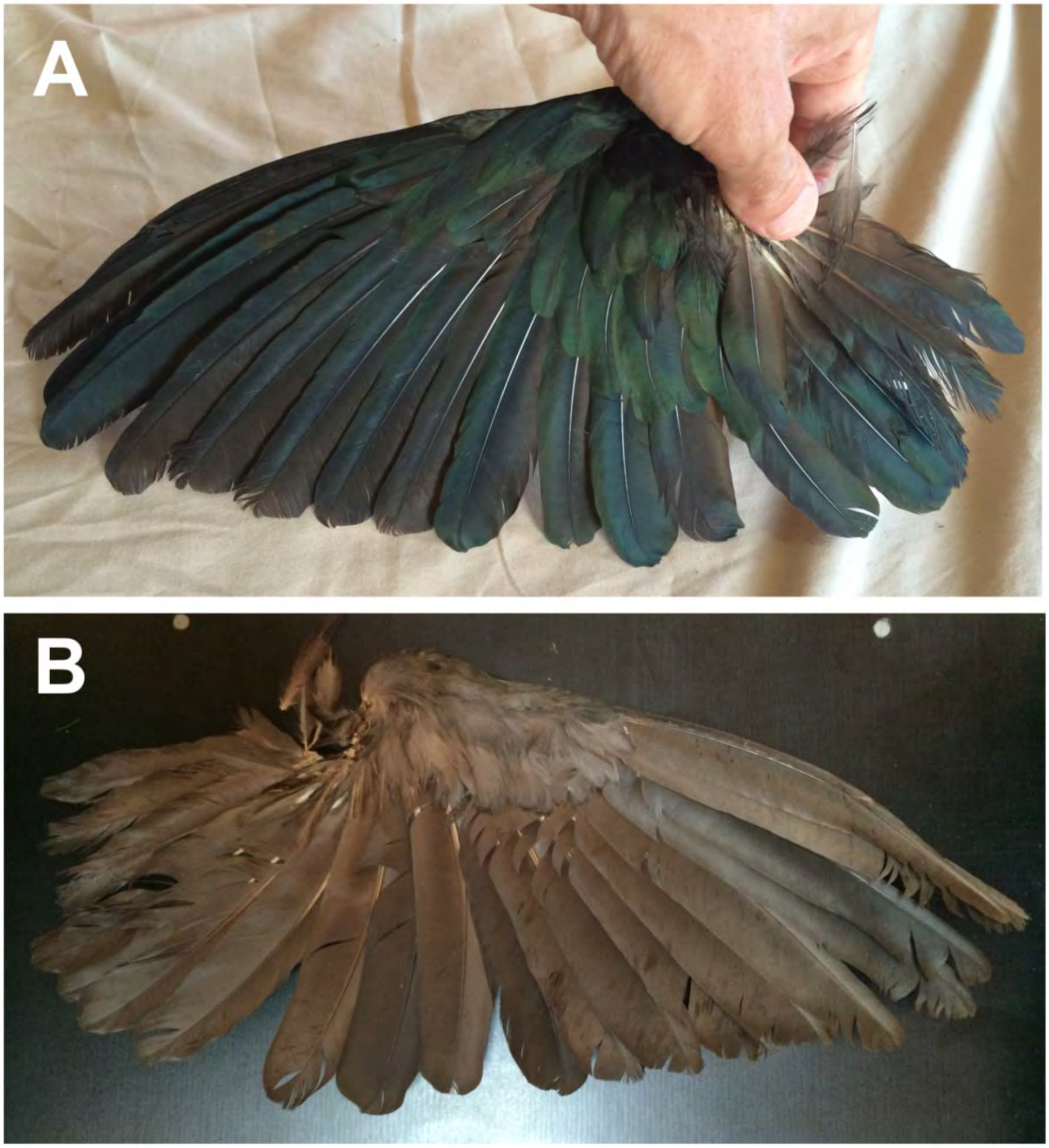

Figure 34. Right wing of SAB Imperial Pigeon found dead on Ofu Island, 5 Dec 2015. Note the three sets of basic primaries (p1, p2-p8, and p9-p10) allowing age-coding to SAB.

Pacific Long-tailed Cuckoo (PLTC) *Urodynamis taitensis*

Range and Taxonomy: Pacific Long-tailed Cuckoos were formerly referred to as just Long-tailed Cuckoos and was recently moved from the genus *Eudynamys* (Gill and Donsker 2017). They breed in New Zealand during the austral summer and migrate widely through the southern Pacific Basin north to Micronesia for the Austral winter, with apparently most or all first-cycle birds remaining to over-summer for their first 1.5 years on the Pacific Basin winter grounds. No subspecies are recognized.

Individuals Examined: 2 specimens (MVZ 2) from Tutuila and Wake islands; 3 captures at TMAPS stations on Tutuila (2) and Ta'u (1).

Structure and Measurements: Ten primaries, 10 secondaries, 10 rectrices. Longest primary is p7, with p9 and p10 reduced to about two-thirds and half the length of p7, respectively (Figs. 35-37). Measurements from Higgins (1999): wing (flat) DCB M 182-196, DCB F 177-193, FCJ M 162-182, FCJ F 164-184; tail DCB M 213-239, DCB F 206-234, FCJ M 160-207, FCJ F 162-208.

Breeding Seasonality: This species breeds in New Zealand during Oct-Mar, with most adults migrating north following breeding into Polynesia and Micronesia (as far north as Wake Island) in Feb-Mar and returning in Oct-Nov (Bogert 1937, Higgins 1999). Bogert (1937) lists 19 specimens from the Samoan Islands including dated specimens collected in Mar (1), May (1), Jun (2) , Aug (1), Nov (3), Dec (2), and Jan (3), and Banks (1984) mentions additional specimens from Oct and May. Bogert (1937) concluded that at least some first-cycle birds remain on winter grounds for their first summer and the Dec-Jan specimens above, along with TMAPS captures in Jan and early Mar, support this idea; Stresemann and Stresemann (1961) suggest that all first-year birds remain north for their first breeding season.

Molt: Group 2, with limited-to-partial preformative and complete prebasic molts (Table 1). Stresemann and Stresemann (1966) and Higgins (1999) indicate that all molting occurs away from breeding grounds and that, in adults, the definitive prebasic molt probably begins in May, is well advanced in Jul, and probably completes in Aug or early Sep before migration back to New Zealand. Banks (1984) indicates that all 8 specimens collected in Samoa in Nov-Jan (Bogert 1937), presumably first-year birds over-summering on the winter grounds, were in molt, and Higgins (1999) ascribes this to a complete preformative molt which follows the same sequence as the definitive prebasic molt, occurring from Nov to Mar/Apr. However, Gill and Hauber (2013) suggest a partial molt of body feathers from juvenile plumage before birds migrate from New Zealand, and specimen evidence confirms that first-year birds in Jun-Jul show mixed body feathers but retain juvenile flight feathers (Fig. 35). We thus propose that a limited-to-partial FPF of body feathers occurs in Mar-Jul or later, commencing on breeding grounds and completing on winter grounds, and that the complete molt in Nov-Apr by over-summering first-year birds is the SPB. Most or all cuckoos are currently assumed to have a complete FPF (e.g., Cramp 1985, Pyle 1997, Higgins 1999) so this may be a novel molt strategy reported for the family, perhaps driven by this species' long migrations, and it should be confirmed. Adopting this strategy here, however, allows for more reliable age coding of birds in American Samoa. If this is correct, we presume that the TPB is pulled forward to occur in May-Aug (commencing shortly after the SPB completes), coincident with the definitive prebasic molt of older birds. Interestingly, a similar strategy to this (but in opposite seasons) appears to occur with Bristle-thighed Curlews (*Numenius tahitiensis*) migrating to similar or the same Pacific-Basin winter grounds from the north (Marks 1993, Pyle 2008).

Pacific Long-tailed Cuckoos appear to undergo an unusual primary molt sequence, as occurs in other cuckoos (Stresemann and Stresemann 1961, Rohwer and Broms 2013), in which several molt series are present among the primaries. Rohwer and Broms (2013) report three series in Yellow-billed Cuckoo *Coccyzus americanus*, p1-to-p5, p6-to-p8, and p9-to-p10, and four series in Common Cuckoo *Cuculus canorus*, p1-to-p3, p4-to-p6, p7-to-p8, and p9-to-p10. Analysis of molt and molt clines in TMAPS captures indicates Pacific Long-tailed Cuckoos may undergo yet a third strategy with four series: p1, p2-p3, p4-p8, and p9-p10 (Figs. 36-37) but this needs to be confirmed. Secondaries may molt distally from the tertials and proximally from centers at s1 and s4, such that the last secondaries replaced may be s3 and s6 (Figs. 36-37), but again, both the sequence and individual variation in this sequence requires further study. Rectrices appear to be replaced initially from r1 but sequence among the outer feathers (r2-r5) may be variable (Fig. 36); in Yellow-billed Cuckoo they are reported to molt distally from r1 and proximally from r5, with the last replaced among r2 and r3 (Rohwer and Broms 2013).

Age Determination: Age-code Group 2 (Tables 1-2). The following coding assumes a partial FPF in Apr-Jul or later and that the first flight-feather molt in Nov-Apr is part of the SPB (see **Molt** and Figs. 35-37). **FCJ**s in New Zealand have bold whitish spots to the upperparts and may vary from whitish to buffy as background underpart coloration, while **FPF**s and **FCF**s also show these plumage patterns but with a variable number of more rufous-barred upperpart feathers and deeper buff formative underpart feathers newly replaced and/or growing in (Fig. 35). Full FCJs may or may not be expected in Samoa in Mar-Apr, most birds in May-Jul or later may be FPFs undergoing protracted body-feather molt (Fig. 35), and some to most birds in Jul-Oct may be FCFs. Once flight-feather molt in these birds is underway in Nov-Apr, with juvenile flight feathers being replaced, they are coded **SPB** (Fig. 36), and birds following this molt and showing uniform basic plumage are **DCB**s (Fig. 37). DCBs show rufous-barred upperpart feathers (without white spots) and patterns in the wings indicating several molt sets, possibly at p1, p2-p3, p4-p8, and p9-p10 (Figs. 36-37; see **Molt**). If all molting over-summering birds in American Samoa are undergoing the SPB, fresh basic birds in Apr-Jul might be reliably age-coded SCB, but we are not ready to make this assumption here; age codes FAJ and TPB are also not acceptable in this species. Arriving, worn, post-breeding birds in Mar-Apr are also coded DCB (though perhaps reliably SAB; study needed), all birds molting from basic-to-basic plumage in Apr-Sep can be age-coded **DPB**, and birds completing this molt with no older feathers remaining (could be SPB or DPB) are coded **UPB**. Age codes **UCU** and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age code UPU is not assigned for this species.

Breeding occurs outside of Samoa during Oct-Mar and molting appears to occur in Samoa during Apr-Jul (preformative molt), Nov-Mar (second prebasic molt), and Apr-Sep (definitive prebasic molt). FCJs may or may not occur in American Samoa and we will expect FCFs primarily in Aug-Nov and DCBs primarily in Mar-Jun (perhaps fresh SCBs and worn SABs, but study needed) and again in Aug-Oct before southbound migration (see Appendix 1).

Sex Determination: Bogert (1937) suggests that ♀♀ may average duller, darker, and with more white spots to upperparts than ♂♂ but considerable variation (including that related to age) appears to preclude sexing individuals. Higgins (1999) indicates sexes are alike in plumage and that ♀♀ are only slightly smaller than ♂♂ on average (see above); thus sexes of non-breeding birds are probably not reliably separated in American Samoa.

Figure 35. Specimen of FPF or FCF Pacific Long-tailed Cuckoo collected on Tutuila Island, 16 Jun 1931 (MVZ 58074). Note the replaced rufous-streaked crown feathers and rufous-barred back feathers with broad white tips (A), and the replaced buffier underpart feathers (B), contrasting with the white-spotted juvenile upperpart feathers and whiter juvenile underpart feathers. The replaced feathers are here considered formative and evidence for a limited-to-partial preformative molt (see Molt). A second specimen of an FPF or FCF collected at Wake Island 16 Jul 1939 (MVZ 79433) had more extensive body-feather replacement, suggesting that the molt may continue through at least Jul on the winter grounds, and that the specimen shown here could have been an FPF (although no pin feathers were observed on this specimen). All flight feathers were juvenile (C-D) except the left p4 (C), which may have been adventitiously replaced or could have represented suspended molt as a commencement node occurs at p4 (see above); the lack of replacement of this feather on the right wing suggests the former.

Figure 36. SPB Pacific Long-tailed Cuckoos captured on Ofu Island on 18 Jan 2016 (A, D, F), and on Tutuila Island on 8 Mar 2014 (B, C, E). The Jan bird (A) is completing second prebasic primary molt, apparently with p1, p3, p8, and p10 missing or growing, terminal feathers in the proposed molt series (see Molt). Secondaries are also completing molt, with s3 and s6 (arrows) still juvenile. The Mar bird appears to have completed this primary molt (with apparent molt series at p1, p2-p3, p4-p8, and p9-p10 based on clines), and to be molting s3 and s7, with s6 juvenile (arrow). In both birds, note how narrow and worn the juvenile secondaries are as compared with replaced formative feathers (A-B). The second-basic upperpart feathers (C) are primarily rufous-barred, unlike juvenile or formative feathers (see Fig. 35) and coinciding with these feathers in DCBs (Higgins 1999). Rectrices of the Jan bird (D) appear to be replacing in sequence r1-r4-r3-r2-r6 on the right side of the tail, but the sequence appears o differ on the left side. Both of these SPBs showed a gray iris (E-F) is an indication of age (compare with the reddish-brown iris color in the DCB in Fig. 37E).

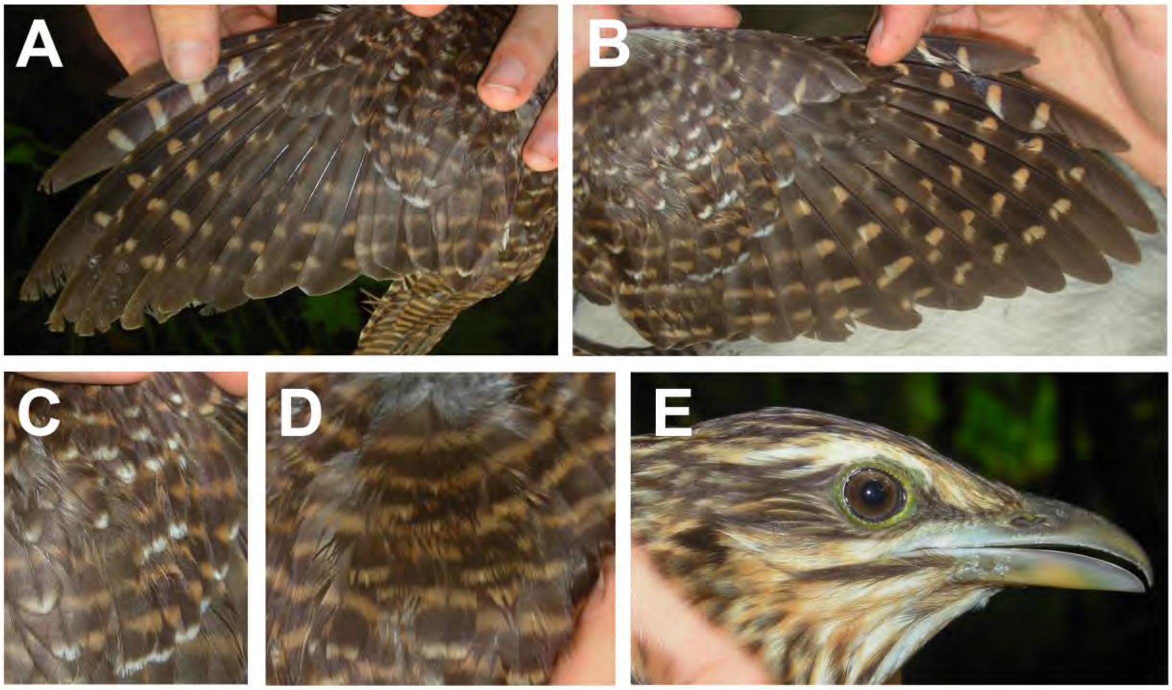

Figure 37. DCB Pacific Long-tailed Cuckoo captured on Ta'u Island, 7 Mar 2014. This bird has completed body-feather and flight-feather molt and is here age-coded DCB. Notice that, in both wings, molt clines appear to show four series, at p1, p2-p3, p4-p8, and p9-p10 (A-B, with possibly an extra series at p4-p5, separate from that at p7-p8). Upperwing coverts are uniformly white-tipped (B) but back feathers are uniformly buff-barred (C), typical of breeding adults (Higgins 1999). The reddish-brown (less grayish) iris (D) than in the SPBs of Figure 36, suggesting that the iris may become more brownish-red in adults and can be used in age determinations. The fact that this DCB appears freshly molted in Mar suggests that it may be an SCB, with arriving older DCBs being worn in Mar-Apr, but confirmation of both molt strategies and iris color as contributing to age-coding in this species is needed.

White-rumped Swiftlet (WRSW) *Aerodramus spodiopygius*

Range and Taxonomy: The White-rumped Swiftlet breeds widely through the southwestern Pacific Basin, from the Bismark Archipelago to the Samoan Islands. Eleven subspecies have been recognized, of which nominate *A. s. spodiopygius* occurs in Western and American Samoa (Gill and Donsker 2017).

Individuals Examined: Six specimens (MVZ 1, WFVZ 5) from Tutuila (MVZ) and Western Samoa (WFVZ); 19 captures at TMAPS stations on Tutuila (14) and Ta'u (5).

Structure and Measurements: Ten primaries, 7 secondaries, 10 rectrices; the longest primary is p9 (Figs. 38-43). No measurements by sex are available. Nineteen captures of unknown sex had wing chord 107-120 and tail 47-53.

Breeding Seasonality: Banks (1984) notes that only one of 21 specimens collected in Nov-Feb in American Samoa was in full breeding condition (several appeared to be commencing breeding and one was a recent fledgling) but also noted that others had observed active nests in a cave in December. None of six captures of DCBs at TMAPS stations on Tutuila and Ta'u were in breeding condition but three juveniles were captured in Aug. Dhondt's (1976) suggestion and Tarburton's (2009) confirmation that White-rumped Swiftlets breed year-round at a rather even pace in Western Samoa seems likely to be the case in American Samoa as well. In Australia, this species is seasonal, breeding primarily in Nov-Mar (Higgins 1999).

Molt: Group 3, with partial preformative and incomplete-to-complete prebasic molts (Table 1; Pyle et al. 2016). Banks (1984) noted that 13 of 21 specimens collected in Nov-Feb in American Samoa were molting primaries and that the others seemed to be fresh first-cycle birds without primary molt. Banks noted specimens in Jun and Oct that were not molting, as was the case with specimens in Apr and May (fresh) and Jul and Nov (worn). At TMAPS stations, molting birds were captured 19 Sep (DPB with p2 growing; see Fig. 43) and 10 May (UPB with p10 growing; see Fig. 42). The molt timing in these captures along with data presented on breeding birds on Western Samoa by Tarburton (2009, Table 5) suggests that many birds begin the definitive prebasic molt in Jul-Nov and complete the molt in Mar-May, but non-molting DCBs were captured year-round and there may be other exceptions to the above schedule, likely including SPBs. Breeding and molting can coincide in this species (Higgins 1999, Tarburton 2009). An FPF was captured in Aug molting body feathers only and FCFs with retained juvenile flight feathers were captured in Nov, Feb, and Aug (e.g., Figs. 38-39), indicating the FPF to be partial, including body but not flight feathers, as found in most or all other swifts (Cramp 1985, Pyle 1997, Higgins 1999). Molt sequence proceeds from p1 to p10 (cf. Figs. 40-43) and likely proceeds distally from the innermost secondary (s7) and proximally from the outermost secondary (s1) as found in other swifts and the related hummingbirds (Pyle 1997). The second and definitive prebasic molts can be suspended (e.g., Fig. 40), perhaps for breeding, and one capture exhibited staffelmauser (Fig. 43), the first recorded instance of this molt pattern we are aware of for swifts.

Age Determination: Age-code Group 3 (Tables 1-2; Pyle et al. 2016). **FCJ**s, **FPF**s, and fresh **FCF**s have narrow pale fringes to the unmolted juvenile upperparts feathers, secondaries, and p1-p6 (Higgins 1999; Fig. 38); FCFs also show narrower outer primaries and rectrices than DCBs, and lack molt clines (Figs. 38-39). FCFs that commence the following complete molt (and show worn juvenile unmolted flight feathers) are **SPB**s, such individuals that suspend the molt can be age-coded **SCB** (Fig. 40), and SCBs that have commenced the following molt can be coded **TPB** (though this code is rare). Birds with completely molted non-juvenile feathers and showing molt clines, most visible among the primaries, are **DCB**s (Fig. 41), such birds that have commenced the next molt cycle (with older feathers basic) are **DPB**s, and birds completing flight-feather molt such that the previous feather generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB** (Fig. 42). Non-molting birds with two generations of basic feathers (either due to molt suspension or arrest) are coded **SAB**, and such birds commencing the following molt are DPBs (Fig. 43); note that DPB is coded for both DCBs and SABs that have commenced the following molt. Age codes **UCU** and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FAJ and UPU are not assigned for this species. As breeding and molting essentially occur year-round (see above), we can expect to see all acceptable age codes for Group 3 species (all codes except FAJ) at any time of year (see Appendix 1).

Sex Determination: Sexes are monochromatic and similar in size (Higgins 1999, Pyle et al. 2016; see Measurements, above) and sexes thus cannot be separated by size or appearance in the hand. Cloacal protuberances appear not to be useful for sexing swifts and reliability of brood-patch condition needs to be assessed (Pyle 1997).

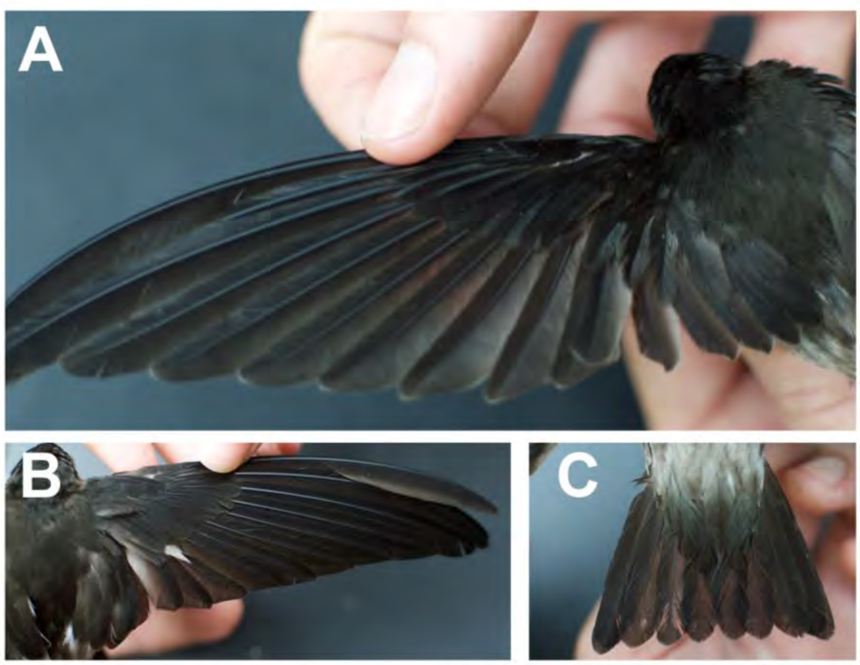

Figure 38. Fresh FCF White-rumped Swiftlet captured on Tutuila Island, 14 Feb 2016. Note the pale or white fringes to the fresh juvenile secondaries (A-B) and the narrow juvenile rectrices (C). The replaced body feathers, contrasting with the retained juvenile wings (A-B), indicate that the preformative molt in partial in this species.

Figure 39. FCF White-rumped Swiftlets captured on Tutuila Island, 16 Aug 2012 (A) and 7 Feb 2013 (B-C). Note the lack of molt clines in the primaries and narrow outer primary (A-B); compare with the DCB, UPB, and DPB in Figures 41-43, below. The left outer rectrix (r5) in C is worn and narrow, typical of a juvenile feather, whereas the right outer rectrix has been adventitously replaced and resembles basic feathers, providing a good comparison.

Figure 40. SCB White-rumped Swiftlet captured on Ta'u Island, 23 Dec 2014. Molt has suspended after p1-p3 (A), s1 and s7 (B), and the pair of r1s (C) were replaced; the remaining primaries are worn juvenile feathers, except for p6, that has been replaced adventitiously (this feather was not replaced on the left wing). Note the narrow and worn retained juvenile outer rpimaries, secondaries, and rectrices. Individuals that suspend the second prebasic molt can be age-coded SCB. Should such a suspension occur with the unmolted feathers basic, age-code SAB would apply (cf. Fig. 43).

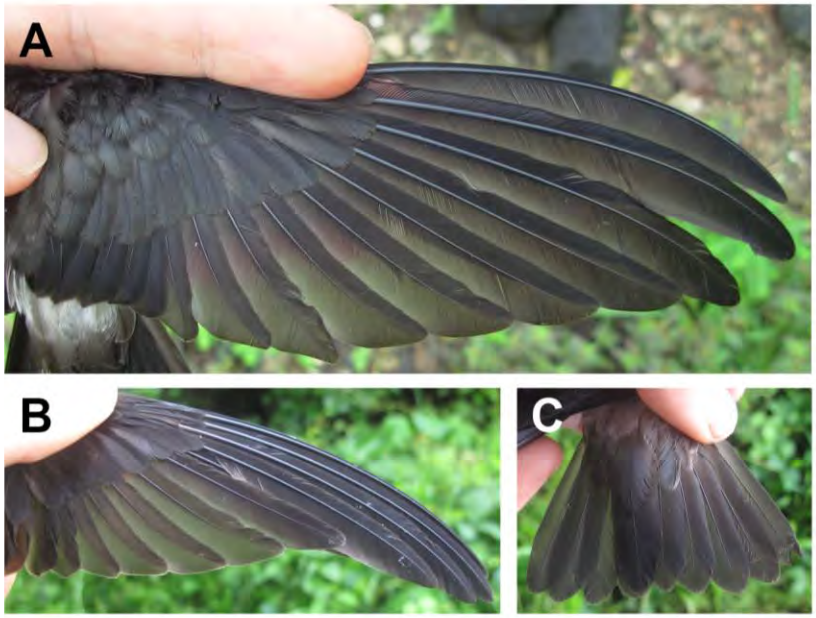

Figure 41. DCB White-rumped Swiftlets captured on Ta'u Island, 7 Jan 2014 (A), and Tutuila Island, 31 Jan 2014 (B-C). Note the molt clines among the primaries (fresher and darker distally) and the darker and fresher outer secondaries than inner primaries (A-B) and the relatively broad outer primaries (A-B) and rectrices (C). Compare these criteria with those of the FCFs and SCB in Figs. 38-40.

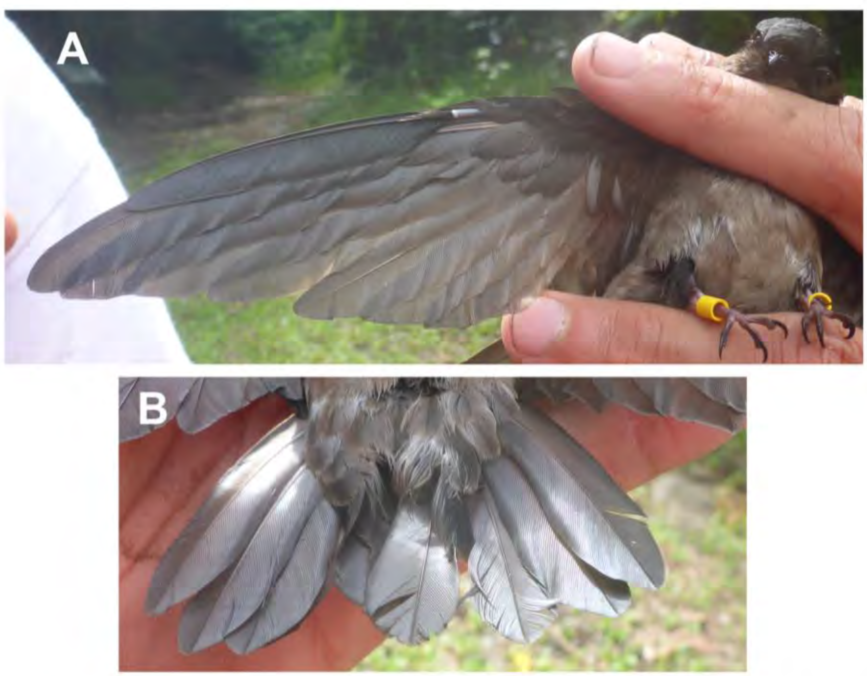

Figure 42. UPB White-rumped Swiftlet captured on Tutuila Island, 10 May 2013. This UPB was just completing molt, with p10 (A), s4, and r5 (B) still growing; note the molt cline among the primaries and the broad basic outer primaries and rectrices. Since we do not know if this was the second or a later definitive prebasic molt, we age code this bird as UPB.

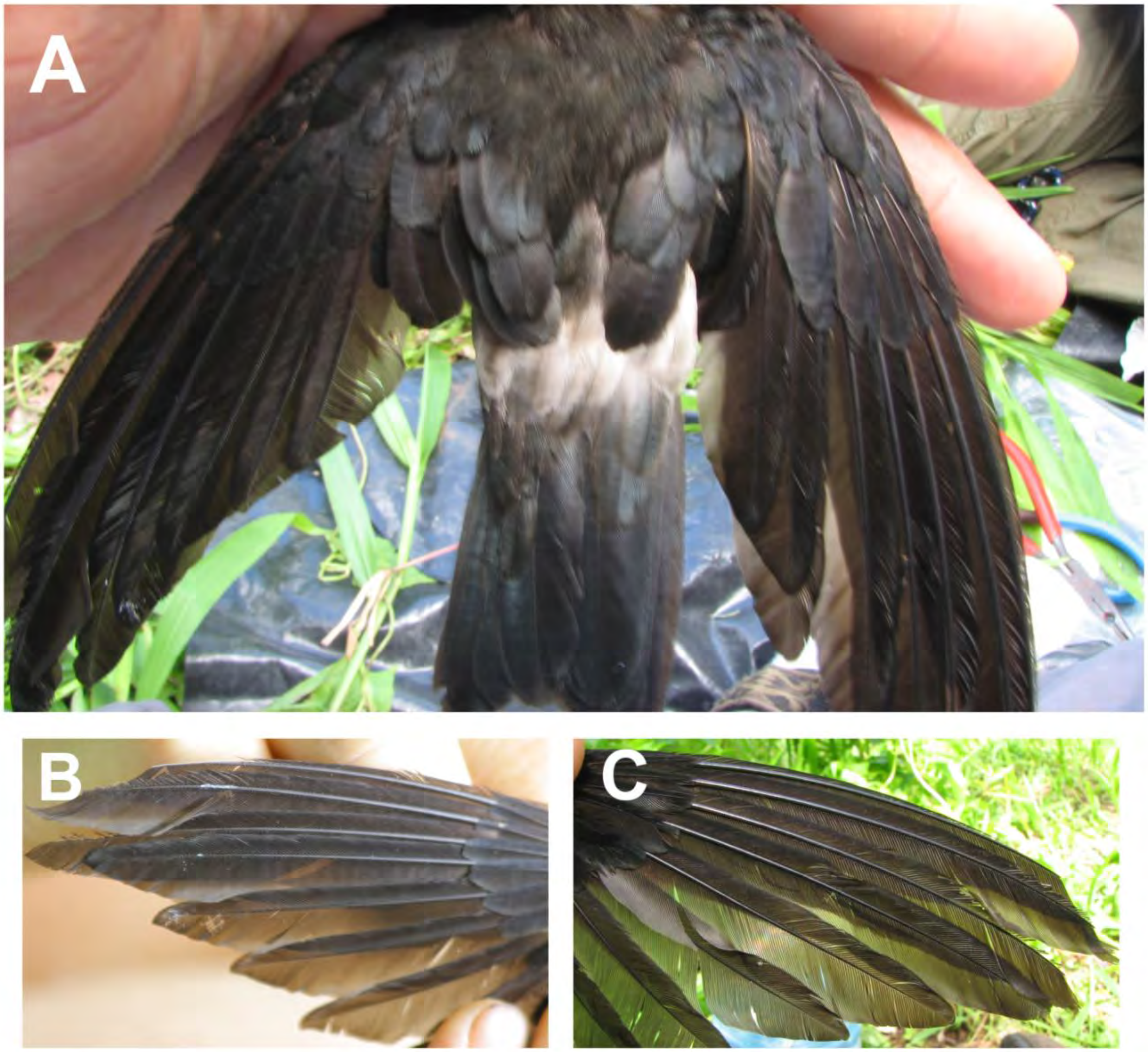

Figure 43. DPB White-rumped Swiftlet captured on Tutuila Island, 19 Sep 2012. This DPB is molting p2 on both wings (A) and also has suspended a wave of molt between basic p7 and basic p8 on both wings (B-C). This indicates staffelmauser, the first report of this molt pattern in a swift that we are aware of. We age-code such birds as DPB, following either DCB or (in this case) SAB with two generations of basic feathers before molt of the inner primaries had initiated (cf. Fig. 41).

Pacific Kingfisher (PAKI) *Todiramphus sacer*

Range and Taxonomy: The widespread Collared Kingfisher (*T. chloris*), of Africa, Asia and the Pacific has recently been split into five species, including Pacific Kingfisher and four other kingfishers of the Pacific Basin (Gill and Donsker 2017). Pacific Kingfisher is currently comprised of 22 subspecies found in the southwestern Pacific Basin and central Polynesia, including the Solomon Islands, Fiji, Vanuatu, Tonga, and the Samoan Islands (Gill and Donsker 2017). Two subspecies occur in American Samoa, *T. s. pealei* on Tutuila Island and *T. s. manuae* on Ta'u, Ofu, and Olosega islands. These two subspecies are rather similar in size (see below) but differ subtly in plumage, with *pealei* showing more white feathering to the crown and head, and being slightly brighter and bluer than *manuae* by age and sex group (see Figs. 44-45, 47).

Individuals Examined: 20 specimens collected in Samoa (MVZ 4, WFVZ 9, MCZ 2, CAS 4, LSU 1) and 355 captures at TMAPS stations on Tutuila (153), Ta'u (104), and Ofu-Olosega (98).

Structure and Measurements: Ten primaries, 12 secondaries, and 12 rectrices. The outer primary (p10) is full-length and the longest primaries are p7 and/or p8. Specimens and captures from American Samoa had wing chord: ♀ (n122) 89-100, ♂ (n190) 89-99; exposed culmen FCJ ♀ (n9) 35-41, DCB ♀ (n16) 40-45; FCJ ♂ (n8) 36-42, DCB ♂ (n22) 39-44. Mayr (1941) gives additional measurements indicating that ♀♀ and ♂♂ have similar wing chord and culmen lengths and that culmen length can be shorter in FCJs than in DCBs as the bill is developing. Analysis of wing chord data from TMAPS indicates no differences between ♀ and ♂, that FCJs have slightly shorter wing chords (by < 1 mm) than DCBs, perhaps due to increased wear of juvenile feathers, and that there is a very slight (1-2 mm overall) difference between the island populations, with Ofu-Olosega > Ta'u > Tutuila in wing lengths.

Breeding Seasonality: Based on evidence form specimen labels on birds collected from American Samoa, Banks (1984) noted that breeding condition was absent for specimens collected in Mar-Jun (at which time molt was completing) but that a high proportion of specimens collected in Oct-Nov were noted to be in breeding condition. This indicates an austral spring and summer breeding season; nesting pairs have also been reported in Jan-Mar, indicating some late or year-round breeding as well. Cloacal protuberances do not develop in kingfishers (Pyle 1997). Among DCBs captured at TMAPS stations, four of 14 in Jun-Oct (three ♂♂ and one ♀) and none of 136 in Nov-May showed brood patches. This along with a clear molting season in Dec-Aug, and the capture of many fresh FCJs in Dec-Feb indicates that most breeding probably takes place in Sep-Nov, agreeing with Banks' findings.

Molt: Group 4, with no preformative molt and a complete prebasic molt which is seldom if ever suspended (Table 1; Pyle et al. 2016). Based on specimen evidence, Banks (1984) suggests that peak molting occurs in Jan-May in American Samoa, with few specimens in molt collected in Jun-Dec, and our TMAPS data generally support this, with a timing for most molt in Dec-May while occasional birds complete the molt in Jun-Aug (Pyle et al. 2016). Banks (1984) indicates that the "post-juvenile" molt is complete. We have found no evidence of an FPF in this species (Pyle et al. 2016) or other kingfishers of this group (cf. Higgins 1999, Radley et al. 2011) and we infer that Banks was referring to the SPB. Remigial molt sequence proceeds from p1 to p10, s1 inward, and the tertials outward (or bilaterally from the second tertial, s11), resulting in the last feathers replaced being p10 and secondaries among s3-s6 (cf. Fig 52). Rectrices are replaced in approximate order r1-r6-r5-r2-r4-r3. No evidence of suspended molt or retained flight feathers has been observed in specimens or at TMAPS stations in American Samoa.

Age Determination: Age-code Group 4 (Tables 1-2). **FCJ**s have smaller bills than **DCB**s (Fig. 44); generally, an exposed culmen length of < 40 mm indicates FCJ and > 42 indicates DCB, at least during Oct-Mar when most FCJs are younger. Within each sex and subspecies, FCJs have duller green rectrices, darker green backs, and duller primary and secondary edging than DCBs (Figs. 45-51), although note that shades of blue and green can be affected by camera settings, photo angle, and lighting. Fresh FCJs in Nov-Feb have black mottling to the breast feathers and whitish fringing to the upperwing coverts (Fig. 48) which averages more prominent than in DCBs at this time of year and perhaps overall, although note that fresh DCBs in Feb-May can also show these characters (cf. Fig. 50**A**). FCJs also average narrower and more worn rectrices and browner and narrower outer primaries than DCBs (Figs. 45-51), and all of these characters can be used to age **SPB**s and **DPB**s, respectively, once molt has commenced (Fig. 52). Individuals just completing molt, with p10 and/or secondaries among s3-s6 growing but no older feathers remaining, are age-coded **UPB**. Age codes **UCU** and **UUU** are acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FPF, FCF, SCB, TPB, FAJ, SAB, and UPU are not assigned for this species.

As breeding completes primarily in Oct-Nov and molting occurs primarily in Jan-May (see above), we can expect to see FCJs year round (fresh in Dec-Mar and worn in Sep-Nov), more DCBs in May-Jan, and more SPBs and DPBs in Jan-May (see Appendix 1) but both molting and (perhaps) breeding birds occur occasionally year-round and non-molting birds seem to be regular in Jan-May as well, in lesser numbers.

Sex Determination: Sex determination needs to be accomplished in consideration of both subspecies and age. Once age has been determined, sexing birds on each island can be achieved by the shade of green vs. blue in the rectrices (Figs. 45-46), back (Fig. 47), and edging to the remiges (Figs. 48-52), with FCJ ♀♀ being the greenest and DCB ♂♂ the bluest, as confirmed by examination of known-sex specimens (see also Radley et al. 2011). Back color ranges from dark forest green in FCJ ♀♀ to bright blue in DCB ♂♂, with DCB ♀♀ and FCJ ♂♂ broadly intermediate in color. The flight-feather edging ranges from greenish blue in FCJ ♀♀ to bright blue in DCB ♂♂, again with DCB ♀♀ and FCJ ♂♂ being intermediate, but not as much as with the back color. For all criteria and age/sex groups, kingfishers on Tutuila (*T. s. pealei*) average slightly brighter than those on Ta'u and Ofu-Olosega (*T. s. manuae*), with less of a difference between DCB ♂♂ than the other age/sex groups. In all cases, there appears to be more overlap between the sexes in Samoan populations than are found in Saipan (Radley et al. 2011), especially regarding back color among FCJs (Figs. 47-49), and so caution is warranted. In addition, shades of blue and green can be affected by camera settings, angle, and lighting, and it is recommended that photographs taken for assessment of age and sex be taken under consistent conditions, optimally even shaded lighting with a uniform neutral-colored back ground. Additional characters to assist with sexing Pacific Kingfishers include head plumage, with more buff coloration occurring in ♂♂ than ♀♀, on average (Fig. 44), and a greater extent of white to the edges and tips to the rectrices of ♀♀ than ♂♂, at least on Tutuila Island (Fig. 46). Brood patch occurs in both sexes and cloacal protuberances appear not to be developed by Pacific Kingfishers.

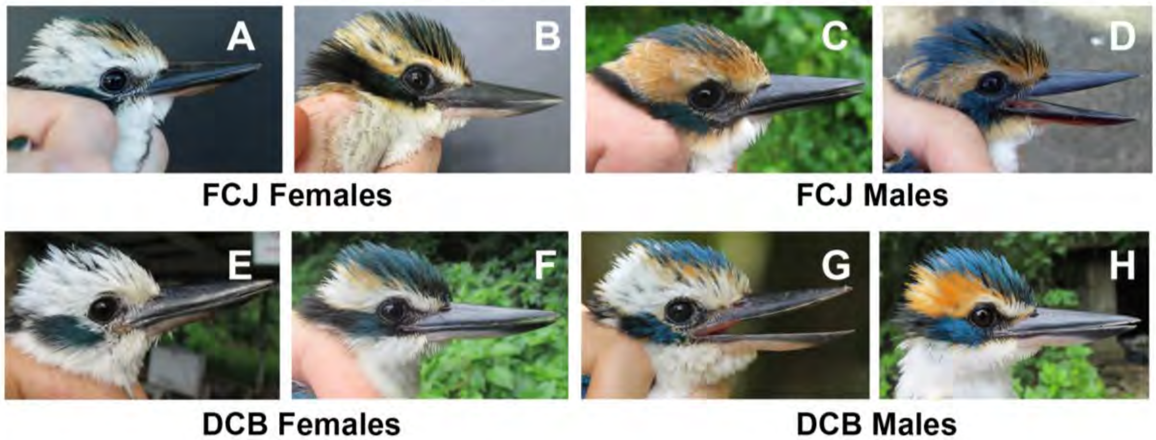

Figure 44. Head plumage and bill size in Pacific Kingfishers in American Samoa by subspecies, age, and sex. FCJ ♀♀ captured on Tutuila, 30 Jan 2016 (A) and Ofu, 5 Feb 2016 (B); FCJ ♂♂ captured on Tutuila, 31 Jan 2014 (C), and Ta'u, 7 Feb 2014 (D); DCB ♀♀ captured on Tutuila, 23 Dec 2014 (E), and Olosega, 2 Dec 2015 (F); and DCB ♂♂ captured on Tutuila, 13 Dec 2013 (G), and Olosega, 5 Jan 2016 (H). Note the greater amounts of white or buff (as opposed to blue) in the heads of birds from Tutuila Island (T. s. pealei; A, C, E, G) than in those from the other three islands (T. s. manuae; B, D, F, H) within each age/sex class, and that ♀♀ (A-B, E-F) tend to show less buff or rufous-orange in the head than ♂♂ (C-D, G-H). Also note the shorter bills in the FCJs (A-D) than in the DCBs (E-H); generally, exposed culmen of < 40 indicates FCJ and > 42 indicates DCB, at least during Oct-Mar when FCJs are younger.

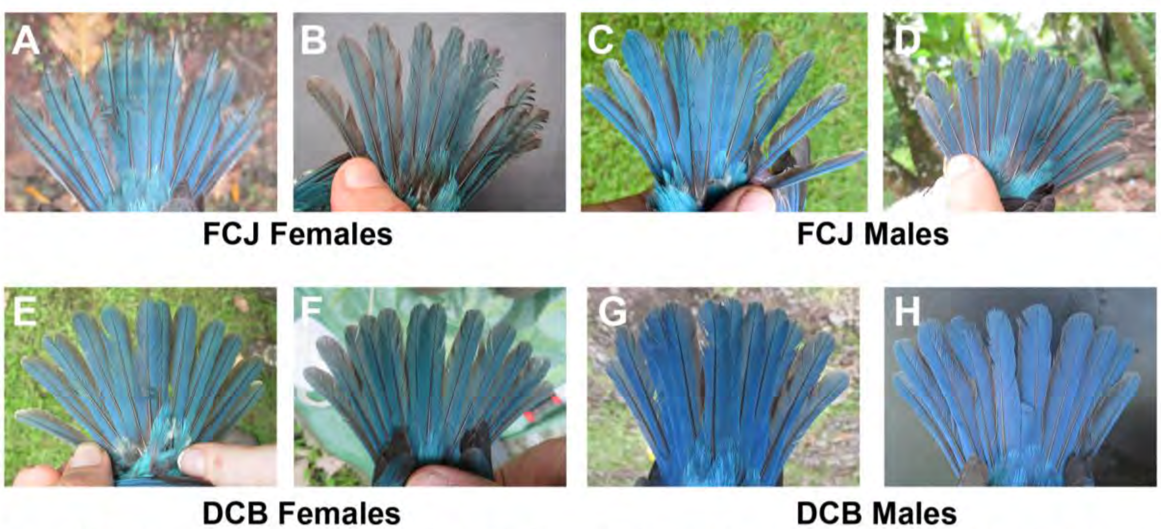

Figure 45. Rectrix shape and coloration in Pacific Kingfishers in American Samoa by subspecies, age, and sex. FCJ ♀♀ captured on Tutuila,19 Feb 2016 (A), and Ofu,15 Feb 2016 (B); FCJ ♂♂ captured on Tutuila, 18 May 2013 (C), and Ta'u, 7 Mar 2016 (D); DCB ♀♀ captured on Tutuila, 19 Jan 2013 (E), and Ofu, 9 Dec 2015 (F); and DCB ♂♂ captured on Tutuila, 8 Dec 2012 (G), and Ta'u, 9 Jan 2016 (H). Note that tails of the ♀♀ and FCJs average brighter or greener on birds from Tutuila (T. s. pealei; A, C, E, G) than in those from the other three islands (T. s. manuae; B, D, F, H) within each age/sex class, although note that shades of blue and green can be affected by camera settings, angle, and lighting. Also note the note the narrower and generally more-worn rectices in the FCJs (A-D) than in the DCBs (E-H).

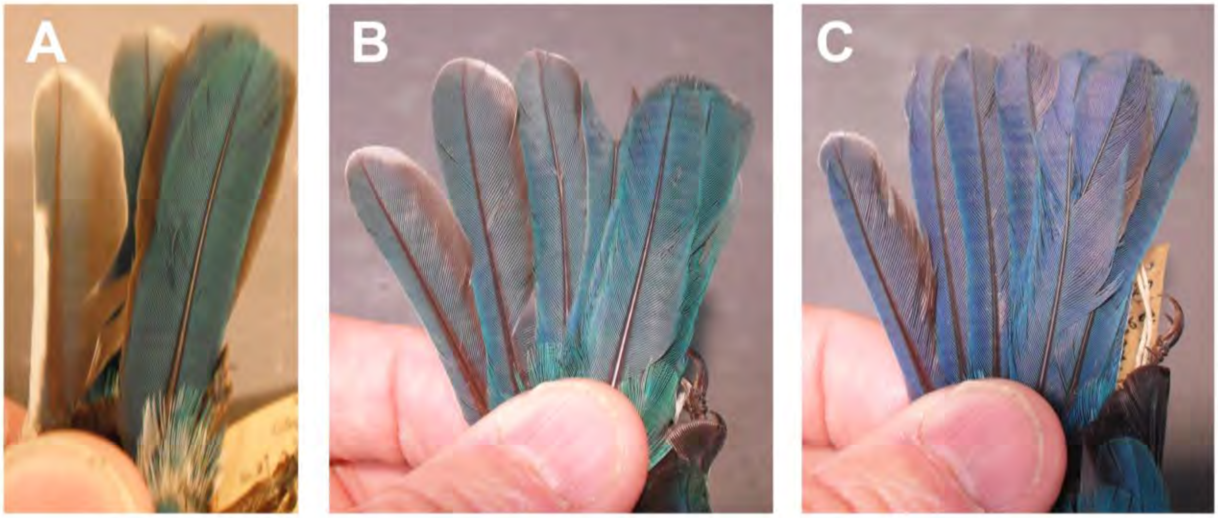

Figure 46. Rectrices in specimens of DCB ♀♀ (A-B) and DCB ♂ (C) Pacific Kingfishers collected on Tutuila. Note the bluer color to the tail in DCB ♂♂ than in DCB ♀♀ (see also Fig. 45) and the greater extent of white in the outer rectrix (r6) of some ♀♀, which does not appear to occur to this extent in ♂♂. This character may be more useful on Tutuila than on the other American Samoan islands.

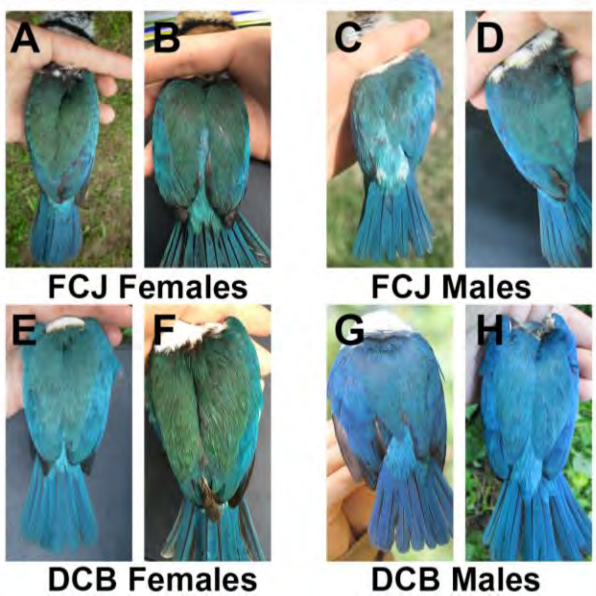

Figure 47. Back coloration in Pacific Kingfishers In American Samoa by subspecies, age, and sex. FCJ ♀♀ captured on Tutuila, 11 Jan 2014 (A), and Ta'u, 23 Dec 2013 (B); FCJ ♂♂ captured on Tutuila, 5 Oct 2012 (C), and Olosega, 1 Mar 2016 (D); DCB ♀♀ captured on Tutuila, 2 Dec 2015 (E), and Ofu, 12 Jan 2016 (F); and DCB ♂♂ captured on Tutuila, 14 Jan 2014 (G), and Ta'u, 30 Nov 2015 (H). Note that the backs and wings of the ♀♀ and FCJs average brighter or slightly bluer on birds from Tutuila (T. s. pealei; A, C, E) than in those from the other three islands (T. s. manuae; B, D, F) within each age/sex class, although note that shades of blue and green can be affected by camera settings, angle, and lighting; DCB ♂♂ (G-H) seem to show less of an average difference (see also Figs. 48-52).

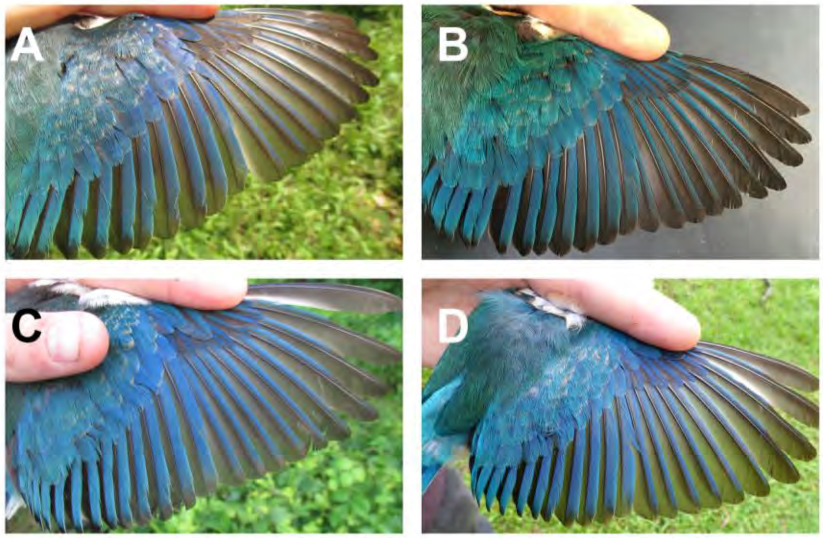

Figure 48. Back and wing color in FCJ Pacific Kingfishers on Tutuila Island: FCJ ♀♀ captured 10 Mar 2014 (A) and 28 Mar 2016 (B), and FCJ ♂♂ captured 7 Jan 2013 (C) and 18 May 2013 (D). The white fringing to the upperwing coverts (along with black mottling to the breast) averages more prominent in FCJs than in DCBs in Nov-Feb, primarily because FCJs are fresher at this time of year; fresh DCBs (primarily in Feb-May) can also show these characters (cf. Fig. 50A). Note the brown and pointed outer primaries and overall duller wings (indicating FCJ), and the slightly bluer (less dark green) back color and bluer primaries in FCJ ♂♂ than in FCJ ♀♀, although note that shades of blue and green can be affected by camera settings, angle, and lighting. See also Figure 49.

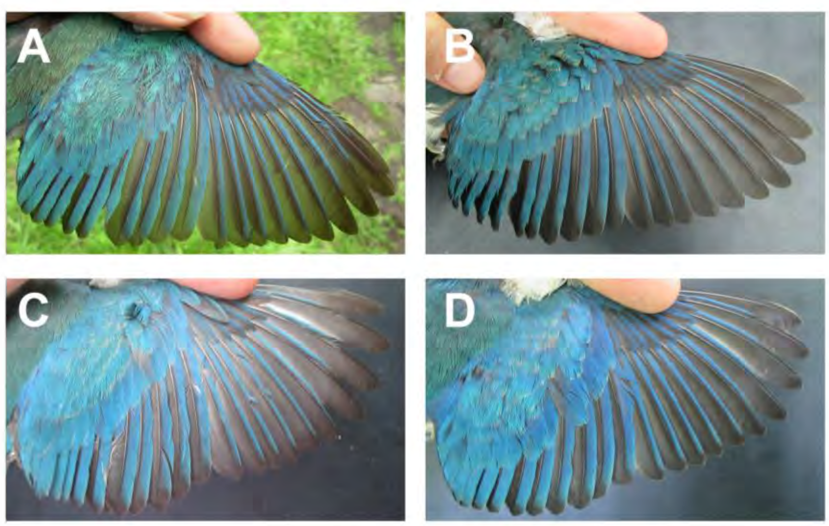

Figure 49. Back and wing color in FCJ Pacific Kingfishers in the Manua Islands: FCJ ♀♀ captured on Ta'u, 23 Dec 2013 (A), and Ofu, 22 Feb 2016 (B); and FCJ ♂♂ captured on Olosega 29 Feb 2016 (A) and 1 Mar 2016 (B). See caption to Figure 48; wing and back color averages duller and greener in the Manua Islands than on Tutuila, although note that shades of blue and green can be affected by camera settings, angle, and lighting.

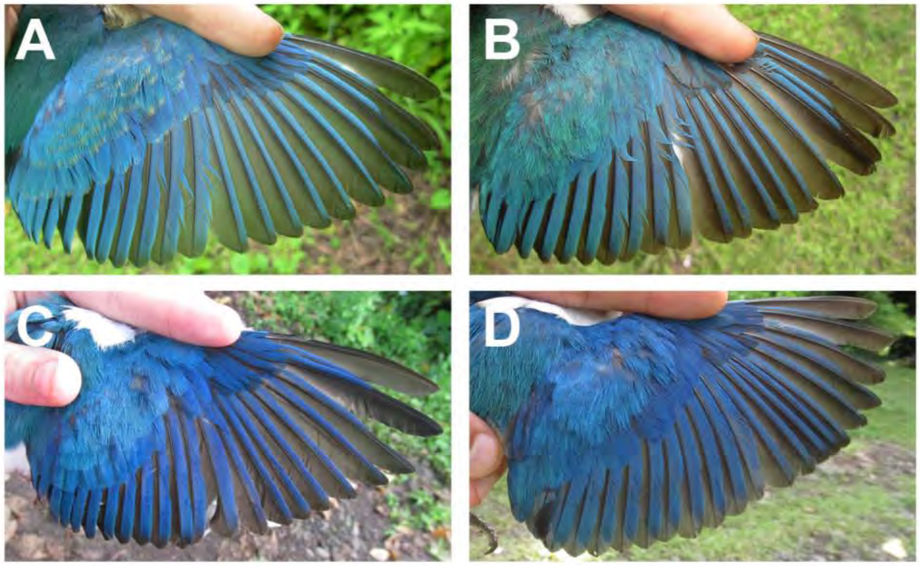

Figure 50. Back and wing color in DCB Pacific Kingfishers on Tutuila Island: DCB ♀♀ captured 7 Jan 2013 (A) and 19 Jan 2013 (B), and DCB ♂♂ captured 8 Dec 2012 (C) and 10 Dec 2012 (D). See caption to Figure 48 regarding black mottling on breast and pale fringing to upperwing coverts. Note the blacker and broader outer primaries and overall brighter wings (indicating DCB), and the bluer (less green) back color and bluer primaries in FCJ ♂♂ than in FCJ ♀♀, although note that shades of blue and green can be affected by camera settings, angle, and lighting. See also Figure 51.

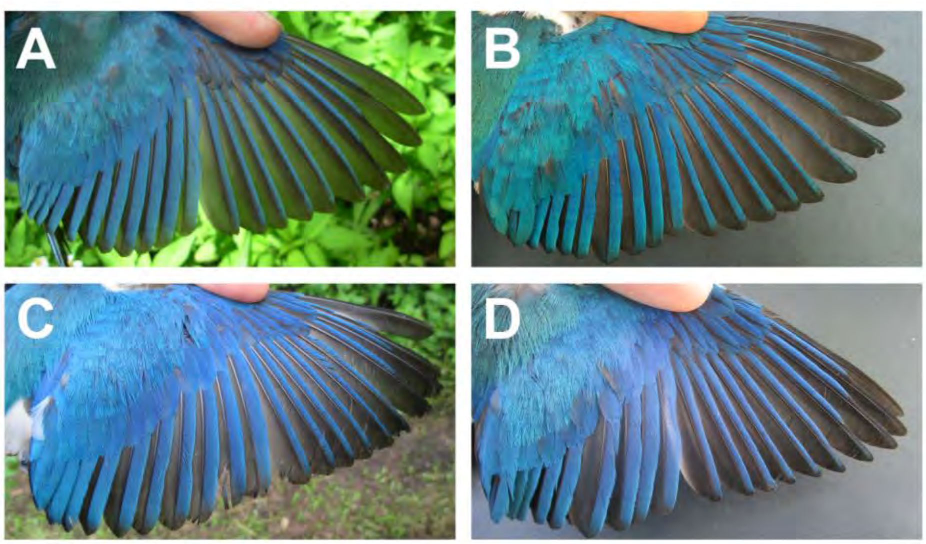

Figure 51. Back and wing color in DCB Pacific Kingfishers in the Manua Islands: DCB ♀♀ captured on Ta'u, 13 Dec 2013 (A), and Ofu, 20 Jan 2016 (B); and DCB ♂♂ captured on Ta'u Island on 6 Jan 2015 (C) and 9 Jan 2016 (D). See caption to Figure 50; wing and back color averages duller and greener in the Manua Islands than on Tutuila in DCB ♀♀ but not as much in DCB ♂♂, although note that shades of blue and green can be affected by camera settings, angle, and lighting.

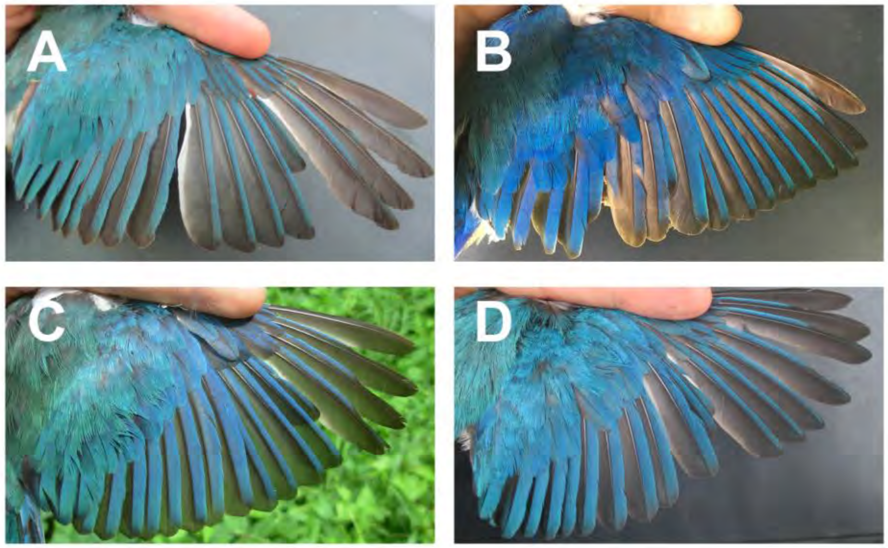

Figure 52. Molting SPB and DPB Pacific Kingfishers at different stages of molt progression: SPB ♀ captured on Ofu, 4 Mar 2016, with p5 growing and p6 and s1 dropped (A); SPB ♂ captured on Tutuila, 17 Mar 2016, with s2 and s6 growing and p9 dropped (B); DPB ♀ captured on Tutuila, 15 Apr 2013, with p6 dropped and p5 and s10 growing (C); and DPB ♂ captured on Ofu, 17 Feb 2016, with p1-p3 growing (D). Note the browner and mroe-worn outer primaries in the SPBs than in the DPBs.

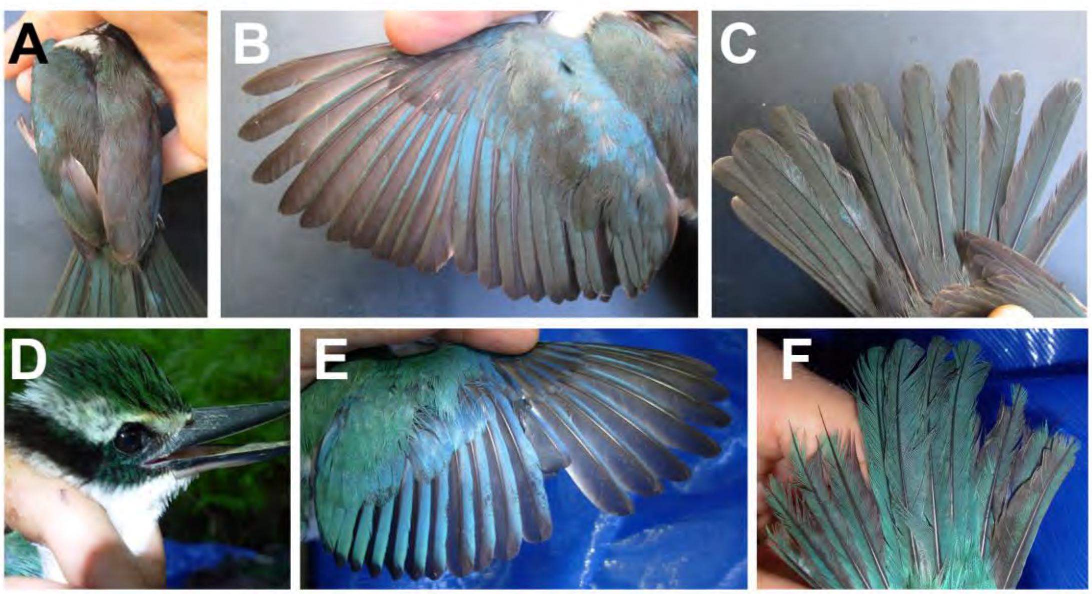

Figure 53. Dark plumage abnormalities in ♀ Pacific Kingfishers captured on Ta'u: DCB ♀ on 2 Feb 2016 (A-C) and SPB ♀ on 19 Dec 2013 (D-F). It is unknown whether or not this plumage state occurs among ♂♂ or on islands other than Ta'u.

Blue-crowned Lorikeet (BCLO) *Vini australis*

Range and Taxonomy: Blue-crowned Lorikeets are found in central Polynesia, from Niue and Fiji through Tonga and the Samoan islands. In American Samoa it is found only in the Manu'a Islands (Ta'u, Ofu, and Olosega). No subspecies are described (Gill and Donsker 2017).

Individuals Examined: 15 specimens (CAS 5, FMNH 1, MCZ 8, YPM 1); all from Western and American Samoa. 21 captures at TMAPS stations on Ta'u.

Structure and Measurements: Ten primaries, 10 secondaries, 12 rectrices; the longest primary is p8, with p10 10-20 mm shorter than p8. Measurements from American and Western Samoa including those of Amadon (1942): Wing chord: ♀ (n15+) 102-113, ♂ (n15+) 104-117; tail ♀ (n15+) 61-67, ♂ (n15+) 61-69. Wing chord range for un-sexed birds captured at TMAPS stations (n20) 99-108 perhaps indicates that birds from Ta'u average shorter winged than those of Western Samoa.

Breeding Seasonality: Banks (1984) noted an adult ♂ collected in Jun with enlarged testes and that only four of 64 specimens taken in American Samoa in Dec-Jan were in breeding condition, suggesting more-active breeding sometime in Mar-Nov, perhaps with a peak in Jun. None of 21 TMAPS captures in Dec-Mar showed brood patches or cloacal protuberances.

Molt: Group 3, with partial preformative and complete prebasic molts, the latter often suspended (Table 1; Pyle et al. 2016). Banks (1984) noted two adult specimens from Jun and Oct showing no primary molt and worn feathers, and that 30% of the Dec-Jan sample were molting primaries while many others (possibly FCFs) showed fresh primaries. Primary molt was noted on two specimens examined for this manual, collected in Aug (molt starting) and Oct (near completed), and no primary molt was noted on DCBs in Aug (2) and FCFs in Aug, Oct, and Dec. Among TMAPS captures in Dec-Feb, two of three first-cycle birds were undergoing preformative body-feather molt and 10 of 16 older birds were undergoing prebasic flight-feather molt with progression indicating commencement in Dec and completion in Feb or Mar for most individuals (see Figs. 58-59). This evidence suggests Dec-Mar as the peak molting season. Specimen and capture evidence indicates the preformative molt to include body feathers but no flight feathers or wing coverts. Sequence of flight-feather molt proceeds as in most other parrots, bidirectionally within primary and secondary tracts from p6, s5, and s9, the middle tertial (Pyle 2013; see Figs. 58-59). Tail molt in one specimen appeared to proceed as r6-r2-r3-r4-r1-r5 and in other specimens and captures generally proceeded from r1 to r6 (see Figs. 57-58). Molt suspensions appeared frequently in SABs (see Figs. 56 and 59) but have not been noted yet in SCBs, which may indicate that the second prebasic molt is more-often complete than subsequent molts due to lack of breeding constraints. Incomplete, staffelmauser-like replacement patterns, as is found in some larger parrots (Pyle 2013), have also not been noted in Blue-crowned Lorikeets.

Age Determination: Age-code Group 4 (Tables 1-2). **FCJ**s show shorter and duller blue crown feathers, little or no red on the throat and abdomen, or purple on the belly or femoral tract, and browner beaks and eyes than older birds (Figs. 54-55). FCJs, **FPF**s, and **FCF**s retain juvenile primaries and rectrices and can be identified by relatively worn, narrow, and pointed feathers, and less-notched outer primaries (Figs. 55-57); eye color change may occur throughout the first cycle but study is needed. FCFs may also average less red to the underparts and weaker blue crown feathers than DCBs (Figs. 54-55) but this might be complicated by variation between the sexes (see below). **SPB**s can be assigned to FCFs that have begun the second prebasic molt but have retained un-notched outer primaries and thin rectrices and/or secondaries (Fig. 58). **SCB**s may be assignable to some birds that suspend the second-prebasic molt, but this appears to be rare, likely because one-year-olds may not breed (see below, Pyle 2013). **DCB**s have uniform and relatively fresh and broad primaries and rectrices and notched outer primaries (Fig. 59), such birds that have commenced the next molt cycle (with older feathers basic) are **DPB**s (Fig. 59), and birds completing flight-feather molt such that the previous generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB**. Adults can also suspend the definitive prebasic molt, probably for breeding, and such birds can be age-coded **SAB** (Fig. 59); note that DPB is coded for both DCBs and SABs that have commenced the following molt. Age codes **UCU** and **UUU** (but not UPU; unknown-cycle birds molting flight feathers should be coded UPB) are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes TPB, FAJ, and UPU are not assigned for this species.

As breeding appears to occur primarily in Mar-Nov and molting occurs primarily in Dec-Mar (see above), we might expect to see FCJs primarily in Oct-Dec, FPFs primarily in Dec-Feb, FCFs, DCBs and SABs primarily in Feb-Nov, and SPBs, UPBs, and DPBs primarily in Dec-Mar (see Appendix 1).

Sex Determination: Wing length appears to vary slightly with sex but overlap is extensive (see Measurements, above), and ranges for the populations in American Samoa need to be determined. DCB, DPB, UPB, and SAB ♀♀ may average slightly duller green, with smaller red and purple patches to the underparts and duller blue crowns than equivalent-age ♂♂ (Fig. 60) but this needs to be confirmed and caution would be warranted as these differences appear to vary more between first-cycle and older birds than between the sexes (Fig. 54). The occurrence and reliability of cloacal protuberance and brood patch for sexing is unknown; both sexes incubate in many parrot species. Until criteria are better determined, most or all birds should be left undetermined to sex by in-hand criteria alone.

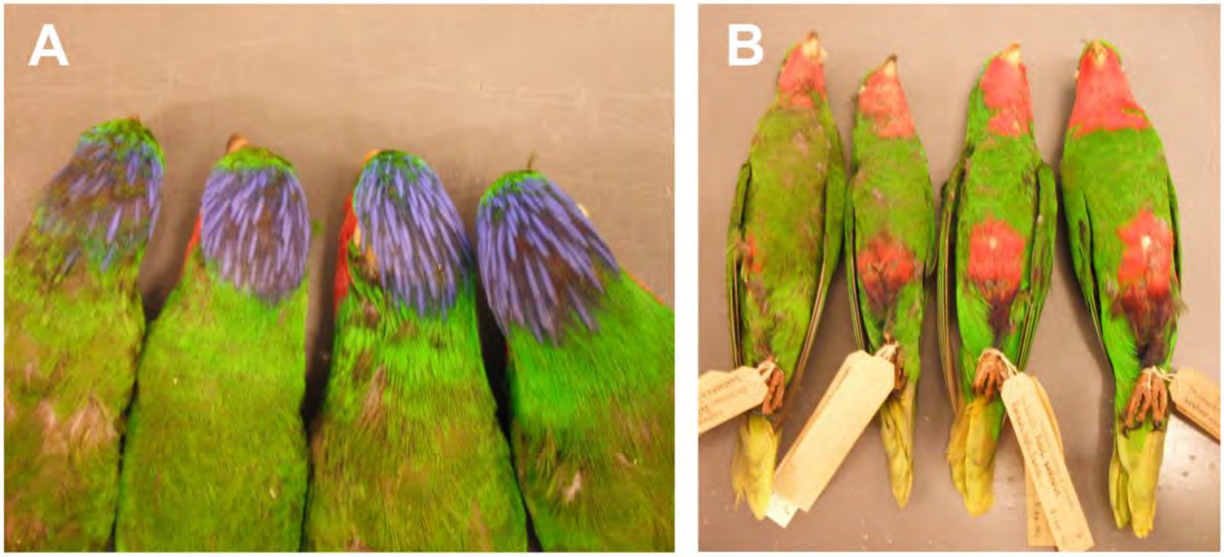

Figure 54. Specimens of Blue-crowned Lorikeets by age and sex showing variation in plumage of crown (A) and underparts (B); from left to right, FPF ♀, FCF ♂, DCB ♀, and SAB ♂. Note the mixed duller juvenile and newer formative crown feathers and that most of the red throat patch but little of the belly patch has molted in on the FPF (A). ♀♀ appear to average duller than ♂♂, age for age, but sexing individual birds on this basis may be unreliable; study needed. The same specimens (from CAS) are shown in Figures 55-56.

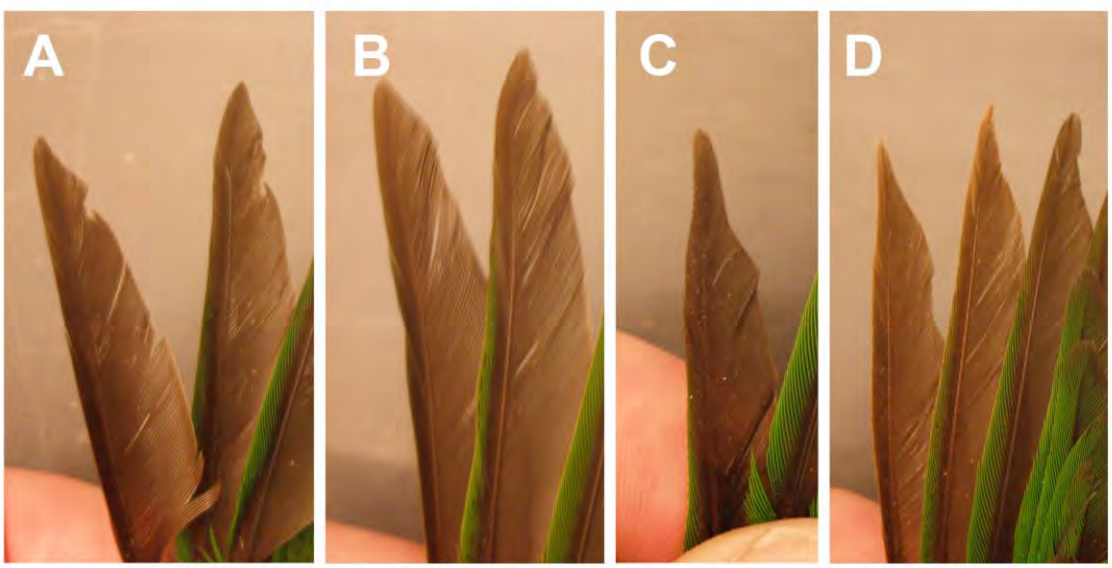

Figure 55. Specimens of Blue-crowned Lorikeets showing variation in the notching to the outer primaries; from left to right, FPF ♀, FCF ♂, DCB ♀, and DCB ♂. The juvenile outer primaries on FCJ, FPF, FCF, SPB lorikeets show reduced notching than the basic feathers on DCBs, but study is needed to see if ♀♀ and ♂♂ differ. Note the molt suspension between p8 and p9 in D, indicating SAB. The same specimens (from CAS) are shown in Figures 54 and 56.

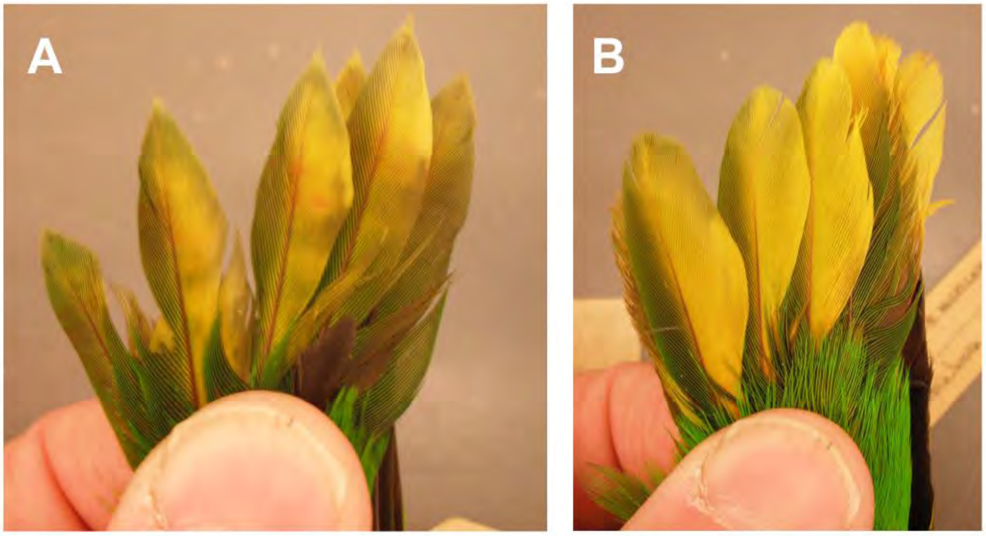

Figure 56. Specimens of FCF (A) and SAB (B) ♂ Blue-crowned Lorikeets showing variation in the shape and color of juvenile (A) vs. basic (B) rectrices. Note the molt suspension among the rectices in B (outer rectrix being retained basic), indicating SAB. The same specimens (from CAS) of FCF and SAB ♂♂ are shown in Figures 54 and 56.

Figure 57. FPF Blue-crowned Lorikeets captured on Ta'u Island 10 Feb 2016 (A), 14 Mar 2016 (B-C), and 21 Dec 2013 (D). Note the evenly worn remiges (without molt limits) and un-notched juvenile p10 (A), the dull brown outer iris (B; compare with Fig. 59D) and the weak and pointed juvenile rectrices (C); the FPF in B has a complete red formative throat patch (but was showing body molt elsewhere) and the FPF in C shows an incomplete (molting) red and purple belly patch.

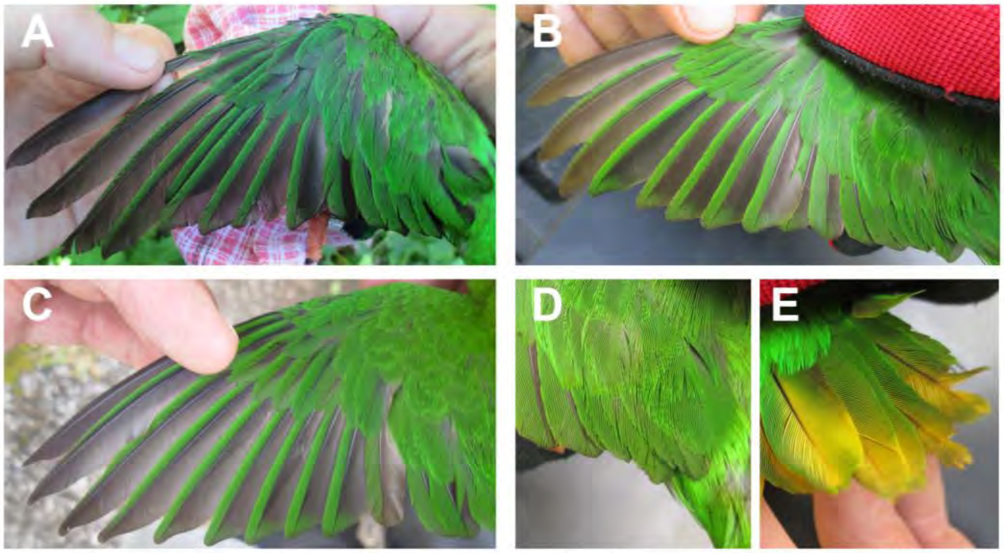

Figure 58. SPB Blue-crowned Lorikeets in various progressions of molt, captured on Ta'u Island 16 Dec 2014 (A), 19 Jan 2016 (B, D-E), and 2 Feb 2014 (C). Primary molt in parakeets proceeds bi-directionally within primary and secondary tracts from p6, s5, and s9, the middle tertial (Pyle 2013). In A p6 is growing and the remainder of the flight-feathers are juvenile; in B, D, and E p6 and s9 are new, p5, p7, and s10 have dropped, and r1-r3 are growing while the remainder of the flight feathers are juvenile; and in C all remiges are new and basic except for s1 (juvenile), p1 and s2 (dropped), and p10 (possibly still growing). Note the progression in these SPBs indicates a peak molting period beginning in Dec and completing in Feb; the second prebasic molt may average earlier than later prebasic molts if one-year-olds don't breed. Note also that the outer primary is juvenile and relatively un-notched in the SPBs of A and B whereas it is basic and more fully notched in the SPB in C.

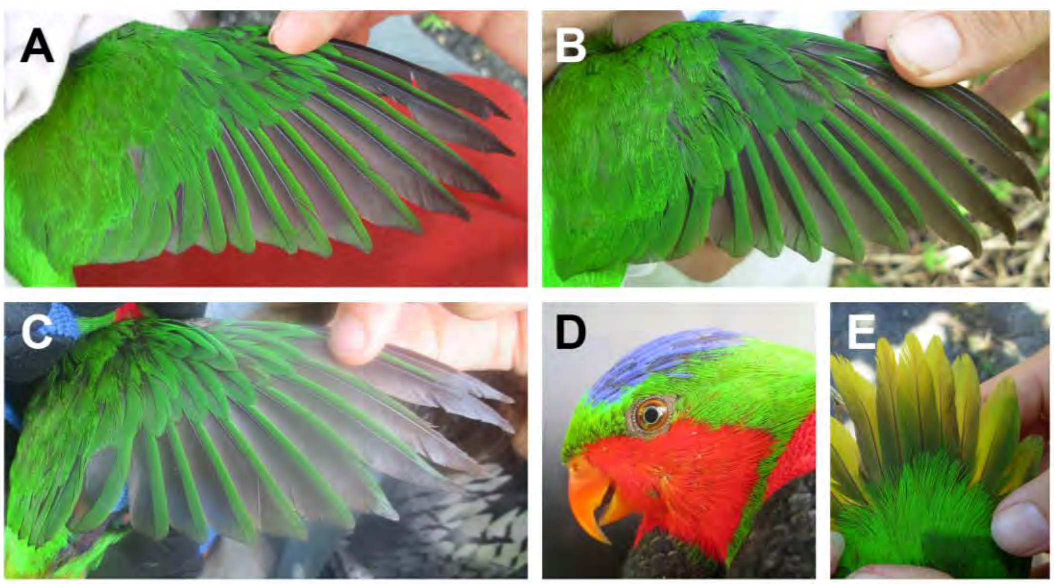

Figure 59. DCB (A, D), DPB (B), and SAB (C, E) Blue-crowned Lorikeets captured on Ta'u Island 26 Feb 2014 (A), 30 Jan 2014 (B), 3 Mar 2015 (C-D), and 2 Feb 2014 (D). All feathers in these birds are basic; note the notched or pointed outer primaries (A-C) and broad and full rectrices (E). The DCB in A has uniformly basic rectrices, the DPB in B is just beginning molt with p6 growing, and the SAB in C suspended molt after p5-p6 had been replaced, with p1-p4 newly replaced and p7-p10 retained but basic. Note also the bright yellowish outer iris (D), typical of older birds (compare with the FPF in Fig. 57B).

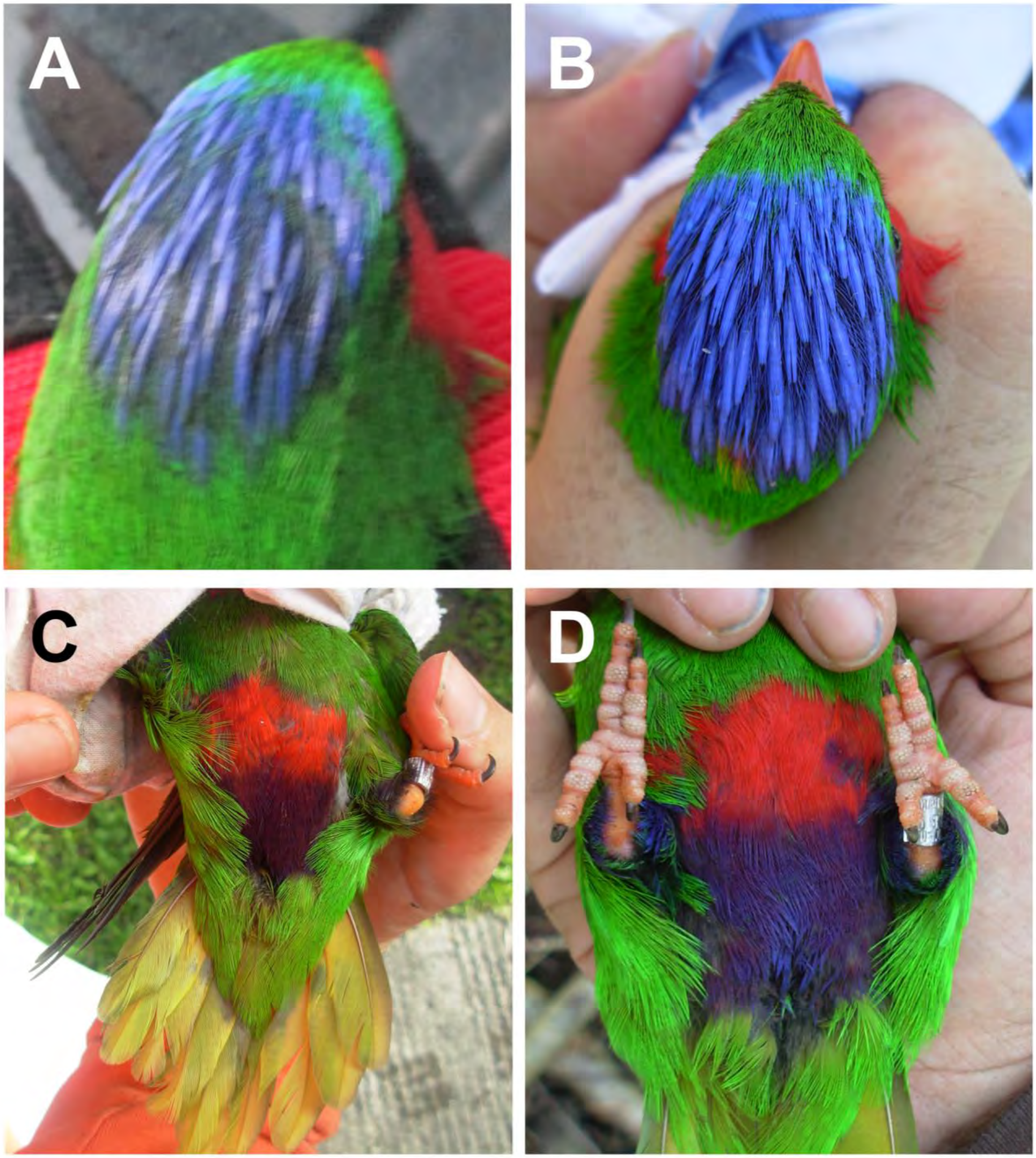

Figure 60. Variation in brightness to the crown and underparts in SAB (A, C) and DCB (B, D) Blue-crowned Lorikeets captured on Ta'u Island, 10 Feb 2014 and 30 Jan 2014, respectively. It is possible that ♀♀ average duller plumage than ♂♂ in DCB and SABs (the SAB had wing chord 99 and the DCB had wing chord 108) but study is needed. FCFs appear to average shorter wings and duller plumage than DCBs, so sexing may only be possible with DCBs, UPBs, DPBs, and SABs. More study is needed.

Cardinal Myzomela (CAMY) *Myzomela cardinalis*

Range and Taxonomy: Cardinal Myzomela (often and formerly known as "Cardinal Honeyeater") is found primarily in the southwestern Pacific in the Solomon and Fijian islands, but also in Western Samoa and American Samoa; in the latter it is confined to Tutuila Island. The subspecies found in the Samoan Islands is *M. c. nigriventris* (Gill and Donsker 2017).

Individuals Examined: 16 specimens (MVZ 5, WFVZ 4, CAS 5, LSU 2), most from Tutuila labeled as ♂♂; Mayr (1932) also mentions a preponderance of ♂♂ in collections although some specimens may be mislabeled ♀♀ with more-extensive red heads than has been described (see Figs64 and 67). A total of 108 captures at TMAPS stations on Tutuila.

Structure and Measurements: Ten primaries, 9 secondaries, 12 rectrices; the longest primary is among p6-p8, p9 is 5-10 mm shorter than the longest primary, and p10 is about half the length of the longest primary. Specimens (captures and from Mayr 1932): wing chord: ♀ (n37) 55-64, ♂ (n94) 62-72; tail ♀ (n13) 37-42, ♂ (n16+) 40-46; culmen from nares: DCB ♀ and ♂ (n14+) 15.5-17.0; FCJ/FCF ♀ and ♂ 15.0-16.0. An analysis of TMAPS data indicate that wing chords by both age and sex on Tutuila Island are: FCJ ♀ 55-60, DCB/SAB ♀ 58-64, FCJ ♂ 62-66, DCB/SAB ♂ 64-72.

Breeding Seasonality: Banks (1984) indicates that, in American Samoa, ♂♂ in breeding condition were taken in Mar-Nov, ♀♀ in non-breeding condition were taken in Jun-Jul, and one recently fledged FCJ was taken in Nov. Captures of DCBs at TMAPS stations were in reproductive condition during Apr-Dec (Pyle et al. 2016). This and molt information (below) suggests protracted breeding in Apr-Dec but some evidence (e.g., an FCJ ♂ in May; Fig. 61**D**-**E**) suggests year-round breeding at lower levels.

Molt: Group 3, with incomplete preformative and incomplete to complete or suspended prebasic molts (Table 1; Pyle et al. 2016). Mayr (1932) mentioned that most specimens collected in Oct-Feb were worn whereas those collected in Mar-May were fresh. Banks (1984) indicated that birds molting primaries were collected only in Feb and that some but not all birds collected in Apr-Nov were undergoing body molt. Capture data confirms that symmetrical definitive prebasic flight-feather molt takes place in most birds during Dec-Mar and that active, protracted preformative molt of primaries can occur throughout the year, with many FPFs molting inner primaries in Dec-Mar and outer primaries in Jun-Dec (Pyle et al. 2016). Birds with heavy body molt were also captured in Dec-Mar whereas light body molt was recorded in most birds year-round; this and several DCB ♂♂ captured that may have replaced tertials (see Fig. 66) suggests that this species may have a prealternate molt but, if so, details would need to be worked out and we here use age coding that assumes replaced tertials are part of protracted and/or suspended preformative and prebasic molts (study needed); prealternate molts have not been reported for other species of Myzomela (Higgins et al. 2001, Radley et al. 2011). The preformative molt appears typically or always to be incomplete in American Samoan populations, with the innermost 2-8 primary coverts retained (Figs.63-65; Pyle et al. 2016); some birds may also retain other feathers (Figs. 64-65) or possibly undergo partial preformative molts. During both preformative and prebasic molts, primaries are replaced distally from p1 to p10 and secondaries are typically replaced bi-laterally from s8 and proximally from s1, such that the last secondaries replaced are either s5 or s6. Among TMAPS captures, 10-15% of adults had suspended or arrested the second or definitive prebasic molt, often with s6 or s5-s6 retained (Figs. 65-67). Retained secondaries during either the preformative or the prebasic molt can be among the first feathers replaced in subsequent molts (Fig. 65), as has also been recorded in Polynesian Wattled Honeyeater and Samoan Starling (see below; Pyle et al. 2016).

Age and Sex Determination: Age-code Group 3 (Tables 1-2). Plumage varies interactively by age and sex in Cardinal Myzomelas (Mayr 1932, Pyle et al. 2016), necessitating concurrent ageing and sexing in this species. The length of the wing chord provides a good criterion for sex determination (see Measurements, above), is reliable for separating most or all birds to sex when age is known, (and vice versa), and should be determined prior to assessment of plumage criteria for age and sex. Gape coloration is brighter and more-extensively yellow in FCJs but also can be yellow in older birds and should not be used in age determination.

In plumage, **FCJ**s of both sexes show olive-gray to brown body plumage, without or with limited red feathering to the crown and throat, and gray-brown, olive-edged, and pointed flight feathers (Figs. 61-62); sexing may not be possible by plumage but known-FCJs can be sexed by wing chord (see Measurements, above). Note that body molt can begin before flight-feather molt (Fig. 62**D**) but such birds are still age-coded FCJ in this species as code FPF requires active replacement of remiges. FCJs that have commenced molt of primaries can be aged **FPF** and sexed by the coloration of incoming flight feathers, brownish with olive fringing in ♀♀ and blackish in ♂♂, and incoming underpart feathers, brown to olive-gray in ♀♀ and black or red (breast) in ♂♂ (see below and Figs. 63-67). **FCF**s of both sexes have 1-8 retained inner primary coverts (sometimes mixed with replaced feathers), which are browner than the remainder of the wing feathers (Figs. 63-65); FCFs can be sexed by plumage and measurements as in DCBs (below), with some FCF ♂♂ retaining one to a few olive feathers to the black underparts (Fig. 64). FCF and **DCB** ♀♀ have variable body plumage, dark brown above and grayish olive below, with head, upperpart, and throat plumage that varies from lacking red to being as fully red as ♂♂ (but usually duller); older (FPF and later) ♀♀ are best identified by broad and olive-edged remiges and rectrices and lack of black to the underparts (Figs. 63-67). FCF and **DCB** ♂♂ show rather invariable black body plumage, remiges, and rectrices (becoming brownish when worn) with bright, uniformly bright red head and mottled red backs, rump, and breast (Figs. 63-64, 66). **SPB** can be assigned to FCFs that have begun the second prebasic molt and still show brown juvenile primary coverts (Fig. 65) and **DPB** can be assigned to DCBs that have begun the definitive prebasic molt but have not reached p4 in primary progression (Fig. 68); birds in which molt has reached p4 or beyond and show no juvenile primary coverts are aged **UPB** (Fig. 68). **SCB** can be assigned to a bird that has suspended or arrested the second prebasic molt while retaining brown juvenile primary coverts (Fig. 65), and **SAB** could be assigned to a bird that has suspended the definitive prebasic molt, but only if suspension occurred before the third primary covert has been replaced; both of these age codes are uncommonly assigned. Thus, birds that had suspended or arrested flight-feather molt (including all those with suspensions among p4-p10 and without juvenile primary coverts) should be assigned age code DCB (Figs. 66-68). Age codes **UCU**, **UPU**, and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes TPB and FAJ are not assigned for this species.

As breeding appears to occur primarily in Apr-Dec and molting occurs primarily in Dec-Mar (prebasic) or protracted year-round (preformative), we might expect to see FCJs primarily in Jul-Feb, FPFs year-round, FCFs, SCBs, DCBs, and SABs primarily in Mar-Dec, and SPBs and

DPBs primarily in Dec-Feb (the beginning of molt), and UPBs, primarily in Jan-Mar (see Appendix 1). Both molting and non-molting birds may be expected at low proportions year-round. Age codes TPB and FAJ are not assigned to Cardinal Myzomelas.

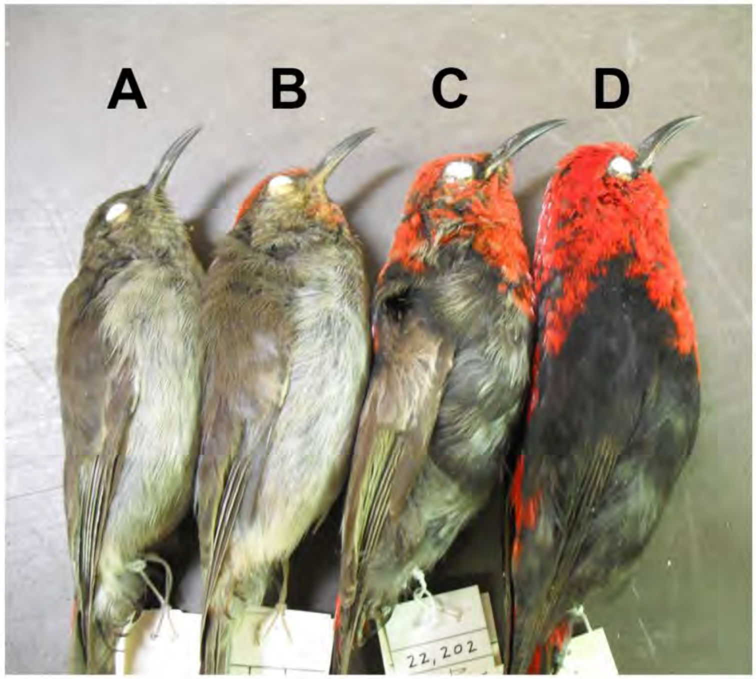

Figure 61. Specimens of FCJ (A), DCB ♀ (B), FPF ♂ (C), and DCB ♂ (D) Cardinal Myzomela collected on Tutuila Island. The FCJ (A) was sexed as a ♀ but FCJs without red it may not be determinable to sex. FCF and DCB ♀♀ vary in the extent of red to the body feathering, many showing red crowns, throats, and rumps (as in B), while others show full or nearly full red heads, matching ♂♂ (Figs. 64 and 67); but DCB ♀♀ continue to show olive-gray remiges with olive edging and lack red and black to the breast and lower underparts. FPF ♂♂ usually show more red than FPF ♀♀ but can be confirmed as ♂♂ by black feathers coming in to the back and underparts (C). DCB ♂♂ show extensive bright red, extending to the upper breast, and black wings and lower underparts (D). Specimens from WFVZ.

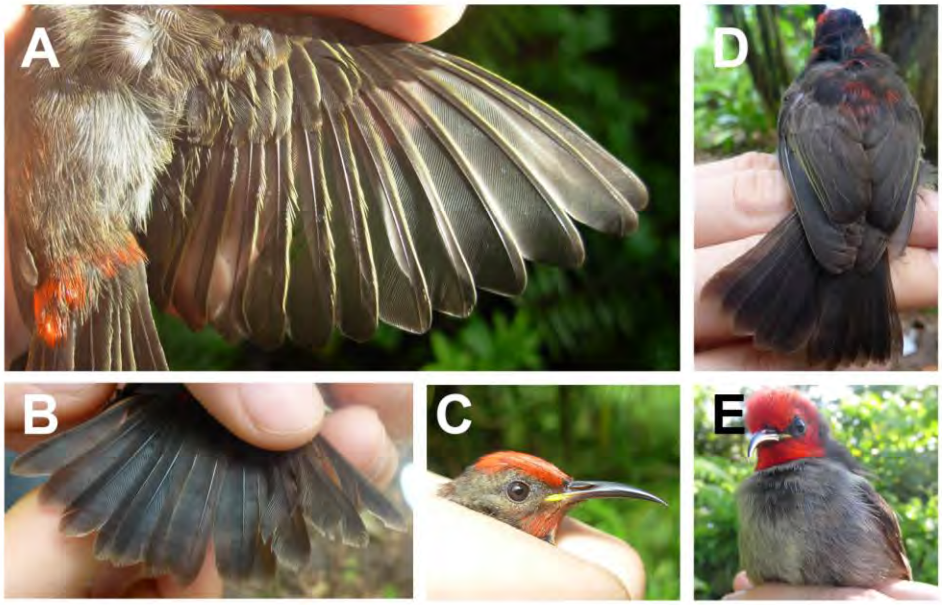

Figure 62. FCJ ♀ (A-C) and ♂ (D-E) Cardinal Myzomelas captured on Tutuila Island, 26 Dec 2012 (A-C, E) and 28 May 2013 (D). Note the uniform juvenile remiges (A) and rectrices (B, D). The extent of red varies in FCJs of both sexes and may indicate red juvenile feathering or commencement of the preformative body-feather molt before flight-feather molt (as with back feather molt in D); further study required.

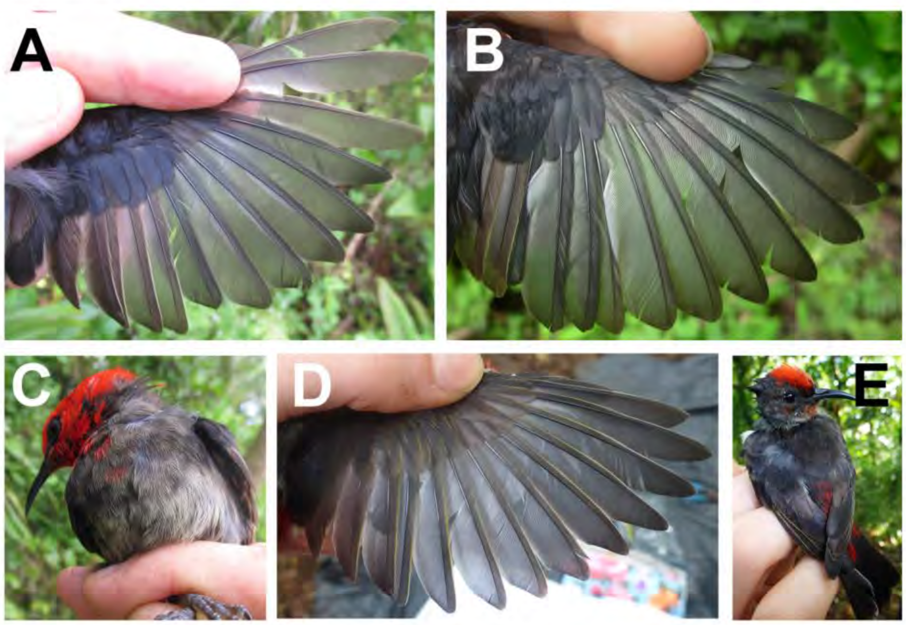

Figure 63. FPF ♂ (A-C) and ♀ (D-E) Cardinal Myzomelas captured on Tutuila Island, 20 Dec 2012 (A), 18 Feb 2013 (B-C), 25 May 2013 (D), and 27 May 2013 (E). The preformative molt has proceeded in sequence to p6 and s2 (A), p9 and s4 (B), and p9 and s3 (D), with s3-s6, s5-s6, and s4-s6 retained juvenile feathers, respectively. Note also that the inner 2 (A-B) or 7 (C) inner primary coverts have been retained and are contrastingly brown an worn (see also Figs. 64-65). The mixed pale olive-gray (juvenile) and red and black underpart feathers in D indicates FPF ♂ and the reduced red in the head and dark brown back feathers in E (at this stage of molt) indicate FPF ♀.

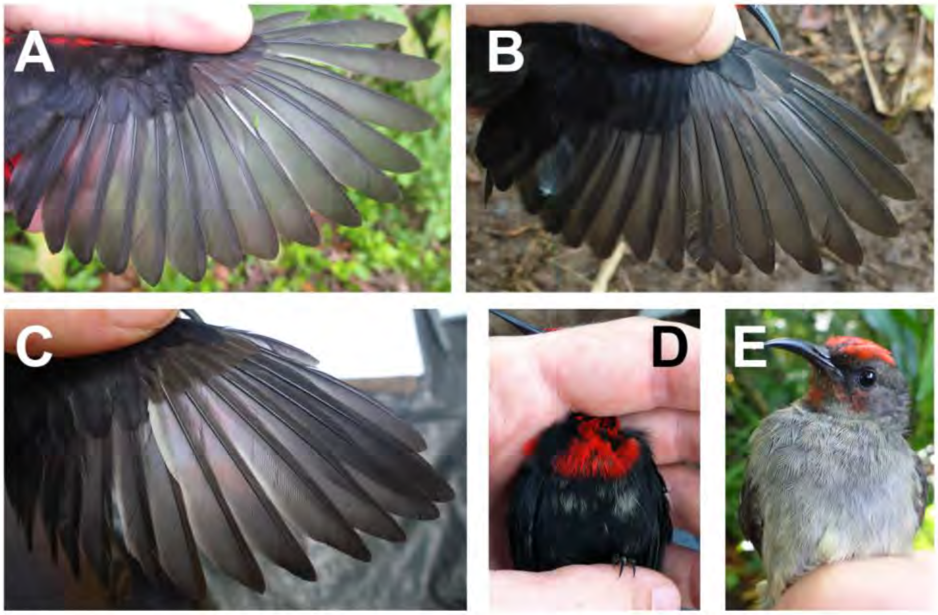

Figure 64. FCF ♂ (A-D) and ♀ (E) Cardinal Myzomelas captured on Tutuila Island, 23 Mar 2013 (A), 28 May 2013 (B-C), 27May 2013 (D), and 25May 2013 (E). Note the retained brown inner primary coverts (4 in A, 6 in B, and 8 in C) characteristic of FCF in this species (see also Figs. 63 and 65). Some FCF ♂♂ also can retain a few pale underpart feathers (D). Head plumages in FCF (and DCB) ♀♀ can vary from little to some red (as in E) to mostly red as in ♂♂, but the breast and underparts remain pale rather than mostly to entirely black as in FCF ♂♂ (see also Fig. 67).

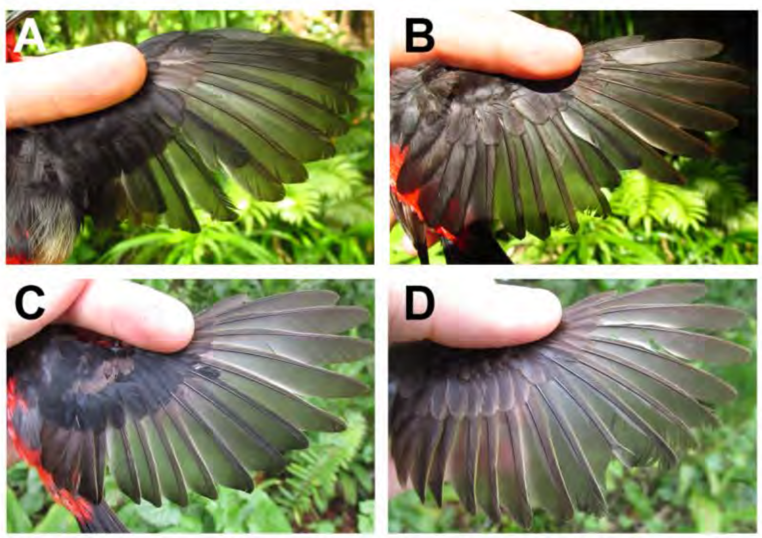

Figure 65. SPB ♂ (A-C) and SCB ♀ (D) Cardinal Myzomelas captured on Tutuila Island, 20 Dec 2012 (A-B), 26 Dec 2012 (C), and 18 Feb 2013 (D). In the SPBs, the second prebasic molt has proceeded to p1 (A), p3 (B), and p4 (C) and note in all cases the retained juvenile primary coverts from the formative plumage remain (see also Figs. 63-64). The SPB in A had also retained the juvenile s3-s6, which are being replaced to commence the SPB rather than in sequence, and the SPB in C appears also to have retained but recently replaced the juvenile s5-s6 and also has retained some juvenile median coverts. The SCB ♀ has suspended molt after p1-p3 and s5-s6 had been replaced and has two brown juvenile primary coverts (corresponding to p4-p5) remaining; SCBs and SABs are uncommon and can only be identified when molt is suspended among inner primaries and/or juvenile primary coverts remain (as here). Prebasic molts commencing with retained feathers from the previous molt (often secondaries among s3-s6, as in A, C, and D) have also been observed in Wattled Honeyeater and Samoan Starling (Pyle et al. 2016; see text).

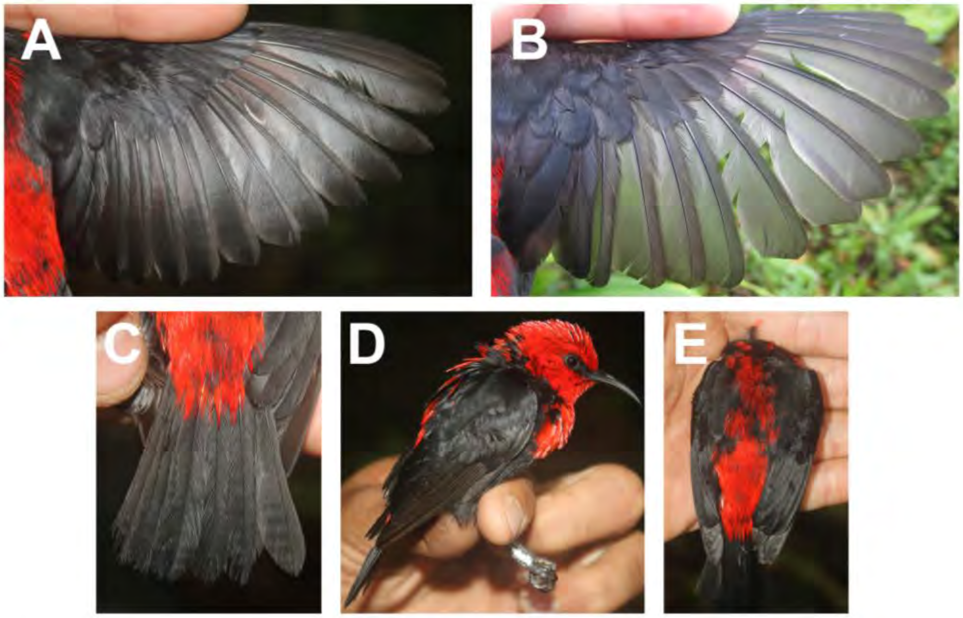

Figure 66. DCB ♂ Cardinal Myzomelas captured on Tutuila Island, 27 Aug 2012 (A, C-E) and 18 Feb 2013 (B). Note the uniform black wings and rectrices (A-C), although the tertials seem to have been replaced again (s8-s9 in A and s8 in B) perhaps suggesting the occurrence of a definitive prealternate molt (see text). Unlike in ♀♀ (Fig. 67), body plumage is rather invariable in FCF (see Fig. 64), DCB, DPB, UPB, and SAB Cardinal Myzomelas, being bright red and black (D-E).

Figure 67. DCB ♀ Cardinal Myzomelas captured on Tutuila Island, 26 Dec 1012 (A, C), 23 Mar 2016 (B, F), 8 Mar 2016 (D), 27 Sep 2012 (E), and 20 Dec 2012 (G). Note the uniform broad brown remiges and rectrices (A-C), the former with olive edging. In the DCBs in A and B, both the left and right s6 were retained during the previous molt; such birds are age-coded DCB rather than SAB because this feather could either be formative or basic. Unlike in ♂♂ (Fig. 66), head plumage varies substantially in FCF (see Fig. 64), DCB, DPB, UPB, and SAB Cardinal Myzomelas, from lacking red (D) to partially red (E-F), to nearly fully red (A, G); note also that the underparts lack the black of ♂.

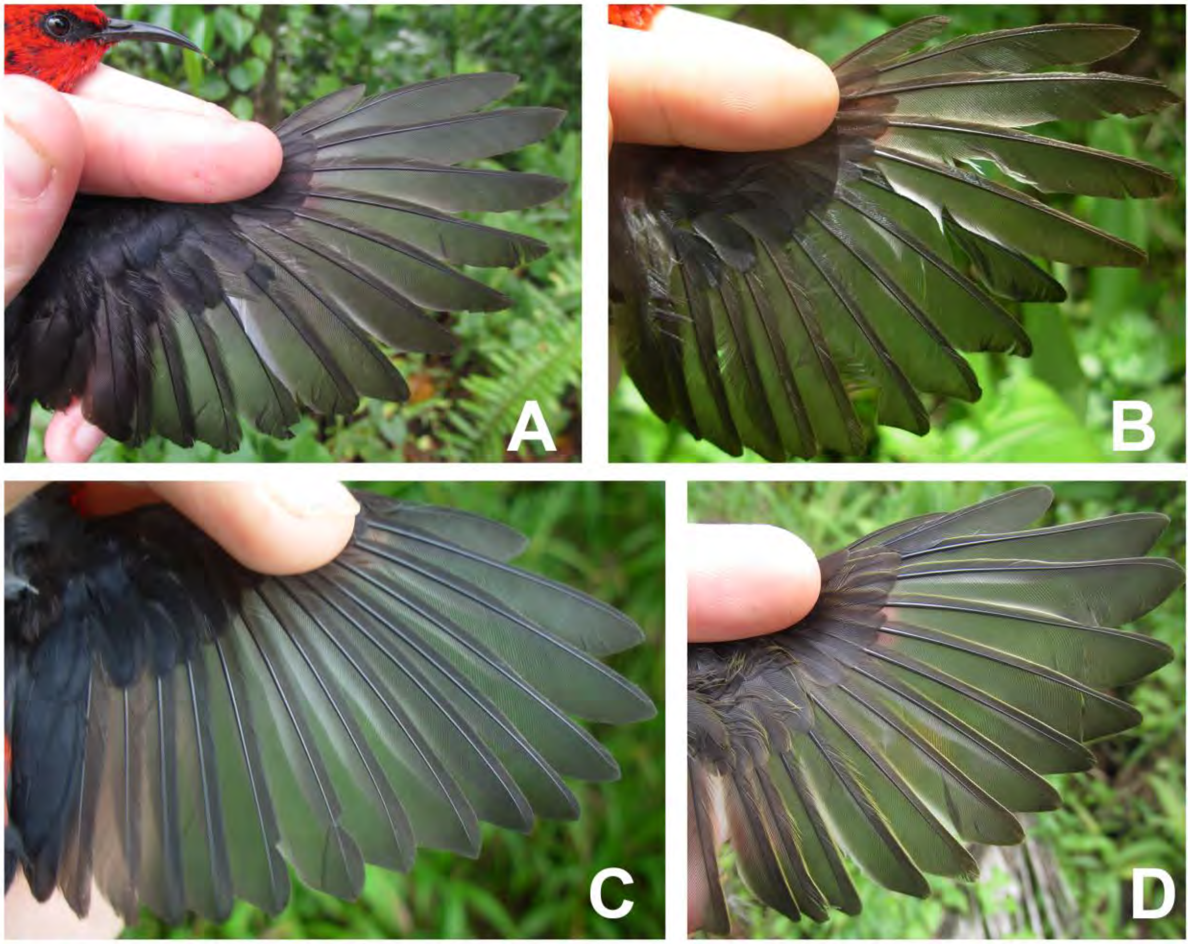

Figure 68. DPB ♂ (A), UPB ♂ (B-C), and UPB ♀ (D) Cardinal Myzomelas captured on Tutuila Island, 24 Dec 1012 (A), 22 Jan 2013 (B), 18 Feb 2013 (C), and 23 Jan 2013 (D). In all cases the older secondaries and outer primaries are not juvenile and no brown primary coverts (as in Figs. 63-65) are visible. The DPB in A has just commenced molt (p1 growing) and can be age-coded DPB because the primary covert corresponding to p2 remains and is not juvenile. The other three birds are age-coded UPB because primary molt has proceeded to p5 (B) or p9-p10 (C-D) and it can no longer be ascertained whether or not juvenile primary coverts were retained before these feathers were replaced (i.e., these could either be SPBs or a DPBs). Note that the middle secondaries (s1-s6 in A-B, 5-s6 in C, and s4-s6 in D) are also either formative or basic but not juvenile.

Polynesian Wattled-Honeyeater (POWH) ***Foulehaio carunculata***

Range and Taxonomy: Polynesian Wattled-Honeyeater is found in the Fijian, Tongan, and Samoan islands. The species (formerly known as just Wattled Honeyeater) has recently been split, with two other species (Fijian Wattled-Honeyeater *F. taviunensis*, and Kikau Wattled-Honeyeater *F. procerior*) now considered full species (Gill and Donsker 2017). Birds of the eastern Fijian Islands, Tonga, and Samoa are now considered a single monotypic species.

Individuals Examined: 11 specimens collected in Samoa (MVZ 6, MCZ 1, CAS 4); all from Samoa. 1402 captures at TMAPS stations (652 on Tutuila, 524 on Ta'u, and 226 on Ofu-Olosega).

Structure and Measurements: Ten primaries, 9 secondaries, 12 rectrices; the longest primary is p8; p10 reduced (about 40%) and p9 about 80% the length of p8 (Figs. 69-74). Measurements (specimens and from Mayr 1932, which included some birds from Western Samoa): wing chord: ♀ (n14+) 87-96, ♂ (n18+) 98-109; tail: ♀ (n14+) 72-78, ♂ (n18+) 80-90. Wing chord in TMAPS data for known-sex birds (with developing or full brood patch or cloacal protuberance): ♀ (n165) 85-94, ♂ (n143) 96-106. Among the three island groups and within each sex, mean wing chord values of captured birds differed by <1.5 mm, with means from Ta'u being slightly less than those on Tutuila and Ofu-Olosega.

Breeding Seasonality: Based on substantial specimen evidence, Banks (1984) concluded that Polynesian Wattled-Honeyeaters breed year-round in American Samoa, perhaps with peaks in Dec-Feb and Jun-Aug. Specimens with enlarged gonads reported on labels were collected in almost every month. TMAPS capture data indicate similar findings, birds in full breeding condition captured throughout the year, with possible bi-modal peaks in May-Jul and Oct-Nov (Pyle et al. 2016).

Molt: Group 3, with partial preformative and incomplete-to-complete prebasic molts (Table 1; Pyle et al. 2016). Mayr (1932) noted that birds collected in Nov were worn and those collected in Feb-May were fresh. Banks (1984) indicated that specimens were collected in body molt during Mar-Jul and Oct-Mar, with some birds in every month not in molt. Flight-feather molt was restricted to Dec-Mar, according with Banks' observations, and this was supported by TMAPS capture data, which show a distinct molting season commencing in Nov and completing in Apr (Pyle et al. 2016). Light body molt was also recorded in some captured birds in May-Oct, largely FPFs, suggesting that the preformative molt can be protracted, as can occur in the similar genus *Meliphaga* of Australia (Higgins et al. 2001). The preformative molt is partial, with body feathers and upperwing lesser coverts, most to all median coverts, no to all inner greater coverts, sometimes 1–3 tertials, and occasionally 1–6 central rectrices among r1–r3 (Pyle et al. 2016; Fig. 70). During prebasic molts, primaries are replaced distally from p1 to p10 and secondaries are typically replaced bi-laterally from s8 and proximally from s1, such that the last secondaries replaced are either s5 or s6 (Figs 71 and 73). Two captures from Ofu-Olosega showed apparent bidirectional replacement from p3 or p4 (Fig. 73**C**), suggesting some variation in molt sequence at least in this population, while another bird from Tutuila exhibited staffelmauser pattern during the definitive prebasic molt (Fig. 73**B**). Among TMAPS captures, 5-6% of older birds had arrested or suspended prebasic molts (Figs. 71 and 74), much more commonly among second prebasic than later prebasic molts (see Age Determination, below), indicating that molt can be suspended when conditions become favorable for breeding during the molting season of Nov-Apr (Pyle et al. 2016).

Age Determination: Age-code Group 3 (Tables 1-2). **FCJ**s are similar in plumage to older birds but have more filamentous feathers, and average grayer irises (Fig. 69); FCJs may also show more dusky mottling to breast than DCBs but this may be more evident on Ta'u and Ofu-Olosega than on Tutuila (Mayr 1932). The juvenile greater coverts appear paler and can average stronger yellowish tips than formative and basic coverts (Figs. 69 and 72), although there is variation in this character, and juvenile primary coverts, outer rectrices, and outer primaries are also more narrow and tapered in FCJs, **FPF**s, and **FCF**s than in basic feathers of later plumages (Figs. 69-74). FCFs can also be separated from later plumages by the lack of molt clines, most evident among secondaries (Fig. 70). **SPB**s can be assigned to FCFs that have begun the second prebasic molt but have retained narrow and worn juvenile outer primaries and rectrices, and lack molt clines to the un-replaced secondaries (Fig. 71). **SCB** is assignable to occasional birds that suspend the second-prebasic molt (Fig. 71) and **TPB** can be assigned to SCBs that have initiated the third prebasic molt, but this appears to be much rarer than suspensions or incomplete replacement during later molts, likely because one-year-olds may not breed. **DCB**s average paler irises than FCFs and have uniform and relatively fresh and broad wing coverts and flight feathers, not showing molt limits but showing molt clines in the outer primaries and (most evident) among s1-s6 (Fig. 72). DCBs that have commenced the next molt cycle (with older feathers basic) are **DPB**s (Fig. 73), and birds completing flight-feather molt such that the previous generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB** (Fig. 73). Adults can also suspend or arrest the definitive prebasic molt, probably for breeding, and such birds can be age-coded **SAB**, with occasional birds showing staffelmauser patterns (Fig. 74); note that DPB is coded for both DCBs and SABs that have commenced the following molt. Age codes **UCU** and **UUU** (but not UPU; unknown-cycle birds molting flight feathers should be coded UPB) are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age code FAJ is not assigned for this species.

As breeding and preformative molt can occur year-round while prebasic molt occurs almost exclusively in Nov-Apr (see above), we can expect to see FCJs, FPFs, FCFs, SCBs, DCBs, and SABs at any time of year while SPBs, TPBs, UPBs, and DPBs will occur in Nov-Apr (see Appendix 1).

Sex Determination: Sexes are similar in plumage but virtually all birds can be sexed by size, with birds showing wing chord < 96 being reliably sexed as ♀♀ and those showing wing chords > 98 being reliable sexed as ♂♂. Birds with wing chords of 96-98 can be reliably aged once age is factored in: FCJs, FPFs, FCFs, SPBs, and SCBs with juvenile outer primaries can be sexed ♂ and DCBs, UPBs, DPBs, and SABs can be sexed ♀ so long as the longest primary (p8) is not molting or broken. Breeding condition (brood patch or cloacal protuberance) appears also be useful for sexing birds year-round, but primarily in Apr-Dec.

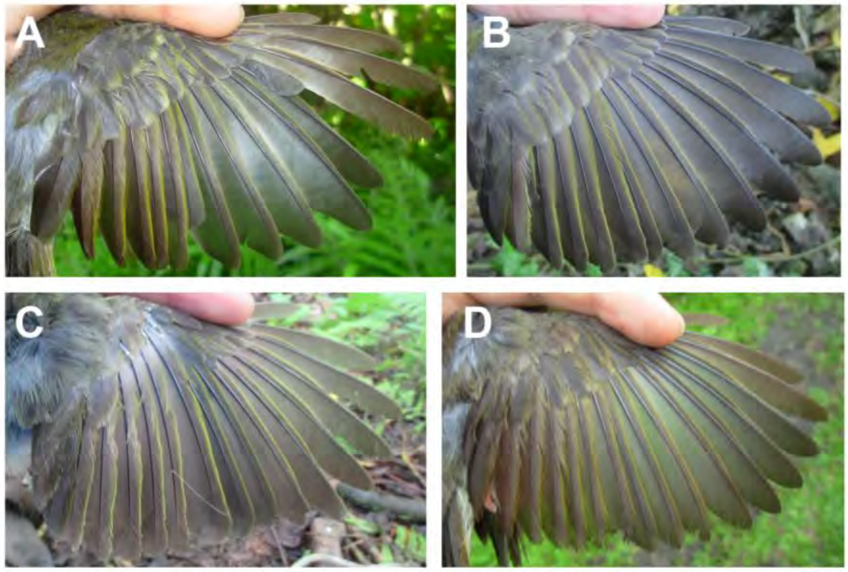

Figure 71. SPB (A-B) and SCB (C-D) Polynesian Wattled Honeyeaters captured on Tutuila Island 12 Feb 2014 (A) and 23 Dec 2013 (D), and on Ta'u Island 29 Jan 2015 (B) and 17 Dec 2014 (C). The second prebasic molt in A had reached p6 distally, s1 proximally, and s7 distally; this molt in B had almost completed but s5 is growing and s6 is old; the SCB in C had suspended the second prebasic molt after p1-p3 and s8 were replaced; and the SCB in D had suspended molt after p1-p7 and s8-s9 were replaced. In all cases note that the un-molted remiges are brown, even in wear without molt clines (especially among older secondaries), narrow, and more worn, indicating retained juvenile feathers. SCBs are not common; others have been recorded that have retained the juvenile s5-s6 or s6, resembling the SPB in B but having completed molt.

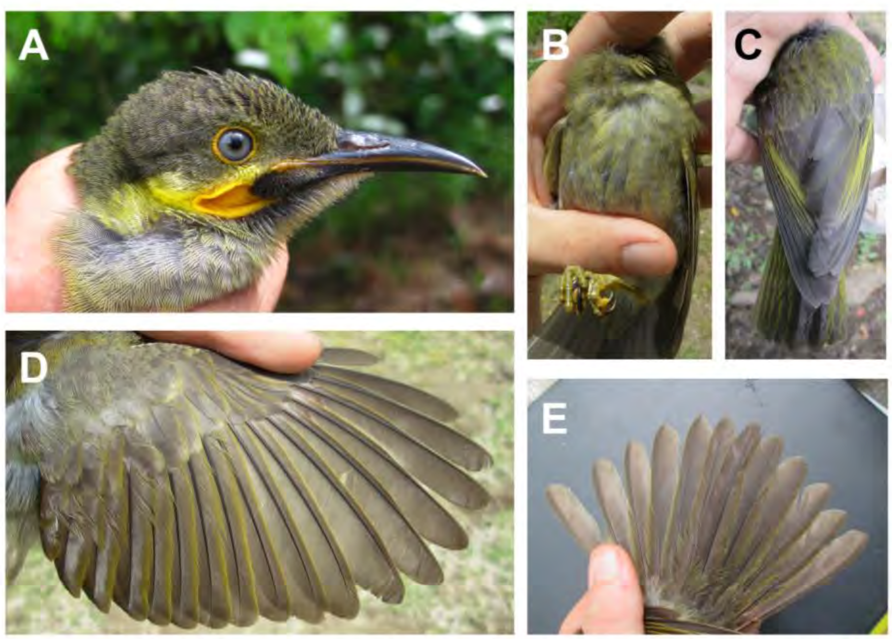

Figure 72. DCB Polynesian Wattled Honeyeaters captured on Tutuila Island 14 Feb 2014 (A), 1 Mar 2013 (B, D), and 13 Mar 2015 (C), and on Olosega Island 2 Jan 2016 (E). Compared to FCJs and FCFs, Note the paler iris (A); darker green head, breast, and back feathering (A-C); and broad and lustrous remiges and rectrices (D-E), without molt limits in the greater coverts or tertials, and often with less distinct fringes to the greater coverts (D). Note also the molt clines in the wing, from more-worn p1 distally to fresher p10, and more-worn s1 proximally to fresher s6, with the tertials appearing older, reflecting the sequence of replacement in these tracts.

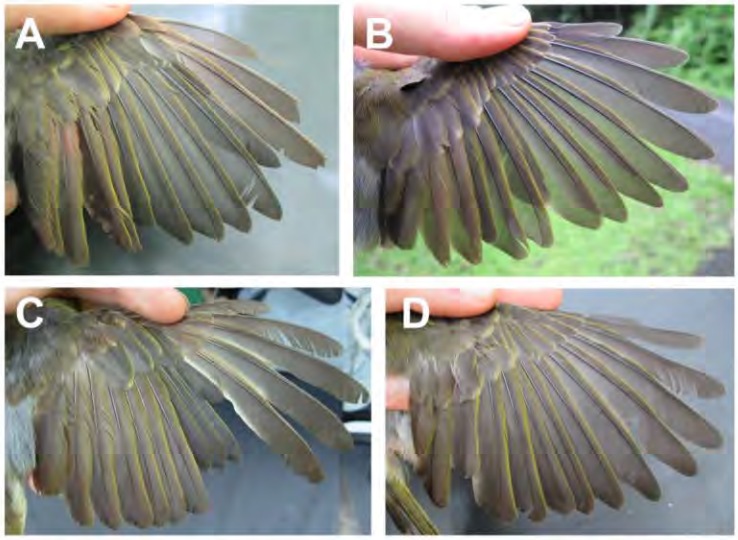

Figure 73. DPB (A-C) and UPB (D) Polynesian Wattled Honeyeaters captured on Ta'u Island 30 Jan 2016 (A), on Tutuila Island 14 Mar 2014 (B) and 21 Dec 2013 (C), and on Ofu Island 16 Feb 2016 (D). The DPBs in A-C are all showing unmolted older feathers that are broad, relatively fresh, and showing molt clines (especially among secondaries), allowing age-coding to DPB. In A, p6, p7 and s1 are growing and p8 and s2 are dropped; in B, p2, p8, p9, and s3 are growing and p10 and s4 are dropped (showing a staffelmauser pattern among primaries, which was symmetrical on both wings); and in C, p1-p5 are all growing or dropped, with molt proceeding bilaterally from a center at p3 (also symmetrical on both wings); in addition s8 is growing and s9 is dropped. In D, the outer primaries and s5 are growing and s6 is dropped; since no older unmolted feathers remain we do not know if this was an SPB or a DPB, and we code it UPB.

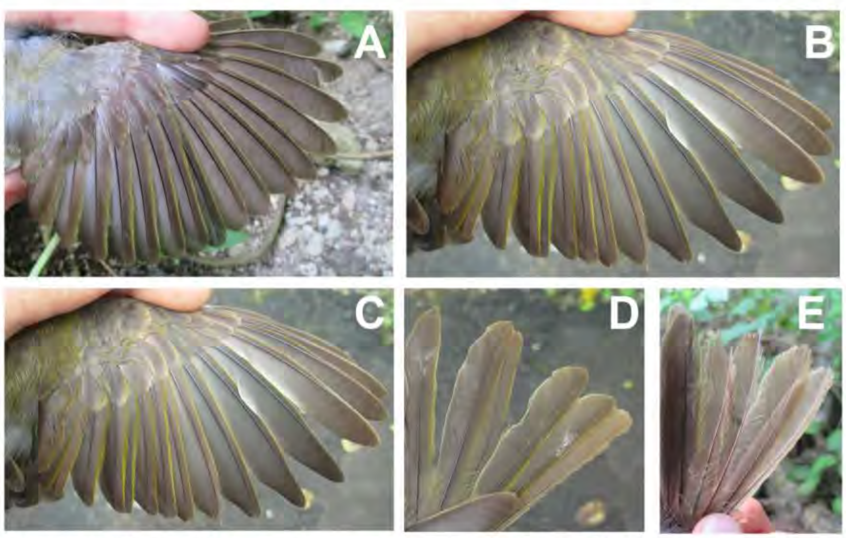

Figure 74. SAB Polynesian Wattled Honeyeaters captured on Ta'u Island 11 Jan 2015 (A, E), 7 Jan 2014 (B), and 25 Feb 2014 (C, D). Each of these SABs had suspended the definitive prebasic molt (perhaps for breeding) symmetrically on both wings or in the tail, and show older feathers that are broad and show molt clines, indicating two or more generations of basic feathers and age code SAB. The SAB in A and E had suspended the prebasic molt after p1, s8, and r1 had been replaced; the SAB in B had suspended the prebasic molt after p3-p5 and s3-s5 had been replaced (following an earlier suspension after p1-p2 and s1-s2 had been replaced); and the SAB in C-D had suspended the prebasic molt after all feathers except s6 and r6 had been replaced. Note that the SAB in C-D can initiate the following molt (at which time it becomes an age-code DPB) with s6 and r6 as well as in normal sequence, in a staffelmauser-like pattern (see Pyle et al. 2016) which in turn can result in variable replacement patterns among remiges and rectrices of SABs, as in the bird in B.

Red-vented Bulbul (RVBU) *Pycnonotus cafer*

Range and Taxonomy: The Red-vented Bulbul is found primarily in mountainous regions of India, Nepal, southwestern China, Pakistan, and Myanmar, where eight subspecies have been described (Gill and Donsker 2017). The species has been introduced in several places around the world, including Fiji, Tonga, and Hawaii. It was introduced to Western Samoa in 1943 and to Tutuila in 1958-1963 (Muse and Muse 1982, McAllen and Hobcroft 2005). The subspecies introduced to Hawaii and apparently other Pacific islands including Tutuila is *P. c. bengalensis* (Pyle and Pyle 2017).

Individuals Examined: Thirty-three specimens collected primarily in Hawaii (MVZ 2, BPBM 32); 20 captures at TMAPS stations on Tutuila.

Structure and Measurements: Ten primaries, 9 secondaries, 12 rectrices; the longest primary is p6 and p10 is about half the length of p6 (Figs. 75-78). Measurements of *P. c. bengalensis* (subspecies in Samoa) from Islam and Williams (2000): wing chord: ♀ (n596) 92-101, ♂ (n514) 97-108 (Fiji); tail: ♀ 85-95, ♂ 90-103 (India). Dhondt (1977) found bimodal distribution in unsexed adults from Samoa, indicating wing chord lengths of 93 or less were ♀♀, lengths of 96 or more were ♂♂, and lengths of 94-95 could be either. This suggests that Samoan birds might be smaller than in Fiji, but confirmation of this is needed. Twenty captures on Tutuila also showed bimodal distribution indicating ♀♀ have chords of 86-95 and ♂♂ have chords of 93-101, supporting the above measures.

Breeding Seasonality: Dhondt (1977) indicates peak breeding in Samoa during Nov-Jan, in accordance with Watling's (1983) findings of Oct-Feb in Fiji. Only three of 20 captures on Tutuila showed breeding characters, ♀♀ with developing or full brood patches in Nov and Dec and with a receding brood patch in Mar. In Hawaii, this species has a protracted breeding season in Jan-Oct, peaking in Mar-Aug (Islam and Williams 2000). The equivalent for this boreal timing at about the same austral latitude in American Samoa would be a protracted breeding season in Jul-Apr with peak in Sep-Feb. Banks (1984) noted specimens of "young" (presumably FPFs) collected from American Samoa in primary molt in Dec, which suggests more-protracted breeding than found by Dhondt.

Molt: Group 5, with complete preformative and prebasic molts (Table 1). Evidence from Samoa, Fiji, and Hawaii, indicate that molt follows breeding and that it is complete in both first-cycle and older birds (Dhondt 1977, Watling 1986, Islam and Williams 2000); in Samoa, it typically begins in mid-Jan and extends through Apr or May (Dhondt 1977). Banks (1984) recorded an FAJ not molting in Jun and FPFs molting inner primaries in Dec. Seven of 8 captures on Tutuila in Feb-Mar (3 FPFs and 4 UPBs) showed flight-feather molt (excepting one FCJ on 2 Feb which showed body molt; Fig. 75) and no birds outside of these months showed such molt. Higgins et al. (2006) indicate that the preformative molt can be partial or incomplete in some birds but this requires confirmation. Flight-feather molt sequence is typical of passerines: p1 to p10, s1 to s6 and bidirectionally from s8, and generally r1 to r6 (Dhondt 1977).

Age Determination: Age-code Group 5 (Tables 1-2). **FCJ**s are somewhat similar in appearance to later plumages but lack of a crest and have filamentous and brown undertail coverts, weak brown back feathers, and uniform juvenile remiges and rectrices, the latter lacking distinct white tips (Fig. 75). Because the preformative molt is complete, birds are coded FCJ until the first primary (p1) is dropped (Fig. 75; see text), at which time they are coded **FPF**, by retention of juvenile body feathers, wing feathers, and undertail coverts (Fig. 76) until the preformative molt has completed. **FAJ**s (indeterminable between FCF and DCB) are identified by the presence of a crest and full red undertail coverts, stronger blackish (fringed gray) back feathers, non-juvenile remiges which often show molt clines (especially from s1 to s6), and broader-tipped rectrices with distinct white tips (Fig. 77). It may be possible to age some FAJs as FCF or DCB by incomplete or complete skull ossification, respectively; however, the skull can be difficult to examine in this species and for now, we consider FCF and DCB not assignable. FAJs that are undergoing the ensuing molt can be aged **DPB** as based on older feathers (especially rectrices) that are non-juvenile (Fig. 78). Note that birds just completing molt (e.g., with p9-p10 or s6 growing), with no older feathers remaining to infer age, should be coded **UPU**. As with FAJs, it may be possible to age some UPUs as FPF or UPB by degree of skull ossification, but we are not assigning these codes at this time. Age codes **UCU** and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FCF, SPB, SCB, TPB, DCB, DPB, and SAB are not assigned for this species.

As peak breeding appears to occur in Sep-Feb and the preformative and prebasic molts appear to occur primarily in Dec-Apr (see above), we can expect to see FCJs primarily in Oct-Feb, FPFs and UPBs primarily in Dec-Apr, UPUs primarily in Feb-Apr, and FAJs primarily in Apr-Jan (see Appendix 1).

Sex Determination: ♂♂ and ♀♀ are similar in plumage (Islam and Williams 2000). ♀♀ average smaller than ♂♂ and measurements appear useful in separating most birds in Samoa: Wing chord < 93 = ♀; wing chord > 95 = M, and wing chord 93-95 may be ♂♂ for FCJs and FPFs and ♀♀ for FAJs and UPBs as long as p6 is not missing, growing, or broken. Breeding condition (brood patch or cloacal protuberance) appears also be useful for sexing some birds in Sep-Feb.

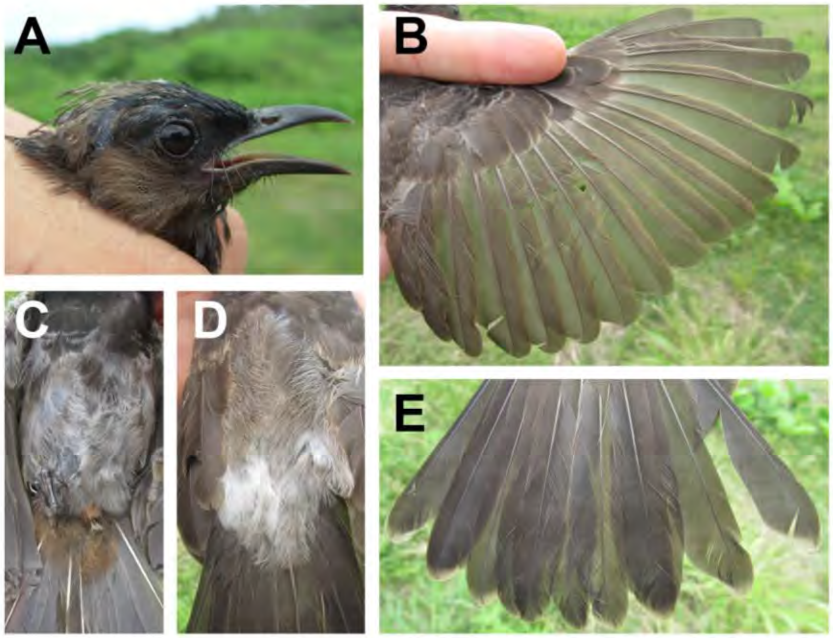

Figure 75. FCJ Red-vented Bulbul captured on Tutuila Island 2 Feb 2013. Compared with the FAJ (Fig. 77), note the lack of a crest (A), uniform juvenile remiges without molt clines (B), filamentous and brown undertail coverts (C), weak brown back feathers (D), and uniform pointed juvenile rectrices without distinct white tips (E). Although some body feathers and wing coverts have been replaced during the preformative molt (A-D) this bird is coded FCJ since the complete primary molt has not commenced (see text).

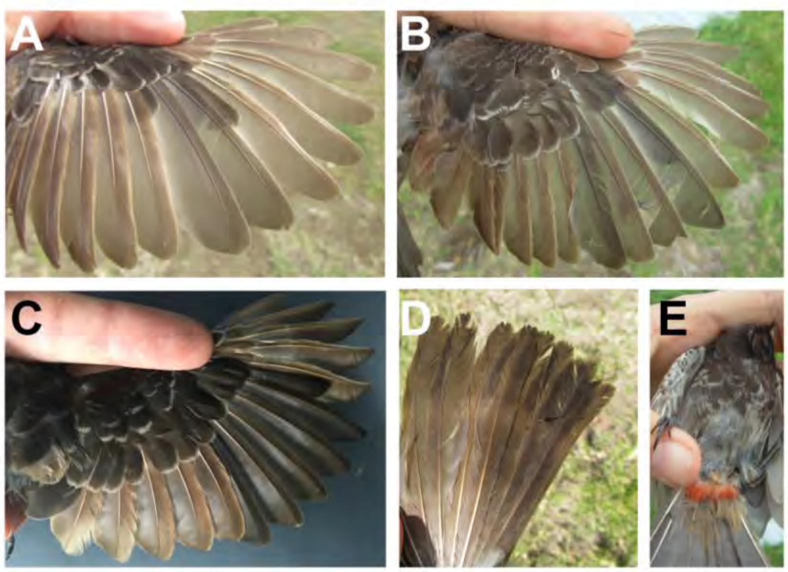

Figure 76. FPF Red-vented Bulbuls captured on Tutuila Island 4 Mar 2013 (A), 2 Feb 2013 (B, E), 18 Mar 2016 (C), and 2 Mar 2013 (D). Note that the unmolted primaries are juvenile, relatively narrow and worn, and uniform in wear, without molt clines; the FPF in A has p1-p2 new, p3 and s1 growing, p4 dropped, and p5-p10 and s2-s6 old juvenile; the FPF in B has p1-p3 and s1 new, p4 growing, and p5-p10 and s2-s9 old juvenile; and the FPF in C has p1-p4 and s1 new, p5, s2, and s8 growing, and p6-p10 and s3-s7 old. Note also the retained juvenile rectrices with fault bar (D) and the mixed red growing formative and brown retained juvenile undertail coverts (E). Note that birds just completing molt (e.g., with p9-p10 or s6 growing) but without any older feathers remaining, are age-coded UPU.

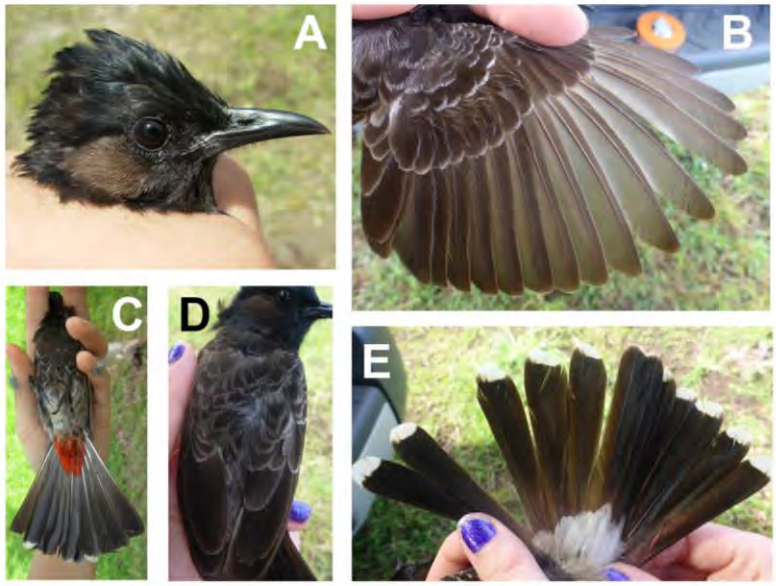

Figure 77. FAJ Red-vented Bulbuls captured on Tutuila Island 6 Nov 2012 (A), 5 Aug 2013 (B and D-E), and 24 Nov 2013 (C). Compared with the FCJ (Fig. 75), note the presence of a crest (A), uniform basic remiges with slight molt clines from p1 to p10 and s1 to s6 (B), full red undertail coverts (C) and blackish back feathers (D), and uniform broad basic rectrices with distinct white tips (E). As the both the preformative and prebasic molts can be complete, these birds could either be FCFs or DCBs and are age-coded FAJ.

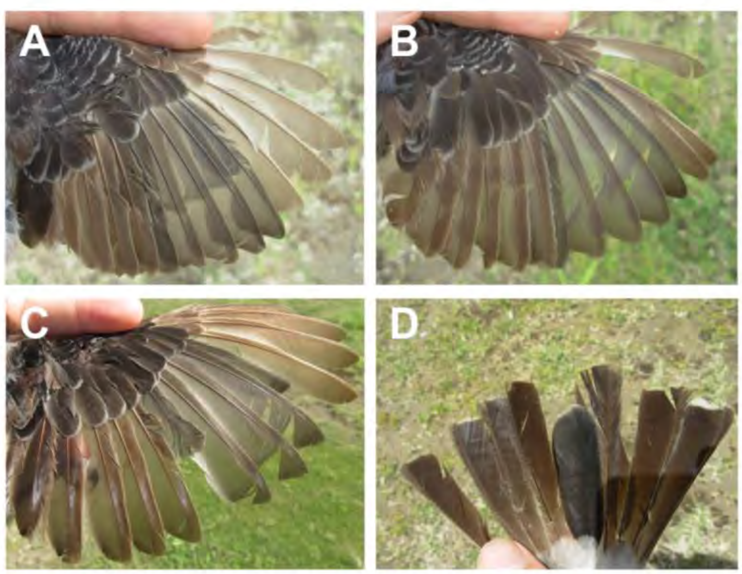

Figure 78. UPB Red-vented Bulbuls captured on Tutuila Island 1 Mar 2013 (A, D), 4 Mar 2013 (B), and 2 Mar 2013 (C). Note that the unmolted primaries are basic or formative, relatively broad (although bleached to brown), and showing molt clines, especially evident from s1 to s6 in the UPB in C. The UPB in A has p1-p4, s1, and s8-s9 new, p5, s2, and s7 growing, and p6-p10 and s3-s7 old; the UPB in B is similar except s8-s9 are growing and s2 is old; and the UPB in C has p1-p3 new, p4-p5, s2, and s8 growing, and p6-p10, s2-s7, and s9 old. Perhaps the best way to age molting birds is by the older rectrices, which are broad and tipped white (though the white can wear off) in UPBs (D). Note that older feathers can be either formative or basic following complete molts, leading to age code UPB rather than DPB, and that birds just completing molt without any older feathers remaining, are age-coded UPU.

Samoan Shrikebill (SASH) ***Clytorhynchus powelli***

Range and Taxonomy: Samoan Shrikebill has been considered one of 12 subspecies of Fiji Shrikebill (*C. vitiensis*), found from Fiji to Samoa, but we follow Pratt (2010) in elevating the Samoan subspecies *powelli* to full-species status. Samoan Shrikebill is found in Western Samoa and on Ta'u, Ofu, and Olosega islands but is absent from Tutuila in American Samoa. No subspecies are recognized among the Samoan Islands.

Individuals Examined: 10 specimens from Ta'u at WFVZ and 114 captures at TMAPS stations in American Samoa, 81 on Ta'u and 33 on Ofu-Olosega.

Structure and Measurements: Ten primaries, 9 secondaries, 12 rectrices; the longest primary is p5 and distally primaries gradually shorten to p10, about half the length of p5 (Figs. 79-83). Measurements of Samoan birds from Mayr (1933): wing chord: ♀ 87-90, ♂ 88-93; tail: ♀ 71-75, ♂ 73-77; exposed culmen: ♀ 23.1-24.2, ♂ 22.8-24.8. Measurements of specimens and captures of sexed birds (by specimen label or breeding condition, respectively) from Ta'u: wing chord: ♀ (n11) 85-90, ♂ (n7) 89-94; tail: ♀ (n4) 72-76, ♂ (n4) 74-76. Only one sexed ♀ was captured on Ofu with wing chord 85. Wing chord ranges (95% confidence intervals) from capture data of all sexed and un-sexed birds combined were Ta'u (n78) 81-93 and Ofu-Olosega (n29) 82-92, suggesting little if any difference in wing length between the two island groups in American Samoa.

Breeding Seasonality: Banks (1984) indicated that four active nests were collected on Ta'u in the first half of Jan. Mayr (1933) noted that birds collected in Dec-Jan were all worn or in early molt. Among TMAPS capture data, birds in breeding condition were captured in Dec-Jan, many with receding conditions, and FCJs were captured in Dec through late Mar, suggesting that breeding may commence in Oct or Nov (before TMAPS banding had begun on Ta'u and Ofu-Olosega) and may conclude in Jan-Mar (see also Pyle et al. 2016)

Molt: Group 3, with partial preformative and incomplete-to-complete prebasic molts (Table 1; Pyle et al. 2016). Mayr (1933) noted that birds collected in Dec-Jan were worn or in early molt. Eight of 10 specimens at WFVZ collected in Mar-Apr were not in molt (DCBs fresh) whereas two were completing molt. TMAPS capture data indicated a clear prebasic molting season beginning in late Nov to early Jan and completing as early as mid-Jan but more frequently in Mar, with few non-molting DCBs recorded in mid-Jan to late Feb. During prebasic molts, molt-commencement nodes among the inner primaries varied, with typical sequence (p1 nodal) recorded for five birds, p2 nodal (and replacement bidirectional) for six birds, and p1 and p2 molting at the same length in two birds; both SPBs and DPBs showed all three strategies (cf. Figs. 81 and 83). Bidirectional replacement among primaries was also found in another Pacific Old-World flycatcher, the Rufous Fantail (*Rhipidura rufifrons*) in Saipan (Junda et al. 2012). Otherwise, flight-feather molt sequence in Samoan Shrikebill is typical of passerines: distally from p1 or p2 to p10, bidirectionally from s8, proximally from s1 to s6, and generally from r1 to r6 on each side of the tail, such that the last feathers replaced are p9-p10, s5-s6, and r5-r6 (cf. Figs. 81 and 83). Seven of 33 non-molting adults had suspended or arrested molt, two during the second prebasic molt (Fig. 81) and five during the definitive prebasic molt (Figs. 81-82), probably for breeding as in other American Samoan landbird species, and probably less commonly during the second than during later prebasic molts. The preformative molt occurs in Dec-Mar as well (FPFs recorded as early as 10 Dec), and the capture of some FCJs as late as 21 Mar suggests that it likely can extend into Apr-Jun or later. The preformative molt is partial, including body feathers and upperwing lesser coverts, most to all median coverts, and 1–8 inner greater coverts but no other wing or tail feathers (Figs. 79-80).

Age Determination: Age-code Group 3 (Tables 1-2). **FCJ**s are similar in plumage to older birds but have slightly more-filamentous juvenile body feathers (especially in the ventral region), uniformly fresh and narrow flight feathers, rufous-fringed secondary coverts, and fleshy pink or yellow gapes, and no pale white to the lower mandible or lower edge to the upper mandible (Fig. 79); **FPF**s show these same characters while molting body feathers and median and inner greater coverts (Fig. 79). **FCF**s can also be separated from later plumages by yellow gape and/or bill edges without extensive white to the mandible edges, molt limits between the median and greater coverts and within the greater covert tract, lack of molt clines, especially from s1 to s6 among the secondaries, and retained juvenile rectrices (Fig. 80). **SPB**s can be assigned to FCFs that have begun the second prebasic molt but have retained narrow and worn juvenile outer primaries and rectrices, and lack molt clines to the un-replaced secondaries (Fig. 81). Occasional birds that suspend the second-prebasic molt can be coded **SCB** (Fig. 81), and **TPB** can be assigned to SCBs that have initiated the third prebasic molt, although this code is rare and has yet to be recorded among TMAPS data. **DCB**s have extensive whitish to the lower mandible and lower edge of the upper mandible, uniform and relatively lustrous and broad wing coverts and flight feathers with thin or no rufous fringes to the wing coverts and no molt limits, and molt clines most evident from s1 to s6 among the secondaries (Fig. 82). DCBs that have commenced the next molt cycle (with older feathers basic) are **DPB**s, and birds completing flight-feather molt such that the previous feather generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB** (Fig. 83). Adults can also sometimes suspend or arrest the definitive prebasic molt, probably for breeding, and such birds can be age-coded **SAB** (Fig. 82); note that DPB is coded for both DCBs and SABs that have commenced the following molt. Age codes **UCU** and **UUU** (but not UPU; unknown-cycle birds molting flight feathers should be coded UPB) are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FAJ and UPU are not assigned for this species.

As breeding appears to occur primarily in Oct-Mar and both preformative and prebasic molting occurs in Dec-Mar (the former likely extending into Jun or later), we can expect to see FCJs primarily in Nov-Mar, FPFs primarily in Dec-Jun, FCFs, SCBs, DCBs, and SABs primarily in Mar-Nov, and SPBs, TPBs, UPBs, and DPBs in Dec-Mar (see Appendix 1).

Sex Determination: According to Watling (2001) sexes are similar in plumage, though ♀♀ may average slightly duller than ♂♂. ♀♀ also average slightly smaller than ♂♂ but measurements indicate extensive overlap (see above); birds with wing chord < 88 can probably be sexed ♀ and those with wing chord > 93 can probably be sexed ♂, but age should be considered (FCFs < DCBs within each sex) and most birds will fall into the overlap zone. Full brood patches or cloacal protuberances appear to be reliable foe sexing ♀♀ or ♂♂, respectively, in Oct-Mar.

Figure 79. FCJ (A-C) and FPF (D-F) Samoan Shrikebills captured on Ta'u Island 7 Mar 2016 (A), 16 Jan 2015 (B), 24 Feb 2016 (C), 10 Jan 2014 (D), 27 Jan 2016 (E), and 29 Dec 2014 (F). Note the rufous edging to the juvenile wing coverts (A, E-F) uniform in the FCJ (A) and with the median and inner greater coverts being replaced in the FPFs (E-F). FCJs and FPFs also show swollen pink or yellow gapes without extensive white edges to the lower mandible or lower edge to the upper mandible (B), fresh, narrow, and pointed juvenile rectrices (C), and filamentous belly and undertail coverts, being replaced in the FPF in D.

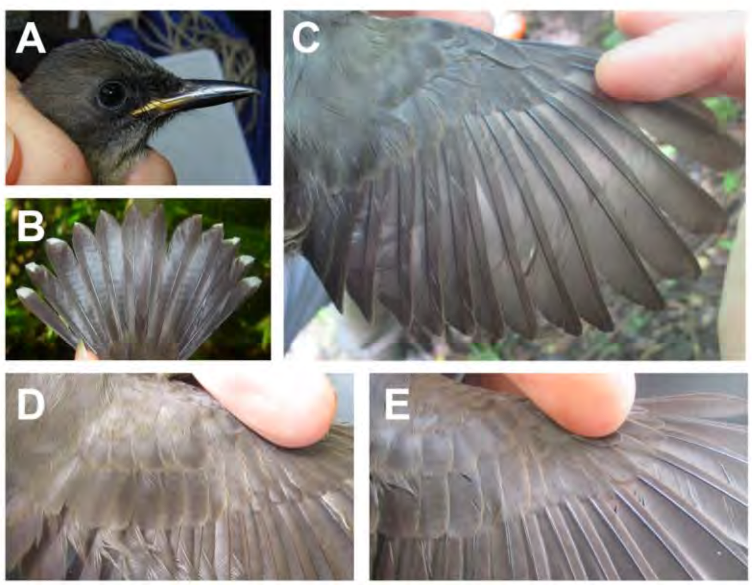

Figure 80. FCF Samoan Shrikebills captured on Ta'u Island 1 Mar 2014 (A), 20 Feb 2014 (B), 17 Dec 2014 (C), 30 Jan 2016 (D), and 19 Mar 2016 (E). Note the yellow gape and reduced yellow rather than extensive white edges to the mandibles (A), uniform juvenile rectrices (B), and molt limits among the wing coverts (C-E), the replaced median and inner greater coverts being glossy and without rufous fringing, contrasting with the retained outer greater (and sometimes outermost median) coverts which are browner and show rufous fringes when fresh (especially evident in C). The number of inner greater coverts replaced varies from 1 to 8; the FCF in C shows 4 inner coverts replaced and 5 outer coverts retained whereas the FCFs in D and E show 6 inner coverts replaced and 3 outer coverts retained. FCFs also lack molt clines in the remiges, in particular from s1 to s6 among the secondaries (C).

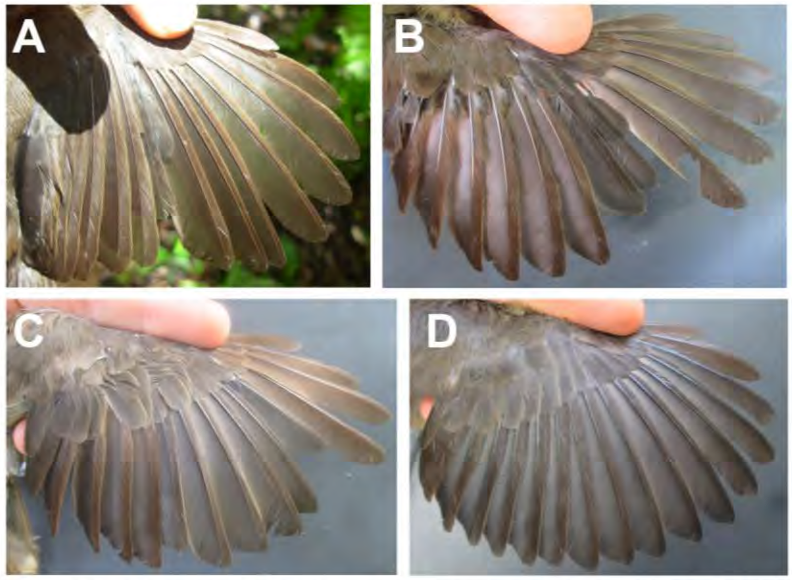

Figure 81. SPB (A-C) and SCB (D) Samoan Shrikebills captured on Ta'u Island 9 Jan 2014 (A), 30 Jan 2016 (B), 29 Jan 2016 (C), and 24 Feb 2016 (D). In the SPBs note that the retained unmolted primaries and secondaries are juvenile, worn, pointed, very brown, and lack molt clines from s1 to s6 among the secondaries; the SPB in A has p1-p2 and s9 growing (note that molt commenced at p1), s8 new, and p3-p10 and s1-s7 old; the SPB in B has p2 new, p1, p3-p4, and s8-s9 growing (note that molt commenced at p2), and p5-p10 and s1-s6 old; and the SPB in C has p1-p4 and s8-s9 new, p5-p6, s1, and s7 growing, and p7-p10 and s2-s6 old. The SCB in D shows similar plumage but suspended or arrested the second prebasic molt, retaining the juvenile p9-p10 and s5-s6; SCBs are not common (see text).

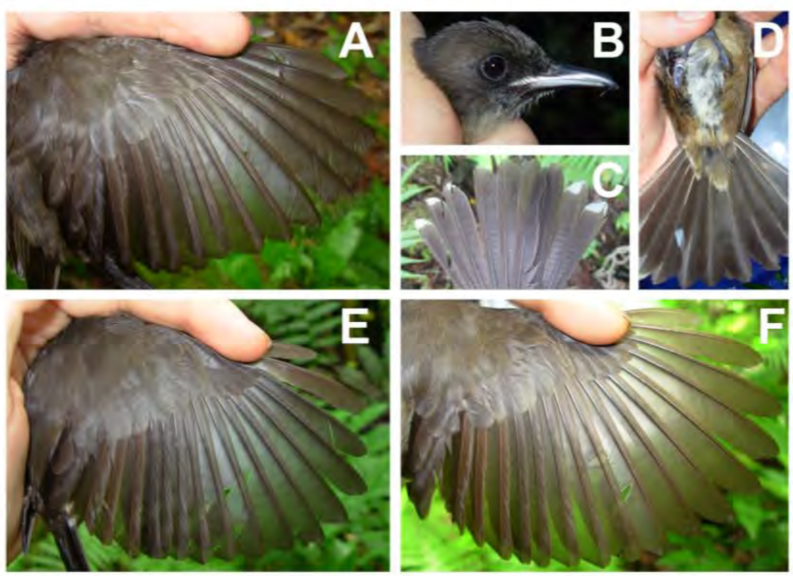

Figure 82. DCB (A-D) and SAB (E-F) Samoan Shrikebills captured on Ta'u Island 28 Dec 2013 (A), 19 Dec 2013 (B, D), 29 Dec 2014 (C), 9 Jan 2014 (E), and 1 Mar 2014 (F). DCBs show lustrous wing coverts and remiges, with little or no rufous edging to the coverts and often showing molt clines from s1 to s6 among the secondaries (A), extensive white edges to the lower mandible and lower edge to the upper mandible (B), broad rectrices (C) which are lustrous when fresh (D), and full (non-filamentous) underpart feathers and undertail coverts (D, vs. FCJ, Fig. 79). SAB's show similar plumage and bill features but have suspended or arrested the definitive prebasic molt; the SABs in E-F have both retained the basic p9-p10 and s4-s6, which are broad and can show molt clines, especially among the retained secondaries.

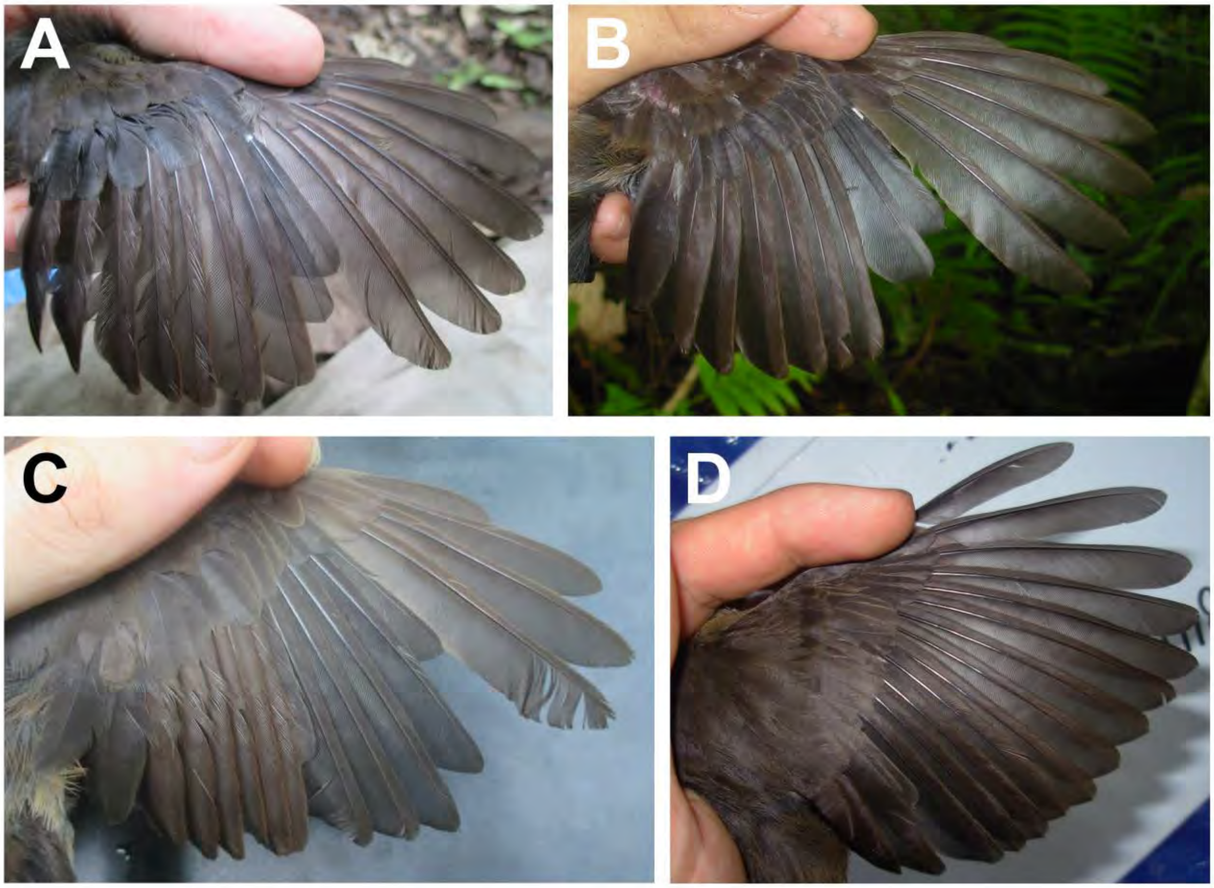

Figure 83. DPB (A-C) and UPB (D) Samoan Shrikebills captured on Ta'u Island 4 Feb 2015 (A), 22 Feb 2014 (B), 5 Mar 2016 (C), and 3 Mar 2014 (D). In the DPBs note that the retained unmolted primaries and secondaries are basic, relatively fresh, broad, and show molt clines, especially from s1 to s6 among the secondaries; the DPB in A has p1-p3 and s8-s9 growing (note that molt commenced at p1) and p4-p10 and s1-s7 old; the DPB in B has s8 new, p1-p4, s7, and s9 growing (note that molt commenced at p2, with p1 dropped and not visible) and p4-p10 and s1-s6 old; and the DPB in C has p1-p3 and s8-s9 new, p4-p6 and s1 growing, and p7-p10 and s2-s7 old. The UPB (D) has p10 and s5-s6 growing; since no older feathers remain we cannot assess whether or not this is SPB or DPB, and it receives age code UPB.

Polynesian Starling (POST) *Aplonis tabuensis*

Range and Taxonomy: The Polynesian Starling is found throughout southwestern Polynesia, from Fiji and surrounding islands to Niue Island, the Tongan Islands, and Western and American Samoa. Twelve subspecies have been described, of which two occur in American Samoa, *A. t. manuae* on Ta'u and Ofu-Olosega, and *A. t. tutuilae* on Tutuila. The subspecies on Ta'u and Ofu-Olosega is slightly smaller (see measurements, below), and has blacker and unstreaked underparts, as opposed to paler and grayer underparts streaked buff in the Tutuila population (Fig. 87); these plumage differences are present in all age/sex groups. Another subspecies, *A. t. brevirostris*, which occurs in Western Samoa, is also streaked below (Fig. 87). About 25 species of *Aplonis* starlings are found in Southeast Asia, Australia, and the Pacific Basic (see Samoan Starling, below).

Individuals Examined: 19 specimens from Samoa at WFVZ (9 from Ta'u and 10 from Western Samoa); 80 captures at TMAPS stations, 54 on Tutuila, 20 on Ta'u, and 6 on Ofu-Olosega.

Structure and Measurements: Ten primaries (p10 short), 9 secondaries, 12 rectrices; the longest primaries are p6-7 and the outer primary (p10) is reduced in length, shorter than the longest primary covert by 3-7 mm (Figs. 84-88). Measurements of American Samoan birds from Mayr (1942), WFVZ, and capture data: from Tutuila, wing chord: ♀ (n31) 99-106, ♂ (n27) 107-115; tail ♀ (n9) 52-58, ♂ (n10) 58-66; from Ta'u and Ofu-Olosega, wing chord: ♀ (n35) 96-104, ♂ (n25) 105-112; tail ♀ (n20) 51-58, ♂ (n23) 57-62; bill lengths among TMAPS captures appear similar in ♀♀ and ♂♂.

Breeding Seasonality: Banks (1984) reports a ♂ Polynesian Starling collected in American Samoa in Jul showing breeding condition and that most specimens collected in Oct-Jan were molting and not in breeding condition. Both DCBs captured in Jul-Aug but only 1 of 19 DCBs captured in Nov-Mar were in breeding condition, fresh molting FPFs were captured primarily in Nov-Jan, and more than half of older birds captured in Nov-Mar were molting flight feathers. This suggests peak breeding during the austral winter, in May-Oct or so, followed by the definitive prebasic molt in adults (see below).

Molt: Group 3, with partial preformative and incomplete-to-complete prebasic molts (Table 1; Pyle et al. 2016). Banks (1984) reports that many birds from Ta'u and Ofu-Olosega collected in Dec-Jan were molting and that a complete molt was taking place on specimens from Tutuila in Oct-Nov whereas Jan birds were fresh. TMAPS capture data indicates frequent symmetrical molt in Nov-Jan; molt scores suggest peak molt in Oct-Nov with the proportion of freshly molted DCBs increasing in Dec-Mar (Pyle et al. 2016). Flight-feather molt sequence is typical of passerines: distally from p1 to p10, bidirectionally from s8, proximally from s1 to s6, and generally from r1 to r6 on each side of the tail, such that the last feathers replaced are p9-p10, s5-s6, and r5-r6 (cf. Figs. 86-88). Five of 28 non-molting adults had suspended or arrested flight-feather molt, four during the definitive and one during the second prebasic molt (Figs. 86 and 88), probably for breeding as occurs more-commonly in other American Samoan landbird species. The second prebasic molt might be less likely to suspend or arrest in Polynesian Starling, also as found in other American Samoan landbird species. The preformative molt appears to occur primarily in Nov-Feb, with recapture data indicating this molt to be protracted and continuing through at least Mar and probably later in some birds. This molt is partial, including most to all body feathers and upperwing lesser coverts, some to most median coverts, no to all inner greater coverts, and rarely 1-3 tertials and up to at least 9 rectrices, but no other remiges (Figs. 84-85). These molt strategies are similar to those of Samoan Starling (see below) and typical of other Pacific *Aplonis* starlings (Higgins et al. 2006, Radley et al. 2011).

Age Determination: Age-code Group 3 (Tables 1-2). **FCJ**s are similar in plumage to older birds but have slightly more-filamentous juvenile body feathers (especially in the ventral region), duller or grayish yellow irises, flat-black crowns, and uniformly fresh and narrow remiges and rectrices (Fig. 84); **FPF**s show these same characters while molting body feathers and secondary coverts, along with tertials and central rectrices in some individuals (Fig. 84); and **FCF**s can be separated from later plumages by resulting molt limits among the median and greater coverts and often among the tertials and central rectrices, between replaced formative feathers and narrower and browner juvenile feathers, the latter not showing molt clines among the remiges, especially s1 to s6 (Fig. 85). **SPB**s show the same characters as FCFs (retained narrow and worn juvenile outer primaries and rectrices, and lack molt clines to the un-replaced secondaries) but have begun the second prebasic molt (Fig. 86); occasional birds that suspend this molt can be coded **SCB** (Fig. 86), and **TPB** can be assigned to SCBs that have initiated the third prebasic molt, although this code is rare and has yet to be recorded among TMAPS data. **DCB**s have bright yellow eyes, glossy crown feathers, and uniform and relatively broad wing coverts and flight feathers without molt limits, but with molt clines most evident from s1 to s6 among the secondaries (Fig. 87). DCBs that have commenced the next molt cycle (with older feathers basic) are **DPB**s, and birds completing flight-feather molt such that the previous feather generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB** (Fig. 88). Adults can also sometimes suspend or arrest the definitive prebasic molt, probably for breeding, and such birds can be age-coded **SAB** (Fig. 87); note that DPB is coded for both DCBs and SABs that have commenced the following molt (Fig. 88). Age codes **UCU** and **UUU** (but not UPU; unknown-cycle birds molting flight feathers should be coded UPB) are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FAJ and UPU are not assigned for this species.

As breeding appears to occur primarily in May-Oct, preformative molt occurs primarily in Nov-Apr, and prebasic molt occurs primarily in Sep-Mar, we can expect to see FCJs primarily in Nov-Mar, FPFs primarily in Nov-Apr, FCFs, SCBs, DCBs, and SABs primarily in Feb-Nov, and SPBs, TPBs, UPBs, and DPBs in Nov-Mar (see Appendix 1).

Sex Determination: Specimen examination and TMAPS data indicate that sexes are similar in plumage, including the extent of glossy plumage to the crown by age (Figs. 84 and 87), unlike in some other *Aplonis* starlings (see Samoan Starling, below). Wing chord can be used to sex almost all birds: on Tutuila wing chord < 107 indicates ♀♀ and wing chord > 106 indicates ♂♂, and on Ta'u and Ofu-Olosega wing chord < 105 indicates ♀♀ and wing chord > 104 indicates ♂♂; in all cases FCJs and FCFs should have shorter wings than DCBs and SABs, and beware individuals with molting, worn, or broken longest primaries, p6-p7. Full brood patches or cloacal protuberances appear to be reliable foe sexing ♀♀ or ♂♂, respectively, in May-Oct.

Figure 84. FCJ (A-D) and FPF (E-I) Polynesian Starlings captured on Ofu Island 14 Dec 2016 (A) and 21 Mar 2016 (I), Ta'u Island 24 Dec 2013 (B-D and G), 27 Jan 2016 (F and H), and Tutuila Island 7 Jan 2016 (E). Note the duller eye color in FCJs (A) which becomes brighter but not fully yellow in FPFs (G, I; the FPF in I is the same bird as the FCJ in A, three months later). In the FCJs, note also the flatter (not glossy) black crown (A), filametous lower underpart feathers and undertail coverts (C), and the uniformly juvenile rectrices (B) and wing feathers (D), the latter lacking molt clines (especially from s1 to s6) evident in basic remiges (Figs. 87-88). The FPFs show the same characteristics but are undergoing the preformative molt, which can be protracted; the FPF in E is replacing inner median and greater coverts along with the inner two tertials (s8-s9), and the FPF in F and H has replaced all greater coverts, the two inner tertials (s8-s9), and the inner four rectirces (r1-r2), and is replacing the outer tertial (s7) and additional rectrices among r3-r5; this FPF is undergoing the most extensive preformative molt for Polynesian Starling recorded in TMAPS data.

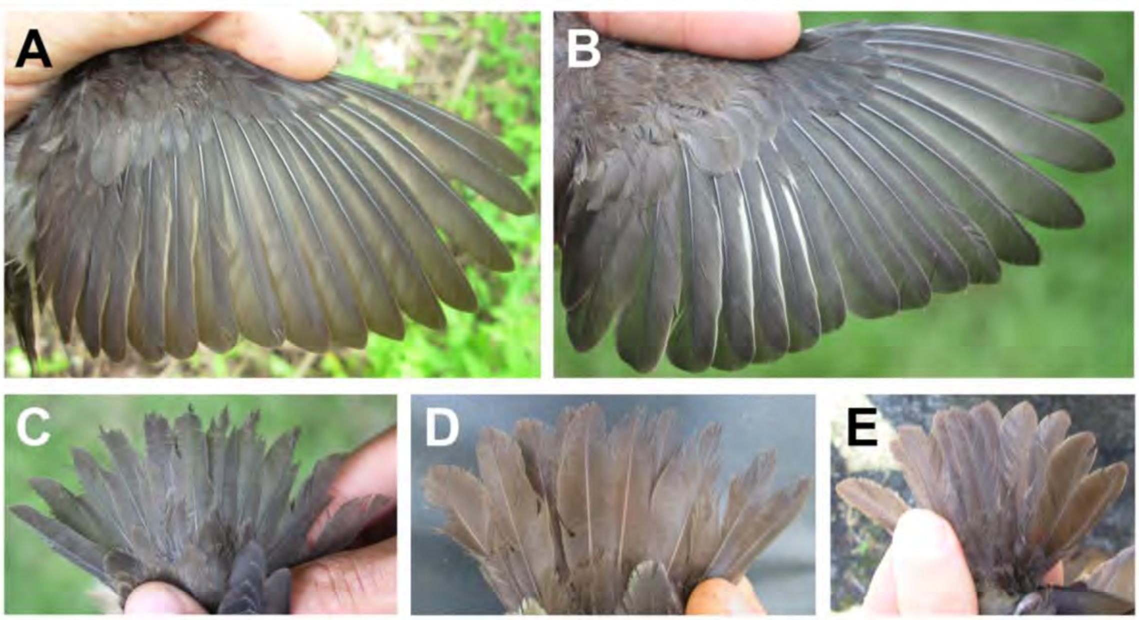

Figure 85. FCF Polynesian Starlings captured on Ta'u Island 31 Jan 2014 (A) and 15 Dec 2013 (E), Tutuila Island 21 Aug 2012 (B-C), and Ofu Island 30 Jan 2016 (D). Note molt limits between the median and greater coverts (A) and among the tertials (B; the formative greater coverts were present on the left wing but dropped adventitiously on the left wing of this FCF). The juvenile rectrices can either be retained (C-D) or partially replaced, for example r1-r2 replaced as in E. Frequently the rectrices of FPF and FCF Polynesian Starlings appear to be affected by feather mites in the nest as in C; note also the fault bars in the tail of this FCF, most evident among the central rectrices.

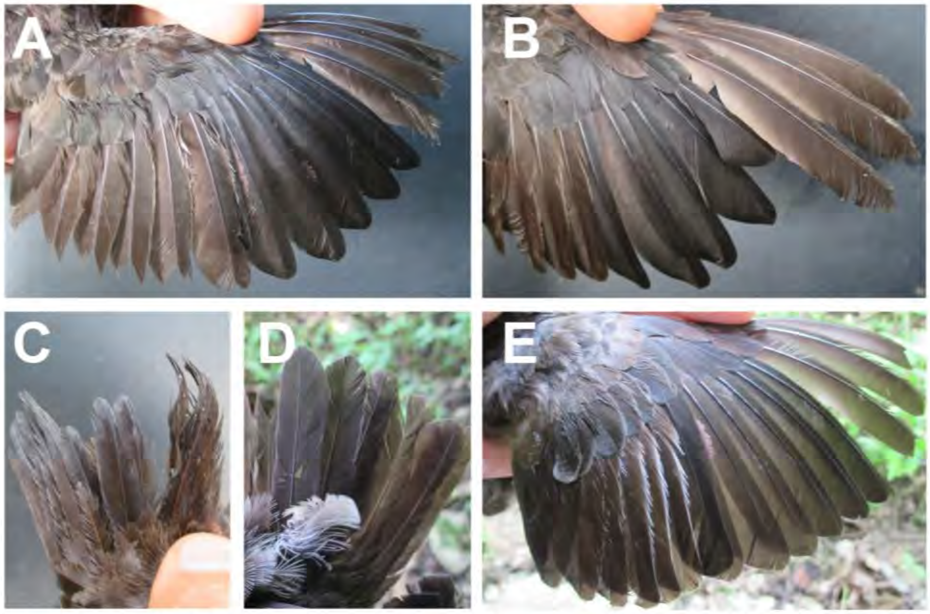

Figure 86. SPB (A-C) and SCB (D-E) Polynesian Starlings captured on Ofu Island 17 Mar 2016 (A and C) and 29 Jan 2016 (B), and Tau Island 7 Feb 2015 (D-E). In the SPBs, note that the retained unmolted primaries and secondaries are juvenile, worn, pointed, very brown, and lack molt clines from s1 to s6; the SPB in A and C has p1-p4 and s8-s9 new, p5, s1, and r1-r2 growing, and p6-p10, s2-s7, and r3-r5 old; the SPB in B has p1-p3, p4-p6 growing, and p7-p10 (note the reduced p10, about the same length as the primary coverts) and all visible secondaries (s1-s4) old. The SCB in D-E shows similar plumage but suspended or arrested the second prebasic molt, retaining the juvenile p7-p10, s2-s7, and r3-r5.

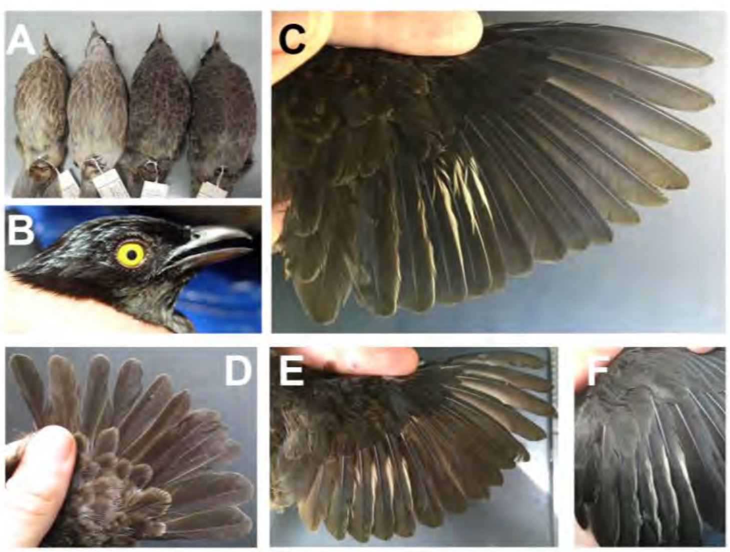

Figure 87. DCB (A-C) and SAB (D-F) Polynesian Starlings housed at WFVZ (A) and captured on Ta'u Island 1 Mar 2014 (A), Tutuila Island 17 Mar 2016 (C) and 18 Feb 2016 (E-F), and Ofu Island 19 Mar 2016 (D). The specimens depict subspecific underpart differences between Polynesian Starlings on Tutuila and Western Samoa (A. t. tutuilae and brevirostris, left two DCBs) and those on Ta'u and Ofu-Olosga (manuae, right two DCBs), differences that are present in all age/sex groups. DCBs also show glossier crowns than FCJs and brighter yellow eyes than FCJs and FCFs (B), uniformly basic wing coverts and remiges usually showing molt clines from s1 to s6 among the secondaries (C), and broad and truncate rectrices (C; the older generation). SAB's show similar eye-color, plumage, and molt-cline features but have suspended or arrested the definitive prebasic molt; the SAB in D has retained a basic right r5, the SAB in E has retained the basic s6, and the SAB in F has retained the basic s5-s6.

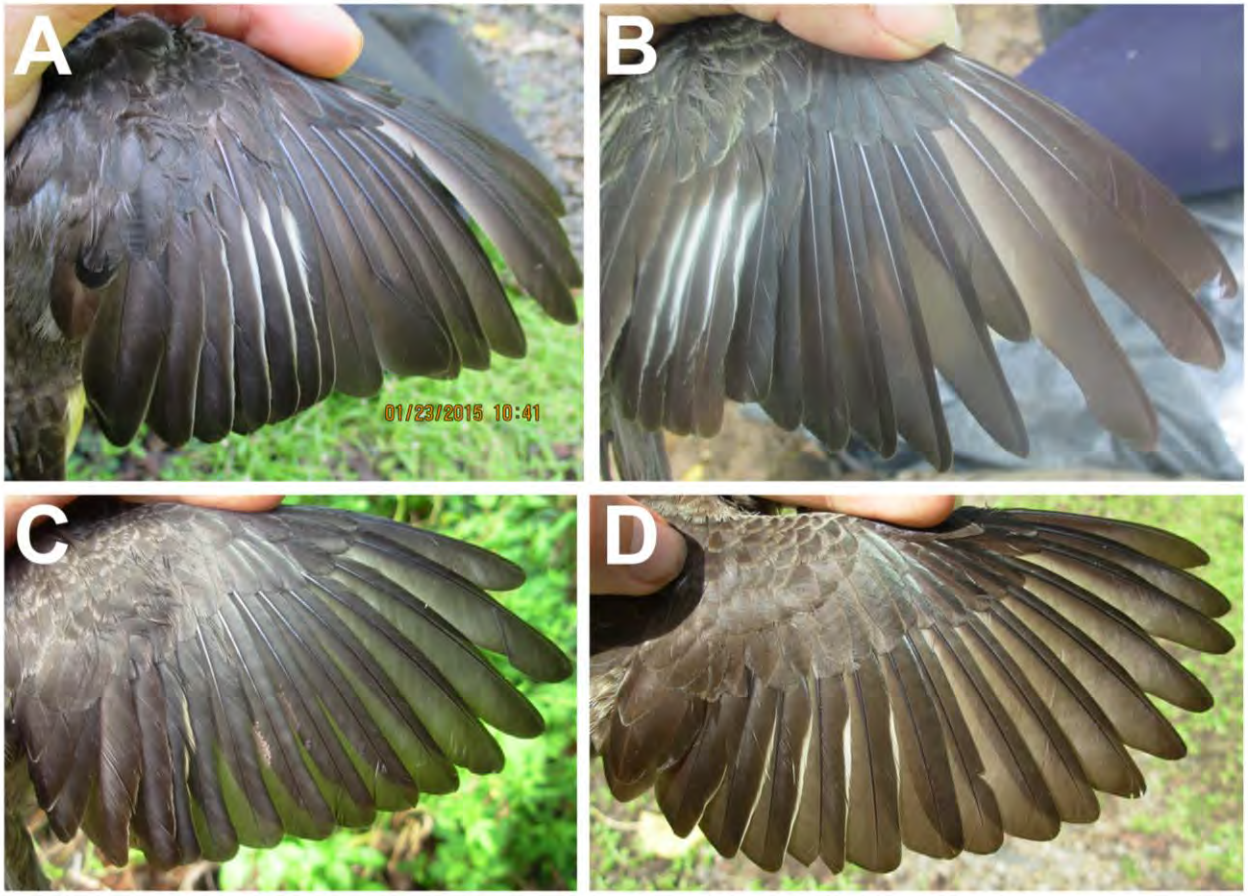

Figure 88. DPB (A-C) and UPB (D) Polynesian Starlings captured on Tutuila Island 23 Jan 2015 (A), 16 Dec 2014 (B), and 7 Apr 2013 (D), and on Ta'u Island 30 Dec 2013 (C). In the DPBs note that the retained unmolted primaries and secondaries are basic, relatively fresh, broad, and show molt clines, especially from s1 to s6 among the secondaries; the DPB in A has just commenced a prebasic molt, with the middle tertial (s8) growing on both wings and all other remiges old; the DPB in B has p1-p5 new, p6 and s1 growing, s2 dropped, and p7-p10 and s3-s7 old (s8-s9 are not visible but are likely new and/or growing); and the DPB in C has p1-p7, s1-s3, and s7-s9 new, p8-p9 (p10 not visible) and s4 dropped or growing, and s5-s6 old. The UPB (D) has p9, p10, and s6 growing and all other feathers new; since no older feathers remain we cannot assess whether or not this is SPB or DPB, and it receives age code UPB. The DPB in A had retained basic s5-s6 and p10 on both wings, and was therefore an SAB before molt had commenced, but we age-code both DCBs and SABs that have begun the subsequent molt as DPBs; it is quite possible that the next feathers replaced on this bird included the retained inner secondaries and outer primaries, in a staffelmauser-like replacement pattern, as found in other American Samoan landbirds (Figs. 74 and 92-93; see Pyle et al. 2016).

Samoan Starling (SAST) *Aplonis atrifusca*

Range and taxonomy: About 25 species and many additional subspecies of *Aplonis* starlings are found in Southeast Asia, northern Australia, and widely throughout the southwestern and western Pacific Basin, from New Guinea through Micronesia and American Samoa (Gill and Donsker 2017). The Samoan Starling is found throughout the high islands of Western and America Samoa, where it is endemic and monotypic (no subspecies recognized within Samoan Islands).

Individuals examined: 17 specimens (MVZ 2, WFVZ 11, CAS 2, LSU 2) from American and Western Samoa; 420 captures at TMAPS stations on Tutuila (95 captures), Ta'u (221), and Ofu-Olosega (104) islands.

Structure and Measurements: Ten primaries, 9 secondaries, and 12 rectrices; the longest primaries are p5 and p6 and the outer primary (p10) is reduced in length (contra indications in Amadon 1943b), varying from slightly shorter than, to about 15 mm longer than, the longest primary covert (Figs 89-93); TMAPS data indicate no significant differences in the length of p10 by age or sex. Analyses of measurements from American Samoa (Mayr 1942, Banks 1984, specimens, and captures; 95% confidence intervals) indicate that birds from Tutuila have wing chord: ♀ (n27) 133-147, ♂ (n46) 145-160; tail ♀ (n13) 88-104, ♂ (n24) 96-117; birds from Ta'u have wing chord: ♀ (n88) 135-149, ♂ (n114) 147-162; tail ♀ (n20) 94-107, ♂ (n42) 99-115; and birds from Ofu-Olosega have wing chord: ♀ (n25) 136-148, ♂ (n65) 146-161; thus birds from Ta'u average about 1 mm longer wings than birds on Ofu-Olosega, which in turn average about 1 mm longer than birds on Tutuila. Analysis of bill measurements indicate that ♂♂ have slightly larger bills than ♀♀ but extreme variation in both sexes prevents accurate discrimination of values by sex or island population.

Breeding Seasonality: Banks (1984) summarizes specimen and other information indicating a peak breeding season for American Samoa in Jun-Dec. TMAPS data indicate that most DCBs captured in May-Sep were in reproductive condition (full brood patches or cloacal protuberances) but <2% of DCBs captured in Nov-Apr were in breeding condition (excepting some ♀♀ with receding brood patches in Nov-Dec), and that FCJs were captured primarily in Nov-Jan, supporting a breeding season confined to May-Oct.

Molt: Group 3, with partial preformative and incomplete-to-complete prebasic molts (Table 1; Pyle et al. 2016). Banks (1984) reported that none of many specimens collected in Feb-Jul were undergoing primary molt and that a small proportion were undergoing body molt in Jun-Jul. Seven specimens collected Mar-Apr were not in molt, four specimens collected Jun and early Jul were worn and not molting, and four collected in Aug (2) and Nov (2) were undergoing primary molt (replacing p5, p6, or p7). Analysis of TMAPS data indicate a clear molting season that can begin as early as Jul and complete as late as Mar, which can be protracted in individual birds (cf. Pyle et al. 2016); adults (DCBs and SABs) not in molt were also commonly captured throughout Nov-Mar. Peak molting appears to occur primarily in Sep-Jan. Flight-feather molt sequence is typical of passerines: distally from p1 to p10, bidirectionally from s8, proximally from s1 to s6, and generally from r1 to r6 on each side of the tail, such that the last feathers replaced are p9-p10, s5-s6 (sometimes s4), and r5-r6 (cf. Figs. 91 and 93). Many DCBs show variation and clines among secondaries, for example s5-s6 or s6 being much fresher than other secondaries, indicating that the molt of this tract can be very can be protracted (Figs. 91-93). Seventeen of 158 non-molting adults had suspended or arrested flight-feather molt, 14 during the definitive and 3 during the second prebasic molt (Figs. 90 and 92), probably for breeding (Pyle et al. 2016). The second prebasic molt appears to be less likely to suspend or arrest, perhaps due to one-year-olds breeding less often than older birds. The preformative molt appears to occur primarily in Nov-May. This molt is partial, including most to all body feathers, some to all lesser coverts, no to all median coverts, no to most (up to 9) inner greater coverts, and often 1-2 (sometimes 3) tertials and sometimes 1-4 (occasionally 5-10) central rectrices, but usually no other remiges (Figs. 89-90). One individual was captured undergoing an eccentric preformative molt, with outer primaries and primary coverts and inner secondaries replaced on both wings, and all rectrices replaced (Fig. 89); study is needed to determine how often this occurs in Samoan Starling. A partial-to incomplete preformative molt is typical of Polynesian Starling (see above) and other Pacific *Aplonis* starlings (Higgins 1999, Radley et al. 2011), although this is the first recorded instance of eccentric molt in *Aplonis* or any other American Samoan landbird.

Age Determination: Age-code Group 3 (Tables 1-2). **FCJ**s have flatter (less-glossy) and browner plumage than older birds, slightly more-filamentous juvenile body feathers (especially in the ventral region), dull brown irises, and uniformly fresh and narrow remiges and rectrices (Fig. 89); **FPF**s show these same characters while molting body feathers and secondary coverts, along with tertials and central rectrices in some individuals (Fig. 89); and **FCF**s can be separated from older age groups by browner irises and molt limits among the secondary coverts, tertials, and central rectrices, between replaced formative feathers and narrower and browner juvenile feathers, the latter not showing molt clines among the remiges, especially s1 to s6 (Fig. 90). **SPB**s show the same characters as FCFs (retained narrow and worn juvenile outer primaries and rectrices, and lack molt clines to the un-replaced secondaries) but have begun the second prebasic molt (Fig. 91); occasional birds that suspend this molt can be coded **SCB** (Fig. 91), and **TPB** can be assigned to SCBs that have initiated the third prebasic molt, although this code is rare and has yet to be recorded among TMAPS data. **DCB**s have reddish-brown eyes, glossy head and breast feathers, and uniform and relatively broad wing coverts and flight feathers, without molt limits, but with molt clines most evident from s1 to s6 among the secondaries (Fig. 92). DCBs that have commenced the next molt cycle (with older feathers basic) are **DPB**s, and birds completing flight-feather molt such that the previous feather generation (juvenile in SPBs or basic in DPBs) is no longer assessable are coded **UPB** (Fig. 93). Adults can suspend or arrest the definitive prebasic molt, probably for breeding, and can also show staffelmauser patterns; such birds can be age-coded **SAB** (Fig. 92). Note that DPB is coded for both DCBs and SABs that have commenced the following molt (Fig. 93). Age codes **UCU** and **UUU** (but not UPU; unknown-cycle birds molting flight feathers should be coded UPB) are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FAJ and UPU are not assigned for this species.

As breeding appears to occur primarily in May-Oct, preformative molt occurs primarily in Nov-May, and prebasic molt occurs primarily in Aug-Feb, we can expect to see FCJs primarily in Sep-Jan, FPFs primarily in Oct-May, FCFs, SCBs, DCBs, and SABs primarily in Feb-Nov, and SPBs, TPBs, UPBs, and DPBs in Aug-Feb, with UPBs being found primarily later within this molting period (see Appendix 1).

Sex Determination: Specimen examination and TMAPS data indicate that sexes are rather similar in plumage. Although the extent of glossy head and breast feathering appears to be greater in ♂♂ than ♀♀, within each age group (after FCJ) as found in some other Pacific *Aplonis* starlings (Higgins 1999, Radley et al. 2011), TMAPS data indicate there to be too much overlap based on age (FCFs are duller than DCBs within each sex) and plumage wear for this to be a reliable characteristic for sexing. On the other hand, wing chord can be used to sex almost all birds: on Tutuila wing chord < 145 indicates ♀♀ and wing chord > 147 indicates ♂♂; on Ta'u wing chord < 147 indicates ♀♀ and wing chord > 149 indicates ♂♂; and on Ofu-Olosega wing chord < 146 indicates ♀♀ and wing chord > 148 indicates ♂♂. In all cases FCJs and FCFs should have shorter wings than DCBs and SABs, such that reliable determination of age should allow reliable sexing of all birds, except perhaps individuals in which the longest primaries (p5-p6) are molting, worn, or broken. Full brood patches or cloacal protuberances appear to be reliable foe sexing ♀♀ or ♂♂, respectively, in May-Oct, with some ♀♀ showing receding brood patches as late as Dec.

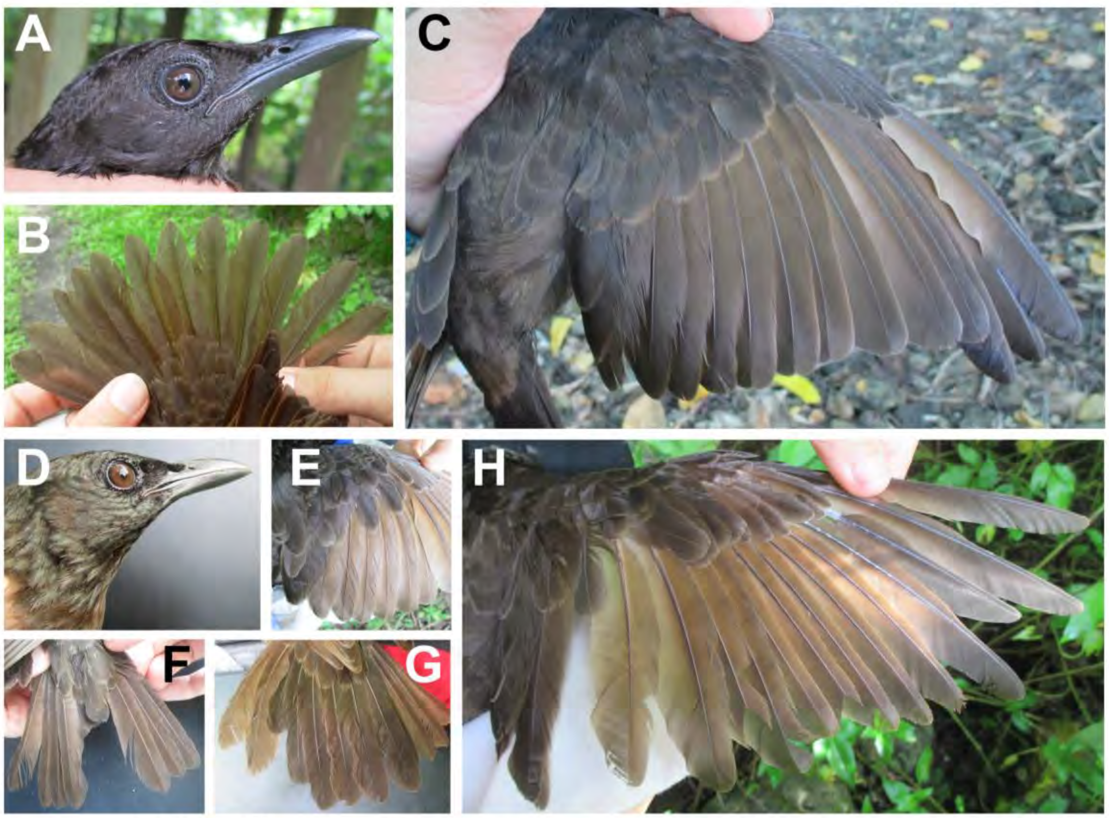

Figure 89. FCJ (A-C) and FPF (D-H) Samoan Starlings captured on Ta'u Island 3 Mar 2015 (A), 12 Feb 2014 (B), 24 Feb 2015 (C), 7 Feb 2015 (E), 18 Mar 2016 (G), and 3 Mar 2015 (H); and on Ofu Island 2 Dec 2015 (D) and 7 Jan 2016 (F). Note the dull brown iris of FCJs (A) which can become tinged reddish in older FPFs (D). In the FCJs, note also the flatter (not glossy) black body feathers (A) and the uniformly juvenile rectrices (B) and wing feathers (C), the latter lacking molt clines (especially from s1 to s6) which are evident in basic remiges (Figs. 92-93). The FPFs show the same characteristics but are undergoing the preformative molt, which can be protracted; the FPF in E is replacing median and inner greater coverts along with the central tertial (s8), the FPF in F is replacing the inner four rectrices (r1-r2), and the FPF in G has replaced the inner four rectrices and is replacing the left r3-r4 and right r3. The FPF in H is undergoing an eccentric preformative molt, with the tertials and p6 replaced and s4-s5 and p7 (and corresponding primary covert) growing on the right wing, and the tertials replaced and s5 and p9-p10 (and coverts) growing on the left wing; this FPF had also replaced all 12 rectrices. This is the only individual case of eccentric molt being recorded in the American Samoan TMAPS program; study is needed to determine how frequently this pattern can occur in Samoan Starling.

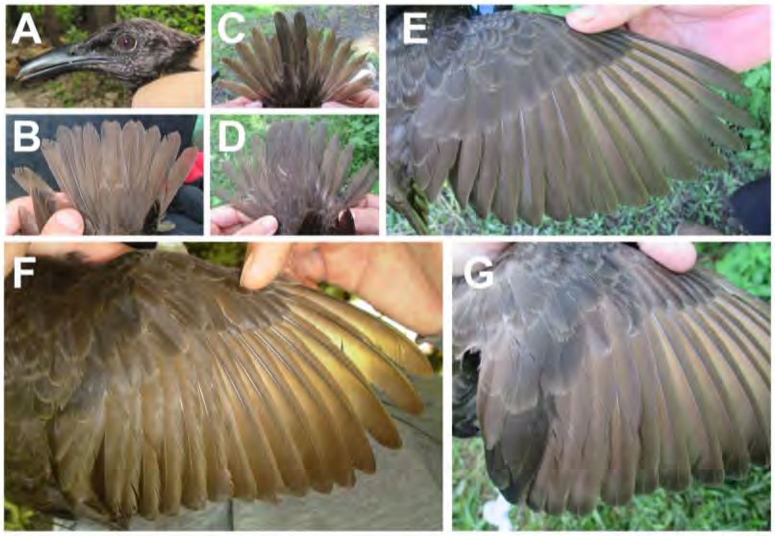

Figure 90. FCF Samoan Starlings captured on Ta'u Island 27 Nov 2014 (A), 27 Feb 2015 (D), 2 Feb 2015 (E), 15 Feb 2014 (F), and 15 Dec 2015 (G); on Ofu Island 27 Dec 2015 (B); and on Tutuila Island 28 Jan 2015 (C). FCFs show reddish-tinged brown irises (A) and often (but not always) molt limits in the rectrices (B-D); the FCF in B has retained juvenile rectrices except an adventitiously replaced left r4, the FCF in C has replaced the two central rectrices (r1), and the FCF in D has replaced the four central rectrices (r1-r2); up to 10 central rectrices can be replaced during the preformative molt. FCFs also show molt limits among wing feathers, typically varying from a few lesser and median coverts replaced (e.g., E), to most lesser and median coverts and some inner greater coverts replaced (e.g., F), to all lesser and median coverts, most greater coverts, and up to all three tertials replaced (e.g., G). Look also for occasional FCFs to replace outer primaries in an eccentric pattern as in Figure 89H.

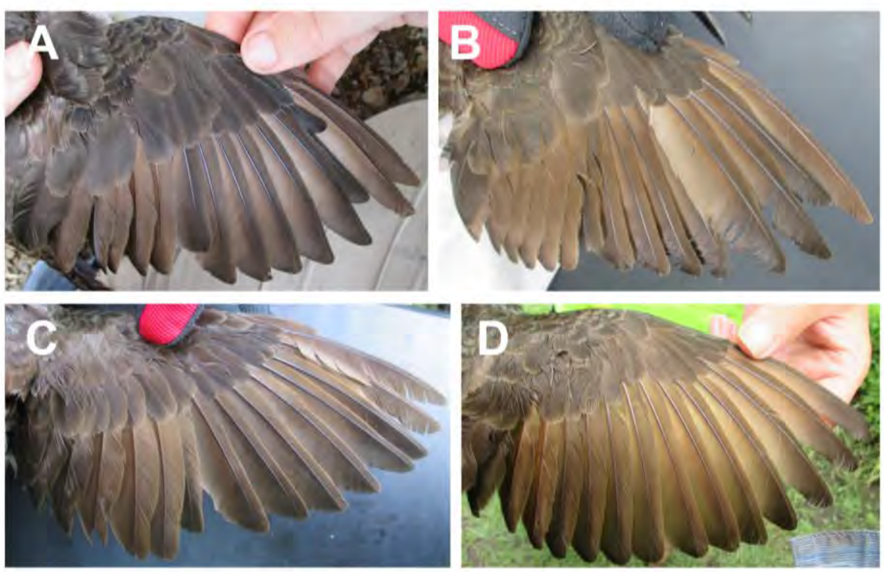

Figure 91. SPB (A-C) and SCB (D) Samoan Starlings captured on Ta'u Island 29 Nov 2014 (A), 2 Jan 2016 (B), and 2 Feb 2015 (D); and on Ofu Island 5 Jan 2016 (C). In the SPBs, note that the retained unmolted primaries and secondaries are juvenile, worn, pointed, very brown, and lack molt clines from s1 to s6; the SPB in A has p1-p5 and s8 new, p6-p7, s1, and s9 growing, and p8-p10 and s1-s7 old; the SPB in B has p1-p6 and s8-s9 new, p7-p8 and s1 growing, and p9-p10 and s2-s7 old; and the SPB in C has p1-p6 and s6-s9 new, p7 and s1-s2 growing, and p8-p10 and s3-s5 old. Note the reduced juvenile p10 extends varying lengths beyond the primary coverts in these three SPBs. The SCB in D shows similar plumage but has suspended or arrested the second prebasic molt, retaining the juvenile s5-s6.

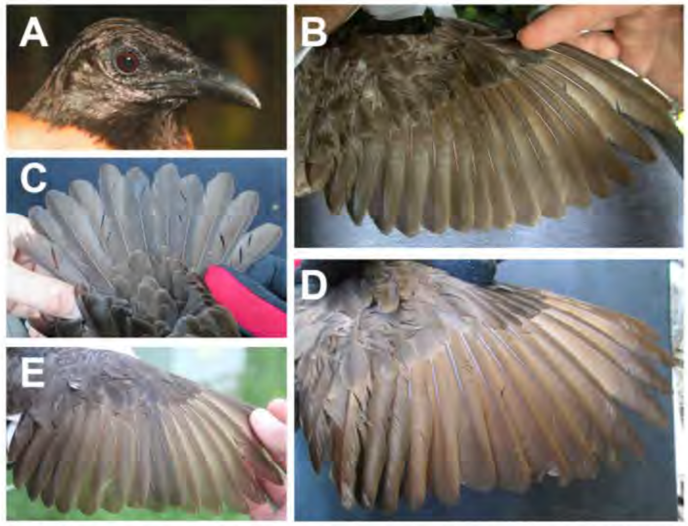

Figure 92. DCB (A-B) and SAB (C-E) Samoan Starlings captured on Tutuila Island 13 Aug 2012 (A) and 21 Aug 2012 (D), Ta'u Island 5 Mar 2014 (B), Ofu Island 10 Feb 2016 (C), and Olosega Island 2 Feb 2016 (E). DCBs show glossier head and breast feathering than FCJs and redder-tinged brown eyes than FCJs and FCFs (A), uniformly basic wing coverts and remiges usually showing molt clines from s1 to s6 among the secondaries (B), and broad and truncate rectrices (C). SAB's show similar plumage, eye-color, flight-feather shape, and molt-cline features but have suspended or arrested the definitive prebasic molt; the SAB in C has suspended molt after the central rectrices (r1s) and left r2 were replaced, retaining basic outer rectrices; the SAB in D suspended molt after the inner two primaries (p1-p2) and primary coverts were replaced, with the older generation basic and showing molt clines from s1 to s6; and the SAB in E is showing staffelmauser-like patterns (see also Fig. 93B), with p1-p3 and s5-s6 recently replaced, p4-p7, s1, and s8-s9 medium in wear, and p8-p10, s2-s3, and s7 older basic feathers.

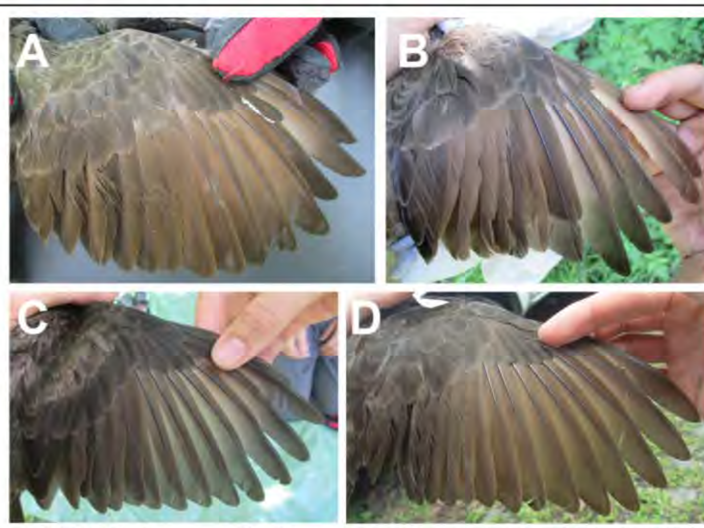

Figure 93. DPB (A-C) and UPB (D) Samoan Starlings captured on Ofu Island 8 Feb 2016 (A), Ta'u Island 27 Feb 2015 (B) and 9 Dec 2015 (C), and Tutuila Island 8 Dec 2012 (D). In the DPBs note that the retained unmolted primaries and secondaries are basic, relatively fresh, broad, and show molt clines, especially from s1 to s6 among the secondaries; the DPB in A has resumed molt after a suspension at p5 (p6 and p7 growing) and also shows mixed generations of basic feathers among the secondaries (a molt cline from s1 to newer s4 and s5 older than these); the DPB in B is undergoing staffelmauser, with p2 and p6 growing and leading waves of molt and secondaries showing multiple generations in sequence (see also Figs 74, 88, 92, and Pyle et al. 2016); and the DPB in C has nearly completed the prebasic molt, with p9-p10, s4, and s6 growing and the basic s5 yet to be dropped. Note that both DCBs and SABs (as in A-B) that have commenced the next prebasic molt are coded DPB. The UPB (D) has s6 growing and all other remiges new; since no older feathers remain we cannot assess whether or not this is SPB or DPB, and it receives age code UPB.

Jungle Myna (JUMY) *Acridotheres fuscus*
Common Myna (COMY) *Acridotheres tristis*

Range and taxonomy: These two species are covered together because they show similar molt patterns and age criteria, and are seldom captured at TMAPS stations on Tutuila. Jungle Myna is indigenous throughout the Indian Subcontinent and through Southeast Asia and Western New Guinea. It has been introduced to various places around the world, including to Western Samoa in the early 1960s and Tutuila around 1986 (McAllen and Hobcroft 2005). Four subspecies are recognized (Gill and Donsker 2017) but that which was introduced to Samoa is not known (probably one of the two widespread subspecies *A. c. fuscus* or *torquatus*). The Common Myna is indigenous to much of southern Asia and parts of Africa, and has also been introduced widely around the world. It was first detected on Tutuila in 1980 and may have spread from here to Western Samoa, where it was first detected in 1988 (McAllen and Hobcroft 2005). Two subspecies are recognized (Gill and Donsker 2017), nominate *A. t. tristis* recognized as that of most established non-native populations, including those of Hawaii and Samoa (Kannan and James 2001).

Individuals examined: Jungle Myna: no specimens, 29 captures at TMAPS stations on Tutuila. Common Myna: 54 specimens (MVZ 14, BPBM 40) collected in Hawaii and elsewhere; eight captures at TMAPS stations on Tutuila.

Structure and Measurements: Both species have 10 primaries (p10 short), 9 secondaries, and 12 rectrices, with the longest primaries being p7-p8 (Figs. 94-96). Measurements of Jungle Myna from capture data: wing chord all birds (n27) 107-122; ♀ (n3) 112-115, ♂ (n2) 115-120. Measurements of Common Myna from TMAPS data: wing chord all birds (n8) 120-142; from Hawaii (Kannan and James 2001): wing chord: ♀ (n39) 120-139, ♂ (n19) 134-142. For both species, FCJs and FPFs have shorter wing-chord measurements than FAJs and UPBs.

Breeding Seasonality: TMAPS data include Jungle Mynas captured in active breeding condition throughout the year, though suggesting peak breeding in Nov-Feb. No Common Mynas were captured in breeding condition. In Hawaii most breeding of Common Myna occurs in Mar-Jul (Kannan and James 2001), the equivalent of Sep-Jan in Samoa.

Molt: Group 5, with complete preformative and prebasic molts (Table 1). In Hawaii, most molting of Common Myna occurs in Sep-Dec following breeding (Kannan and James 2001). TMAPS Capture data indicate symmetrical molt for both species in Jan-Mar (4 Jungle Mynas, 2 Common Mynas), suggesting a peak molting season in Jan-Apr following a peak breeding season in Sep-Feb, as found in other American Samoan landbirds. In Common Myna the preformative molt is complete and occurs at the same time as the prebasic molt (Kannan and James 2001) TMAPS data indicate this to be the case for both species in American Samoa. Molt sequence is typical of passerines, p1 to p10, s1 to s6 preceded by the tertials in sequence s8-s9-s7, and the rectrices generally replaced distally on each side of the tail.

Age/Sex Determination: Age-code Group 5 (Tables 1-2). **FCJ**s are somewhat similar in appearance to later plumages but lack a crest, have browner body feathers with filamentous undertail coverts, duller eyes, and uniform juvenile remiges and rectrices, the latter lacking

(Common Myna) or with less-distinct (Jungle Myna) white tips (Fig. 94). Because the preformative molt is complete, birds are coded FCJ until the first primary (p1) is dropped (Fig. 94), at which time they are coded **FPF**, by retention of juvenile flight and body feathers (Fig. 94), until the preformative molt has completed. **FAJ**s (indeterminable between FCF and DCB) are identified by darker and glossier plumage, full crest feathers, brighter red iris (Common Myna) or brighter exposed yellow orbital skin (Jungle Myna), and broad primaries showing molt clines from p1 to p10 and broad rectrices with distinct white tips (Figs. 95-96). FAJs that are undergoing the ensuing molt can be aged **DPB** as based on older feathers (especially rectrices) that are non-juvenile (Figs. 95-96). Note that birds just completing molt (e.g., with p9-p10 or s6 growing), with no older feathers remaining to infer age, should be coded **UPU** (Figs. 95-96). Age codes **UCU** and **UUU** are also acceptable for birds of undeterminable age and/or molt status, but an attempt should be made to avoid these codes (see Introduction); age codes FCF, SPB, SCB, TPB, DCB, DPB, and SAB are not assigned for this species.

As peak breeding appears to occur in Sep-Feb and the preformative and prebasic molts appear to occur primarily in Jan-Apr (see above), we can expect to see FCJs primarily in Oct-Feb, FPFs and UPBs primarily in Jan-Apr, UPUs primarily in Feb-Apr, and FAJs primarily in Apr-Jan (see Appendix 1).

Acceptable age coding: FCJ (Nov-Feb), FPF (Dec-May), FAJ (year-round), DPB (Dec-May); also UPU (Dec-May) and UCU (year-round) for birds of undeterminable age. In both species, FCJs resemble later plumages but are paler and have pale fringing to some of the body feathers and secondaries (cf. Kannan and James 2001); body feathers may also be more loosely textured. Ageing birds following the PF is not possible; all birds lacking molt and juvenile feathers should be assigned FAJ. Shape and condition of primaries and rectrices useful in distinguishing juvenile from post-juvenile feathers, and check also the distinctness of the white in rectrices and primaries and presence/absence of black marks to the primary coverts (in COMY, Fig. 69). FCJs in molt (with older juvenile flight feathers) should be assigned FPF and FAJs in molt (with older basic feathers) should be assigned DPB. Measurements (see above) may be helpful for sexing some individuals but metrics in Samoa need to be determined. In both species there is variation in distinctness of head and back plumage, and ♀♀ may have shorter and duller modified crown feathers than ♂♂ (cf. Fig. 68), but details and reliability of this for sexing needs to be worked out. cloacal protuberance and brood patch are reliable for sexing other starlings (Pyle 1997, Radley et al. 2011) ♂ COMY may occasionally incubate eggs (Kannan and James 2001) so it may be possible that full brood patches indicate ♀♀ whereas partial brood patches are found in both sexes; cloacal protuberances should be reliable for sexing ♂♂.

Figure 94. FPF Common (A-C) and Jungle (D-F) Mynas captured on Tutuila Island 4 Jan 2013 (A-C) and 5 Jan 2013 (D-F). In all of these FPFs, much of the juvenile body plumage remains, which is browner and weaker than in later plumages. As compared with FAJ and UPB mynas (Figs. 95-96), note also the duller colored irises (A, D), the thinner juvenile rectrices that lack broad white tips in Common Myna, (B; note the adventitiously replaced left r6) or have less-distinct white tips with dark shafts in Jungle Myna (E), and the browner and thinner, unmolted primaries and secondaries (C, F). The FPF in C has p1-p3 new, p4-p5 growing, and p6-p10 and all secondaries old and juvenile, and the FPF in F has p1-p3 growing and the remainder of the remiges old and juvenile.

Figure 95. FAJ (A-E) and UPB (F) Common Mynas captured on Tutuila Island 10 Aug 2012 (A-B), 2 Aug 2013 (C, E), 7 Jan 2016 (D), and 2 Mar 2013 (F). Compared with the FAJ Crested Myna (Fig. 96), note the exposed yellow orbital skin and the paler brown body plumage (A-B). Compared with the FPF mynas (Fig. 94), note the brighter red iris of older Common Mynas (A-B), the uniform broad basic rectrices with distinct white tips (C-D), and the uniform basic, darker and broader remiges with slight molt clines from p1 to p9 and s1 to s6 indicating previous replacement (E-F; p10 is short and not visible in these images).The UPB in F has p1-p3 new, p4 and s8 dropped or growing, and p5-p9 and all remaining secondaries older and basic, showing the features mentioned above. As both the preformative and prebasic molts can be complete, molting birds could either be SPBs or DPBs and are age-coded UPB and that birds just completing molt without any older feathers remaining, should be age-coded UPU.

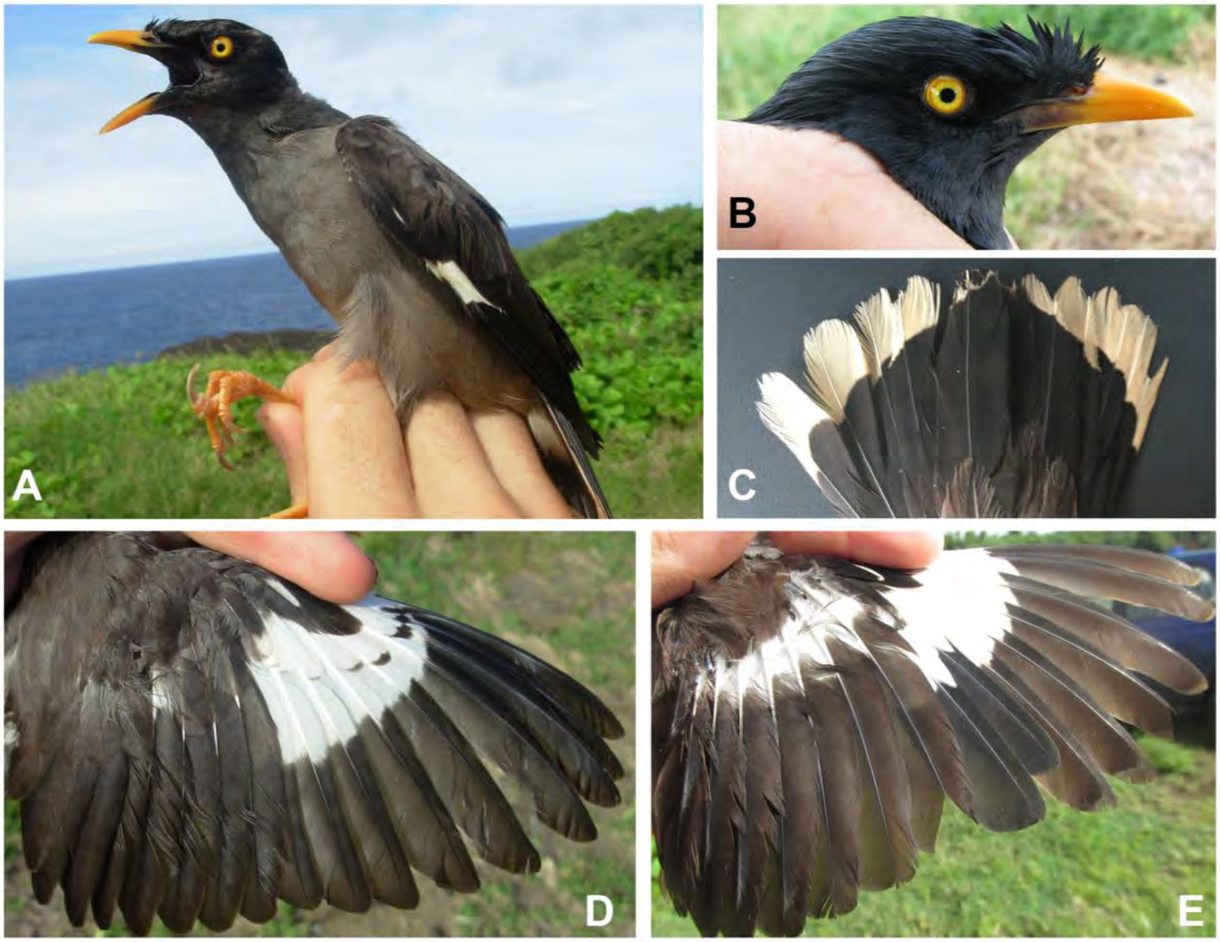

Figure 96. FAJ (A-D) and UPB (E) Jungle Mynas captured on Tutuila Island 2 Feb 2013 2012 (A, E), 7 Nov 2012 (B), 12 Jan 2016 (C), and 4 Jan 2013 (D). Compared with the FAJ common Myna (Fig. 95), note the lack of exposed yellow orbital skin and the darker and sootier body plumage (A-B). Compared with the FPF mynas (Fig. 94), note the brighter yellow iris of older Jungle Mynas (A-B), the uniform broad basic rectrices with distinct white tips and shafts (C), and the uniform basic, darker and broader remiges with slight molt clines from p1 to p9 and s1 to s6 indicating previous replacement (D-E; p10 is short and not visible in these images).The UPB in F has p1 new, p2-p3 dropped or growing, and p4-p9 and all secondaries older and basic, showing the features mentioned above. See Fig. 95 regarding age-coding of birds undergoing prebasic molt.

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Appendix 1. Verification table for acceptable molt-cycle-based age codes attributable to American Samoan landbirds by month. This table can be used to ensure that unacceptable or erroneous age codes for a given species are updated in final data sets. Y - the age code is accepted for a given month; N - the age code is not accepted for a given species or month; C - the age code may be rare in a given month or possibly could be updated ("unknown" codes). When "C" is given, the age code can be checked manually to see if it is correct and/or if a better code can be used. With increased years of data verification, this table can be refined.

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TGDO	FCJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TGDO	FPF	Y	Y	Y	C	C	C	Y	Y	Y	Y	Y	Y
TGDO	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TGDO	SPB	C	C	C	C	C	C	C	C	C	C	C	C
TGDO	SCB	N	N	N	N	N	N	N	N	N	N	N	N
TGDO	TPB	N	N	N	N	N	N	N	N	N	N	N	N
TGDO	FAJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TGDO	UPB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
TGDO	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TGDO	DPB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
TGDO	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TGDO	UCU	C	C	C	C	C	C	C	C	C	C	C	C
TGDO	UPU	C	C	C	C	C	C	C	C	C	C	C	C
TGDO	UUU	C	C	C	C	C	C	C	C	C	C	C	C
MCFD	FCJ	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
MCFD	FPF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C
MCFD	FCF	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
MCFD	SPB	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C
MCFD	SCB	N	N	N	N	N	N	N	N	N	N	N	N
MCFD	TPB	N	N	N	N	N	N	N	N	N	N	N	N
MCFD	FAJ	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
MCFD	UPB	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C
MCFD	DCB	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
MCFD	DPB	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C
MCFD	SAB	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
MCFD	UCU	C	C	C	C	C	C	C	C	C	C	C	C
MCFD	UPU	C	C	C	C	C	C	C	C	C	C	C	C
MCFD	UUU	C	C	C	C	C	C	C	C	C	C	C	C

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CCFD	FCJ	Y	Y	Y	Y	C	C	C	C	C	C	C	C
CCFD	FPF	Y	Y	Y	Y	Y	Y	Y	C	C	C	C	Y
CCFD	FCF	Y	Y	Y	Y	Y	Y	Y	C	C	C	C	C
CCFD	SPB	C	C	C	C	C	C	C	C	C	C	C	C
CCFD	SCB	N	N	N	N	N	N	N	N	N	N	N	N
CCFD	TPB	N	N	N	N	N	N	N	N	N	N	N	N
CCFD	FAJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CCFD	UPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
CCFD	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CCFD	DPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
CCFD	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CCFD	UCU	C	C	C	C	C	C	C	C	C	C	C	C
CCFD	UPU	C	C	C	C	C	C	C	C	C	C	C	C
CCFD	UUU	C	C	C	C	C	C	C	C	C	C	C	C
PIPI	FCJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C
PIPI	FPF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PIPI	FCF	Y	Y	Y	Y	Y	Y	C	C	C	Y	Y	Y
PIPI	SPB	C	C	C	Y	Y	Y	Y	Y	Y	Y	Y	C
PIPI	SCB	N	N	N	N	N	N	N	N	N	N	N	N
PIPI	TPB	N	N	N	N	N	N	N	N	N	N	N	N
PIPI	FAJ	Y	Y	Y	Y	Y	Y	C	C	C	Y	Y	Y
PIPI	UPB	C	C	C	C	C	Y	Y	Y	Y	Y	Y	Y
PIPI	DCB	Y	Y	Y	Y	Y	Y	C	C	C	Y	Y	Y
PIPI	DPB	C	C	C	C	C	Y	Y	Y	Y	Y	Y	Y
PIPI	SAB	Y	Y	Y	Y	Y	Y	C	C	C	Y	Y	Y
PIPI	UCU	C	C	C	C	C	C	C	C	C	C	C	C
PIPI	UPU	C	C	C	C	C	C	C	C	C	C	C	C
PIPI	UUU	C	C	C	C	C	C	C	C	C	C	C	C
PLTC	FCJ	N	N	C	C	C	N	N	N	N	N	N	N
PLTC	FPF	N	C	Y	Y	Y	Y	Y	C	C	N	N	N
PLTC	FCF	N	N	N	C	C	C	Y	Y	Y	Y	C	N
PLTC	SPB	Y	Y	Y	Y	C	N	N	N	N	C	Y	Y
PLTC	SCB	N	N	N	N	N	N	N	N	N	N	N	N
PLTC	TPB	N	N	N	N	N	N	N	N	N	N	N	N
PLTC	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
PLTC	UPB	N	N	C	C	Y	C	C	Y	Y	N	N	N
PLTC	DCB	C	C	Y	Y	Y	Y	C	C	C	Y	Y	C
PLTC	DPB	N	N	C	Y	Y	Y	Y	Y	Y	C	N	N
PLTC	SAB	N	N	N	N	N	N	N	N	N	N	N	N
PLTC	UCU	C	C	C	C	C	C	C	C	C	C	C	C
PLTC	UPU	N	N	N	N	N	N	N	N	N	N	N	N
PLTC	UUU	C	C	C	C	C	C	C	C	C	C	C	C

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WRSW	FCJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	C	C
WRSW	FPF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	SPB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	SCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	TPB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
WRSW	UPB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	DPB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
WRSW	UCU	C	C	C	C	C	C	C	C	C	C	C	C
WRSW	UPU	N	N	N	N	N	N	N	N	N	N	N	N
WRSW	UUU	C	C	C	C	C	C	C	C	C	C	C	C
PAKI	FCJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PAKI	FPF	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	FCF	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	SPB	Y	Y	Y	Y	Y	C	C	C	C	C	C	Y
PAKI	SCB	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	TPB	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	UPB	Y	Y	Y	Y	Y	C	C	C	C	C	C	C
PAKI	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PAKI	DPB	Y	Y	Y	Y	Y	C	C	C	C	C	C	Y
PAKI	SAB	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	UCU	C	C	C	C	C	C	C	C	C	C	C	C
PAKI	UPU	N	N	N	N	N	N	N	N	N	N	N	N
PAKI	UUU	C	C	C	C	C	C	C	C	C	C	C	C
BCLO	FCJ	Y	Y	C	C	C	C	C	C	C	Y	Y	Y
BCLO	FPF	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
BCLO	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
BCLO	SPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
BCLO	SCB	C	C	C	C	C	C	C	C	C	C	C	C
BCLO	TPB	N	N	N	N	N	N	N	N	N	N	N	N
BCLO	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
BCLO	UPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
BCLO	DCB	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	C
BCLO	DPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
BCLO	SAB	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	C
BCLO	UCU	C	C	C	C	C	C	C	C	C	C	C	C
BCLO	UPU	N	N	N	N	N	N	N	N	N	N	N	N
BCLO	UUU	C	C	C	C	C	C	C	C	C	C	C	C

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CAMY	FCJ	Y	Y	C	C	C	C	Y	Y	Y	Y	Y	Y
CAMY	FPF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CAMY	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CAMY	SPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
CAMY	SCB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
CAMY	TPB	N	N	N	N	N	N	N	N	N	N	N	N
CAMY	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
CAMY	UPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
CAMY	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CAMY	DPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
CAMY	SAB	C	C	C	C	C	C	C	C	C	C	C	C
CAMY	UCU	C	C	C	C	C	C	C	C	C	C	C	C
CAMY	UPU	C	C	C	C	C	C	C	C	C	C	C	C
CAMY	UUU	C	C	C	C	C	C	C	C	C	C	C	C
POWH	FCJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	FPF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	SPB	Y	Y	Y	Y	C	C	C	C	C	C	Y	Y
POWH	SCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	TPB	Y	Y	Y	Y	C	C	C	C	C	C	Y	Y
POWH	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
POWH	UPB	Y	Y	Y	Y	C	C	C	C	C	C	Y	Y
POWH	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	DPB	Y	Y	Y	Y	C	C	C	C	C	C	Y	Y
POWH	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POWH	UCU	C	C	C	C	C	C	C	C	C	C	C	C
POWH	UPU	N	N	N	N	N	N	N	N	N	N	N	N
POWH	UUU	C	C	C	C	C	C	C	C	C	C	C	C
RVBU	FCJ	Y	Y	C	C	C	C	C	C	C	Y	Y	Y
RVBU	FPF	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
RVBU	FCF	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	SPB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	SCB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	TPB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	FAJ	Y	C	C	Y	Y	Y	Y	Y	Y	Y	Y	Y
RVBU	UPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
RVBU	DCB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	DPB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	SAB	N	N	N	N	N	N	N	N	N	N	N	N
RVBU	UCU	C	C	C	C	C	C	C	C	C	C	C	C
RVBU	UPU	C	Y	Y	Y	C	C	C	C	C	C	C	C
RVBU	UUU	C	C	C	C	C	C	C	C	C	C	C	C

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SASH	FCJ	Y	Y	Y	Y	C	C	C	C	C	C	C	C
SASH	FPF	Y	Y	Y	Y	Y	C	C	C	C	C	C	Y
SASH	FCF	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
SASH	SPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
SASH	SCB	Y	Y	Y	N	N	N	N	N	Y	Y	Y	Y
SASH	TPB	Y	Y	Y	Y	N	N	N	N	N	N	N	Y
SASH	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
SASH	UPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
SASH	DCB	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
SASH	DPB	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
SASH	SAB	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
SASH	UCU	Y	Y	C	C	C	C	C	C	Y	Y	Y	Y
SASH	UPU	N	N	N	N	N	N	N	N	N	N	N	N
SASH	UUU	Y	Y	C	C	C	C	C	C	Y	Y	Y	Y
POST	FCJ	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
POST	FPF	Y	Y	Y	Y	C	C	C	C	C	C	Y	Y
POST	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POST	SPB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
POST	SCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POST	TPB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
POST	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
POST	UPB	Y	Y	Y	C	C	C	C	C	C	C	C	C
POST	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POST	DPB	Y	Y	Y	C	C	C	C	C	C	C	Y	Y
POST	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
POST	UCU	C	C	C	C	C	C	C	C	C	C	C	C
POST	UPU	N	N	N	N	N	N	N	N	N	N	N	N
POST	UUU	C	C	C	C	C	C	C	C	C	C	C	C
SAST	FCJ	Y	Y	Y	C	C	C	C	C	Y	Y	Y	Y
SAST	FPF	Y	Y	Y	Y	Y	C	C	C	C	Y	Y	Y
SAST	FCF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SAST	SPB	Y	Y	Y	C	C	C	C	Y	Y	Y	Y	Y
SAST	SCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SAST	TPB	Y	Y	Y	C	C	C	C	Y	Y	Y	Y	Y
SAST	FAJ	N	N	N	N	N	N	N	N	N	N	N	N
SAST	UPB	Y	Y	Y	C	C	C	C	C	C	C	C	Y
SAST	DCB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SAST	DPB	Y	Y	Y	C	C	C	C	Y	Y	Y	Y	Y
SAST	SAB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SAST	UCU	C	C	C	C	C	C	C	C	C	C	C	C
SAST	UPU	N	N	N	N	N	N	N	N	N	N	N	N
SAST	UUU	C	C	C	C	C	C	C	C	C	C	C	C

SPEC	WRP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
JUMY	FCJ	Y	Y	C	C	C	C	C	C	C	Y	Y	Y
JUMY	FPF	Y	Y	Y	Y	C	C	C	C	C	C	C	Y
JUMY	FCF	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	SPB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	SCB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	TPB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	FAJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
JUMY	UPB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	DCB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	DPB	Y	Y	Y	Y	C	C	C	C	C	C	C	C
JUMY	SAB	N	N	N	N	N	N	N	N	N	N	N	N
JUMY	UCU	C	C	C	C	C	C	C	C	C	C	C	C
JUMY	UPU	C	Y	Y	Y	C	C	C	C	C	C	C	C
JUMY	UUU	C	C	C	C	C	C	C	C	C	C	C	C
COMY	FCJ	Y	Y	C	C	C	C	C	C	C	Y	Y	Y
COMY	FPF	Y	Y	Y	C	C	C	C	C	C	C	C	Y
COMY	FCF	N	N	N	N	N	N	N	N	N	N	N	N
COMY	SPB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	SCB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	TPB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	FAJ	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
COMY	UPB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	DCB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	DPB	Y	Y	Y	Y	C	C	C	C	C	C	C	C
COMY	SAB	N	N	N	N	N	N	N	N	N	N	N	N
COMY	UCU	C	C	C	C	C	C	C	C	C	C	C	C
COMY	UPU	C	Y	Y	Y	C	C	C	C	C	C	C	C
COMY	UUU	C	C	C	C	C	C	C	C	C	C	C	C