White-rumped Dark Storm-petrels in Hawaiian Island Waters

The quandary of Leach's vs. Band-rumped storm-petrels throughout the world

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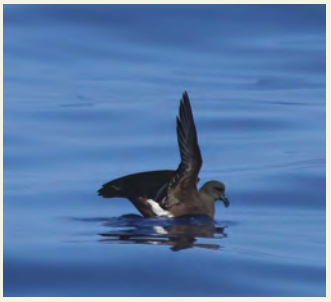
Four species of "white-rumped dark storm-petrels" have been reported from Hawaiian Island waters, two of which, Wilson's and Wedge-rumped storm-petrels, are not regularly encountered. The Wilson's Storm-Petrel is an uncommon fall migrant, primarily through Northwestern Hawaiian Island waters (Pyle and Pyle 2009), and only one well-documented sight record exists for the Wedge-rumped Storm-Petrel, from 326 kilometers southwest of Hawai'i Island on October 9, 2010 (D. Breese, personal communication). The remaining two species, Leach's and Band-rumped storm-petrels, are regular in the vicinity. Leach's Storm-Petrel is a fairly common migrant and uncommon winter visitor to Hawaiian Island waters, with records occurring from September 18 to May 20 (Pyle and Pyle 2009). No Leach's with other than full white patches to the upper-tail coverts have been recorded, indicating that most birds are of the nominate subspecies, including populations breeding from the Kurile Islands around the northern Pacific rim to central California. However, white-rumped birds of the Guadalupe Island subspecies might also occur; see Fig. G.

The Band-rumped Storm-Petrel is a very rare and little-known breeder in the Hawaiian Islands (Pyle and Pyle 2009). Most breeding activity documented thus far, including the only nest crevice found to date, has been along steep rugged cliffs on Kaua'i Island (Wood et al. 2002, USFWS 2015). The Kaua'i population has been estimated at 171–221 pairs, and birds have been heard at night in appropriate habitats on Maui and Hawai'i, indicating likely breeding in very small numbers on those islands as well. Downed fledglings found on Kaua'i's roads and beaches from October 4 to November 18, the timing of nesting activity ashore, and offshore records restricted to the months of April through November indicate a summer breeding season in Hawai'i (Wood et al. 2002, Pyle and Pyle 2009).

Band-rumped Storm-Petrels in the Hawaiian Islands region were first described as subspecies *cryptoleucura* by Ridgway (1882), but this and all other subspecies were later synonymized ("lumped") by Austin (1952). Recently, differences in several plastic criteria, including vocalizations, timing of breeding,

Feature Photo–Leach's Storm-Petrel. Several aspects of the bird in our featured photo, including the shapes of the upper-tail–covert patch and the tail, might suggest that it is a Band-rumped Storm-Petrel. However, careful analysis of all 93 photos of this bird (see Fig. A) indicate that it is a fresh **Leach's Storm-Petrel,** perhaps an adult that is just completing or has recently completed molt, and that may not have fully grown outer rectrices (but see Fig. H). Enlargement of the images indicates that the longest upper-tail coverts lack broad black tips; note also the lack of contrast to the under-tail coverts. *Off Kona, Hawai'i Island; November 8, 2015. Photo by © Deron S. Verbeck–Cascadia Research Collective.*



Identification of storm-petrels frequently requires viewing from multiple perspectives—whether you are in the field or at the computer monitor. Here is the bird in our "Featured Photo," but in a rather different posture. Go to page 62 for more photos and discussion of white-rumped dark storm-petrels in the Hawaiian Islands region.

timing of molt, and slight average mensural data, along with interpretations of cursory genetic evidence, have led some recent authors to consider splitting Band-rumped into multiple species (Smith et al. 2007, Howell et al. 2010, Howell 2012). Whether or not these differences indicate isolating mechanisms is questionable, however, and no defining morphological or plumage differences have been described. Such proposals may result from over-splitting exuberance (see Pyle 2012).

Two populations of Band-rumped Storm-Petrels presumably have occurred off the Atlantic North American coast, winter-breeding "Grant's Storm-Petrels" and summer-breeding "Madeiran Storm-Petrels" (Howell et al. 2010, Howell 2012). (Given the timing of the breeding season, should the Hawaiian population be considered conspecific with Madeiran Storm-Petrel?) Seriously, though, our own field studies and analyses of images online indicate few if any differences in appearance among any of these and the Hawaiian populations.

The Cascadia Research Collective (hereafter, "CRC," cascadiaresearch.org) has been conducting at-sea surveys in Hawaiian Island waters, primarily for marine mammals, since 2003 (Baird et al. 2012). During the course of 40 survey periods (including 738 days at sea) through 2015, CRC personnel, primarily Webster and Baird, obtained more than 47,000 digital images of birds and provided them to Pyle for identification. More than 4,000 of these images have been of Leach's or Band-rumped storm-petrels (close to 2,000 of each species); those photographed in April–May and September–November, when both species are present, have proven difficult to identify. Every long series of the same bird, consisting of up to 200 or more photographs, contain individual images that could be "confidently" identified as either species.

Here we present the challenge of separating these two species in Hawaiian waters during fall (see Howell et al. 2010 and Howell 2012 for the separation of Band-rumped from other white-rumped dark storm-petrels). Supplemental online content for this article, starting on page 62, treats in detail the variation in the white upper-tail–covert patches, covers identification in spring, and presents additional photos of Hawaiian Band-rumped Storm-Petrels, images of which have rarely been published. With global ocean warming upon us, this information may eventually apply on pelagic trips off the Pacific North American coast, where Leach's Storm-Petrel is regular and Band-rumped Storm-Petrels, ostensibly from the Galápagos Island breeding populations, have been reported but remain unconfirmed (CBRC 2007; M. Force, personal communication).

Criteria for separating Leach's from Band-rumped storm-petrels are seasonally dependent, as fresh vs. worn birds (including juveniles vs. adults) can differ to a greater degree *within* species than they differ *among* species in similar feather condition. Both species in Hawaiian waters are derived from summer-breeding populations and molt primarily in fall through spring (Pyle 2008). The two species can thus be fresh from September to December (both juveniles and older birds that have completed molt early) and are worn from June to September. Criteria proposed for the separation of Leach's from Band-rumped include: a deeper tail fork; a "double oval," rather than a band-like shape, on the upper-tail–covert patch; browner and paler (less sooty) plumage coloration; a more prominent and extensive pale upper-wing ulnar band; and less white extending from the upper-tail–covert patch to the lateral under-tail coverts (Pyle 2008, Howell 2012). Flight style also differs: Band-rumped tends to have steadier and shallower wing flaps and a less-buoyant flight style than Leach's (Howell et al. 2010, Howell 2012).

Careful analyses of CRC's images and specimens indicate that the above-mentioned plumage marks are nearly useless on their own because (1) they can overlap extensively between species and (2) plumage wear can mask any intrinsic differences. There is also the widely known truth that flight style can be used to identify any given storm-petrel species as any other species by birders not considering wind speed and direction relative to a bird's path of flight, not to mention a bird's wing-molt status.

The Band-rumped Storm-Petrel has

Fig. A. This is the same bird as that shown in the Featured Photo. The shape and division of the upper-tail–covert patch and the forked tail more clearly indicate this to be a **Leach's Storm-Petrel**. The degree of tail spread, the position and torque of flight, and the angle of the bird relative to the camera can all greatly affect the appearance of the tail fork in these species. Note also the distinct upper-wing ulnar bar in fresh plumage, further supporting the identification. But also note that the white upper-tail area wraps around to the under-tail coverts, a mark ascribed more to Band-rumped Storm-Petrel. *Off Kona, Hawai'i Island; November 8, 2015. Photo by © Deron S. Verbeck–Cascadia Research Collective.*

Fig. B. The divided-oval look to the upper-tail–covert patch and longish tail might suggest that this is a Leach's Storm-Petrel, but careful analysis of all 122 photos of this bird (compare with Fig. C) indicate that it is a **Band-rumped Storm-Petrel,** apparently a recently-fledged juvenile. Enlargement of the images indicates that the longest upper-tail coverts are broadly tipped black. Note also the rather indistinct upper-wing ulnar bar. *Off Kona, Hawai'i Island; October 29, 2011. Photo by © Daniel L. Webster–Cascadia Research Collective.*

Fig. C. This is the same bird as that shown in Fig. B. Here the upper-tail–covert patch and tail shape appear more typical of a **Band-rumped Storm-Petrel.** Note too that the apparent central division to the white patch (see Fig. B) is actually a result of a division between slightly displaced feathers on the right side of the upper-tail–covert tract. Other Band-rumped Storm-Petrels photographed by CRC show a similar division down the center of the patch (see Fig. G), making this an unreliable mark on its own for species identification. The whitish appearance to the upper-wing ulnar bar's caudal end (actually the tips to the humerals) indicates a fresh juvenile at this time of year. *Off Kona, Hawai'i Island; October 29, 2011. Photo by © Daniel L. Webster–Cascadia Research Collective.*

broad dark tips to the white central upper-tail coverts, which creates the eponymous "band-rumped" appearance, whereas in Leach's Storm-Petrel these feathers are completely white or can have dark corners (Pyle 2008; see Figs. F, G). We have found that this is a good means for separating the two species among sharper images taken by CRC, although this distinction can be tricky to evaluate. We have also noticed that the under-wing greater coverts of Hawaiian Band-rumped Storm-Petrels can be contrastingly paler than the lesser and median coverts, whereas all under-wing coverts are more uniformly colored in Leach's (as discussed in the following pages). Some of the above-mentioned criteria can be used as "average" characters, especially the shape and relative length of the outer rectrix when not in molt, but only with careful study of multiple images, along with consideration of the effects of angle, lighting, and the position and posture of the bird itself.

We hope that this presentation will improve birders' ability to identify these two species. Due to the lack of extensive geographic variation among both nominate Leach's and all Band-rumped Storm-Petrels, our results should be applicable not only in Hawaiian Island waters but throughout the world's oceans.

Acknowledgments

We thank the many participants of Cascadia Research Collective surveys who have obtained images of birds for assessment

and evaluation. Field research conducted by the Cascadia Research Collective in Hawaiian waters was funded by the National Marine Fisheries Service and the U.S. Navy. We thank Michael Force for information on reports of Band-rumped Storm-Petrels off Oregon in September 2015. This is Contribution no. 526 of the Institute for Bird Populations.

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Leach's vs. Band-rumped Storm-petrels in the Pacific

Age, Plumage Wear, the Nitty-gritty, and a Band-rumped Storm-Petrel Specimen from Offshore California Waters

Previously we mention reported criteria for separating Leach's from Band-rumped storm-petrels at sea and in the hand. These include the shapes of the tail and outer rectrices, the tone of the plumage coloration, characteristics of the upper-tail–covert patch, the degree to which this patch extends to the under-tail region, the extent and prominence of the upper-wing ulnar ("carpal") bar, and the color contrast among the under-wing coverts. We also discuss above how the effects of age and plumage wear need to be carefully accounted for when applying any of these criteria, and that there is at least some overlap in each of these individual characteristics. A synthesis of characters must be overlaid on an assessment of age, plumage wear, and molt status to reach a reasonable identification.

The following material provides details on the seasonal variation in these features and presents additional information on the occurrence and identification of Leach's and Band-rumped storm-petrels in Hawaiian waters. These photographs either were taken at sea by CRC in Hawaiian waters or are of specimens examined by Pyle at the B. P. Bishop Museum (BPBM; 23 specimens of Leach's from the central Pacific and 7 specimens of Band-rumped from Hawaii) and the California Academy of Sciences (CAS; 150 specimens of Leach's collected in the Pacific and 31 specimens of Band-rumped collected at or near the Galápagos Islands). We include an image gallery of Band-rumped Storm-Petrels of the Hawaiian population (Figs. K–O), and also document a previously unreported specimen of this species, collected 569 nautical miles southwest of Point Sur, Monterey County, California.

Both nominate Leach's and Hawaiian Band-rumped storm-petrels breed in the summer months, and fresh juveniles can be found from August to November; however, the earliest Leach's photographed by CRC in Hawaiian waters was on October 22 (see Fig. G3), and was beginning to show some signs of fading and wear. The prebasic molt in Leach's Storm-Petrels appears to be variable, with some birds in the central Pacific completing molt as early as October 10 (BPBM 161908 and 161910, first-year birds growing second-basic outer primaries, collected along the equator at 140° West), whereas others complete the molt in April (CRC photographs). It may be possible that these BPBM specimens are from winter-breeding populations on Guadalupe Island (subspecies *cheimomnestes*); alternatively, this may be typical of the timing for the second prebasic molt for nominate birds.

In any case, adult Leach's photographed by CRC and collected in Hawaiian Island waters can show various levels of wear in all seasons. Nothing is known of molt timing in Hawaiian Band-rumped Storm-Petrels, although plumage wear in CRC photographs and specimens suggests a protracted over-winter molt that spans the period November–March, when the species is absent from Hawaiian waters. In most cases, then, first-year birds of both species are fresh and dusky in late summer and fall, and very worn and relatively pale brown in spring. Adult Leach's Storm-Petrels can be fresh and dark brown in either late fall or spring, and are usually worn or molting, and relatively pale brown, in fall; in contrast, adult Band-rumped Storm-Petrels appear relatively fresh in spring and summer and are likely worn in late fall through winter.

FIGS. D This **Band-rumped Storm-Petrel** (Fig. D1) was collected by Rollo Beck at 30.5° North 130.9° West, about 569 nautical miles (1,054 kilometers) southwest of Point Sur, Monterey County, California, on November 9, 1906 (CAS 496). The best way to confirm the identification of specimens is by the extensively white bases to the outer rectrices (Fig. D2), as most other plumage and mensural criteria for Band-rumped Storm-Petrel can overlap or come close to overlapping with those of Leach's Storm-Petrel. Leach's Storm-Petrels show entirely dark rectrices or may have a slight basal paling. Unfortunately, these white bases are seldom discernable in photographs of Band-rumped Storm-Petrels, excepting those wheeling dramatically over a surface item. This specimen is of a first-cycle bird by the pointed primaries, lack of clines indicating previous molt, and slightly rounded shape to the outer rectrix; it appears moderately worn, suggesting it came from a summer-breeding population.

Whether the bird originated from the Hawaiian, Galápagos, or some other population will likely require DNA or feather isotope analysis. Beck's journal from this expedition (tinyurl.com/Rollo-Beck-notes), during the return of a long CAS expedition to the Galápagos Islands, confirms the approximate position of collection and states that he "got a Common Fulmar and a white rumped petrel [with] little or no fork in [the] tail" on this date. This specimen has been previously overlooked in the literature, the northernmost confirmed records in the eastern Pacific being from he vicinity of the Cocos Islands, Costa Rica (Howell 2012), 2,990 nautical miles (5,537 kilometers) to the southeast of this position. This record may lend some additional credence to sight reports of Band-rumped Storm-Petrels off Mexico and California (CBRC 2007, Howell 2012), as well as Oregon, although a good series of photographs would be needed to confirm any future records in these waters.

FIGS. E These specimens of **Band-rumped Storm-Petrels** and **Leach's Storm-Petrels** at BPBM (Fig. E1, left to right: 185162, 184416, and 156975 of Band-rumped and 184055, 184591, and 7559 of Leach's) and CAS (Fig. E2, left to right:

Fig. D2. *Photo by © Peter Pyle.*

Fig. D1. *Photo by © Peter Pyle.*

Fig. E1(below): Specimens collected in or near the Hawaiian Islands. Left to right October 4, 1906; September 3, 2001; July 12, 1893; December 29, 1997; December 24, 2003; and March 10, 1892. **Fig. E2** (above): Specimens collected, left to right, off California, October 4, 1950; off Alaska, June 17, 1896; in the Galápagos Islands, August 13, 1906; and near the Galápagos Islands, May 8, 1906. *Photos by © Peter Pyle.*

61107 and 43459 of Leach's and 514 and 499 of Band-rumped) show the affects of age and wear on plumage tone. Direct comparison of specimens indicates that fresh juveniles of both species (BPBM 185162 and 184055 and CAS 61107 and 514) are the same shade of sooty gray, fresh adults of both species (BPBM 184416 and 184591) are the same shade of very dark brown, and worn juveniles or adults of both species (BPBM 156975 and 7559 and CAS 43459 and 499) can be the same shade of paler brown, at least in the Pacific.

Previous suppositions that Band-rumped Storm-Petrel averages darker in plumage coloration than Leach's Storm-Petrel thus may have been biased by the comparison of fresher juvenile and adult Band-rumped with more-worn juvenile and adult Leach's Storm-Petrels at latitudes and seasons in which birders encounter these species at sea. Age and plumage condition can be helpful for identification; for example, the earliest juvenile Leach's photographed by CRC in Hawaiian waters was on October 22 (Fig. G3), whereas sootier-plumaged juvenile storm-petrels photographed from mid-August to mid-October have all been of Band-rumped.


Fig. F1


Fig. F2


Fig. F3


Fig. F4


Fig. F5


Fig. F6

FIGS. F Variation in upper-tail–covert patterns of **Band-rumped Storm-Petrel** (Figs. F1–F3) and **Leach's Storm-Petrel** (Figs. F4–F6). Band-rumped usually has moderate to broad dark tips to the upper-tail coverts (Figs. F2, F3), creating the "band-rumped" appearance, but occasional birds, perhaps more often juveniles, can show smaller dark tips (Fig. F1, a juvenile); similar variation is found in birds from both Hawaiian and Galápagos populations. In Leach's, the longest upper-tail coverts are dark or mostly dark, but these are usually covered by the lateral upper-tail coverts, which can vary from being all white (Fig. F4) to white with dark tips (Fig. F5), approaching some Band-rumped Storm-Petrels (Fig. F1). However, they are patterned such that a white point usually extends distally through the tract, rather than the cutoff being more lateral and sheer as in Band-rumped.

A previous assumption that the shaft streaks to the upper-tail coverts are dark in Leach's but white in Band-rumped does not hold, there being exceptions in both species (see Fig. F4, of a Leach's with white shafts and a Band-rumped Storm-Petrel, BPBM 156975, with dark shafts to some coverts). Leach's can also show darker coverts lateral to the central pair (Fig. F6), as well as all-dark coverts, but birds with these patterns have not been observed in Hawaiian waters. Examination of specimens and photographs suggests that juveniles may average whiter upper-tail coverts than adults, and that worn birds can show frayed upper-tail coverts resulting in more of the underlying dark being visible. Thus, Leach's Storm-Petrels may show more dark when worn than when fresh; likewise, dark divisions between feathers may occur more often in worn than in fresh Band-rumped Storm-Petrels (see Figs. B, C, and G1).

Galápagos Islands, August 13, 1906, CAS 514 (**Fig. F1**); Hawai'i, September 3, 2001, BPBM 184416 (**Fig. F2**); Galápagos Islands, August 13, 1906, CAS 518 (**Fig. F3**); French Frigate Shoals, February 17, 1986, BPBM 162173 (**Fig. F4**). Alaska, June 30, 1896, CAS 4345 (**Fig. F5**); Alaska, June 17, 1896, CAS 43459 (**Fig. F6**). *Photos by © Peter Pyle.*

FIGS. G In sharp images, the pattern to the upper-tail coverts can be assessed and used to separate **Band-rumped Storm-Petrel** (Fig. G1) from **Leach's Storm-Petrel** (Figs. G2, G3). Note that the broad dark tips to the coverts are visible in Fig. G1, helping to identify this bird despite the appearance of a split white patch (see also Figs. B and C), whereas the coverts are nearly or entirely white in Fig. G2; these patterns match those of most birds in each of these two species (see Fig. F). Age and plumage freshness also appear to play a role in the upper-tail–covert pattern, with juveniles and fresh birds having patches that appear fuller and brighter than those of adults and worn birds (Fig. F).

The fresh juvenile Leach's Storm-Petrel (Fig. G3) has dark plumage and a full white patch, leading us at first to believe it might have been from summer-breeding Guadalupe Island populations (subspecies *soccoroenisis*). However, specimen examination indicates that these upper-tail–covert traits may be more indicative of age and plumage freshness than of subspecies per se. (We wonder if identification criteria for *soccoroensis* in Pacific North American waters may be influenced by age, with juveniles of this subspecies being encountered more often in summer, before juveniles of the nominate subspecies have arrived to these waters.) Note the upperwing ulnar bar in these three images, duller and less extensive in the Band-rumped Storm-Petrel than in the Leach's Storm-Petrels, although there is overlap between these two species in this feature as well (see Fig. J).

Off Kona, Hawai'i, April 26, 2015 (**Fig. G1**), April 17, 2015 (**Fig. G2**), and October 22, 2009 (**Fig. G3**). *Photos by © Deron S. Verbeck (Fig. G1), Robin W. Baird (Fig. G2), and Daniel L. Webster (Fig. G3)–Cascadia Research Collective.*


Fig. G1


Fig. G2


Fig. G3

FIGS. H Tail shape tends to be more deeply forked in Leach's Storm-Petrels than in Band-rumped Storm-Petrels, and this is borne out by measurements (Pyle 2008). But as we show above (see Featured Photo, Figs. A–C, and Fig. O3), the degree of a forked appearance in the field can vary greatly with the angle and position of the bird. One of the causes for the more fork-tailed appearance of **Leach's Storm-Petrel** is that the outer rectrix (r6) tends to be narrower and more rounded and to be elongated and curved outwards at the tip a bit, as shown in Fig. H1 (the same individual as in the Featured Photo).

Off Kona, Hawai'i, April 27, 2015 (**Fig. H1**) and November 8, 2015 (**Fig. H2**); and Galápagos Islands, August 13, 1906, CAS 498 (**Fig. H3**). *Photos by © Daniel L. Webster (Fig. H1) and Deron S. Verbeck (Fig. H2)–Cascadia Research Collective; and Peter Pyle (Fig. H3).*

Fig. H1

Fig. H2

The shape of the rectrices and the possible molt cline toward fresher feathers distally might indicate that this is a fresh adult, as supposed above, but it may also be a fresh juvenile. In **Band-rumped Storm-Petrel** r6 is broader and shorter and with an evenly squared tip, as shown in Fig. H2 (a fresh adult). As is well known in storm-petrels and many other birds, juvenile outer rectices average narrower and more rounded than definitive basic outer rectrices (Pyle 2008), and this is the case for the juvenile r6 in the Band-rumped specimen (Fig. H3). The preceding underscores the importance of aging a storm-petrel before using the shape of the outer rectrix or entire tail to identify it.

FIGS. I White-rumped storm-petrels show a variable amount of white wrapping around the upper-tail coverts to the under-tail region. Specifically, the lower flank feathers can be white and in some cases appear elongated, forming ornamental plumes that extend around the base of the tail to cover the bases of the lateral under-tail coverts. In many cases, the lateral under-tail coverts can also be white, resulting in a larger "wrap-around" effect.

Band-rumped Storm-Petrels (Fig. I1) average a greater amount of white wrapping around to the under-tail area than Leach's Storm-Petrels: At CAS, 25 of 32 Band-rumped Storm-Petrels

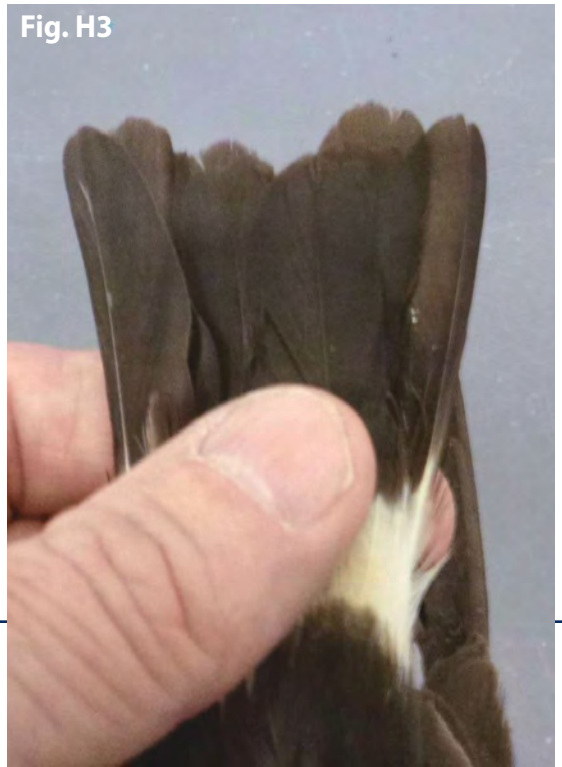

Fig. H3

show white to the lateral under-tail coverts, whereas only 9 of 37 nominate Leach's show white here. However, some Band-rumps can lack white to the under-tail coverts (Fig I1, right specimen; and see Fig. O3), and some **Leach's Storm-Petrels** (Fig. I2) can show extensive white to the coverts; the result is that this feature is an "average" character at best for identification. It may be the case that juveniles average more white than adults, as is the case in Fig I1. Fig. I3 shows a fresh adult Band-rumped Storm-Petrel (left) and a fresh adult Leach's Storm-Petrel (right) showing differences in the white wrap-around pattern expected of most individuals.

FIGS. J

The upper-wing ulnar bar is stated to be more distinct and extensive in **Leach's Storm-Petrel** (Fig. J1, lower detached wing) than in **Band-rumped Storm-Petrel** (Fig. J1, upper specimen) and we have found this generally to be the case. On Leach's, paler brown feathers include the majority of the outer greater coverts, about half the outer median coverts, and often a block of outermost lesser coverts extending to the bend of the wing. On Band-rumped, the same greater and median coverts are also a paler brown but tend to be darker than these same feathers in Leach's, and the pale bar does not as often extend to the lesser coverts or bend of the wing.

On a cautionary note, we have photographed adult Leach's with Band-rumped–like bars (Fig. J2) and Band-rumps with more prominent bars (see Figs. M–O). Interestingly, the bars tend to become less prominent with wear, on average more-distinct in fresh juveniles and adults and less-distinct in worn birds, perhaps opposite to what might be expected. As mentioned above, we have noticed in CRC


Fig. I1


Fig. I2

Fig. I1: Kaua'i, October 4, 2006, left, and Hawai'i, September 3, 2001, right (BPBM 185162 and 184416, respectively). **Fig. I2**: Alaska, June 17, 1896 (CAS 43459). **Fig. I3**: off Kona, Hawai'i, April 26, 2015. *Photos by © Peter Pyle (Figs. I1, I2) and © Deron S. Verbeck–Cascadia Research Collective (Fig. I3).*


Fig. I3

Fig. J1

Fig. J2

photographs that the contrast between lesser/median and greater under-wing coverts may average more prominent in Band-rumped Storm-Petrel than in Leach's Storm-Petrel, as exemplified by Fig. J3 (the same two specimens as in Fig. J1); see also Fig. O3.

Summary

Most or all plumage characters show some to extensive overlap between Band-rumped and nominate Leach's storm-petrels in the central and eastern Pacific. The most reliable character appears to be the patterns to specific upper-tail coverts and to the shape of the tail and outer rectrices. But in each case, and as with all other criteria, assessment of species must coincide with assessment of age, plumage wear, and molt status to reach a confident identification. We have also found that, in the Pacific, more reliable identifications are often possible only with a long series of good images, and we predict that such image series will be needed to confirm a Band-rumped Storm-Petrel in Pacific North American waters.

Figs. J1, J3: Hawai'i, September 3, 2001 (Band-rumped Storm-Petrel specimen BPBM 184416) and O'ahu, December 14, 2005 (Leach's Storm-Petrel wing BPBM 184896). **Fig. J2**: off Kona, Hawai'i, November 12, 2015. *Photos by © Peter Pyle (Figs. J1, J3) and © Annie B. Douglas–Cascadia Research Collective (Fig. J2).*

Fig. J3

Some Additional Photos of Hawaiian Band-rumped Storm-Petrels

Here we present images of Band-rumped Storm-Petrels from the Hawaiian breeding grounds and nearby Hawaiian waters, few of which have been previously published. We show different ages, plumages, and states of wear, and we show how these factors influence criteria useful for separating Band-rumped Storm-Petrels from nominate Leach's Storm-Petrels.

FIGS. K Shown here are two of 15 breeding adult Hawaiian **Band-rumped Storm-Petrels** captured near a suspected breeding colony on Kaua'i. These birds were banded as part of the Kaua'i Endangered Seabird Recovery Project (kauaiseabirdproject.org), which focuses on learning about the breeding distribution and ecology of this little-known species in Hawaii. All 15 birds were at least two years old based on molt clines, and all 15 had brood patches. Note that the plumage is moderately worn on this date, reflecting molt that completes in the spring. The upper-wing ulnar bars of both individuals are indistinct, reflecting moderate plumage wear; and note also the wide dark tips to the upper-tail coverts in Fig. K2.

FIG. L This Hawaiian **Band-rumped Storm-Petrel** is a moderately worn adult. The upper-wing ulnar bar appears to become less distinct with wear, and the indistinct bar on this

Figs. K1, K2: Along the Na Pali Coast, Kaua'i, August 23, 2012. *Photos by © Andre F. Raine (Fig. K1) and Oscar Johnson (Fig. K2)–Kaua'i Endangered Seabird Recovery Project.*

Fig. L1: Off Kona, Hawai'i, July 17, 2006. *Photo by © Annie B. Douglas–Cascadia Research Collective.*

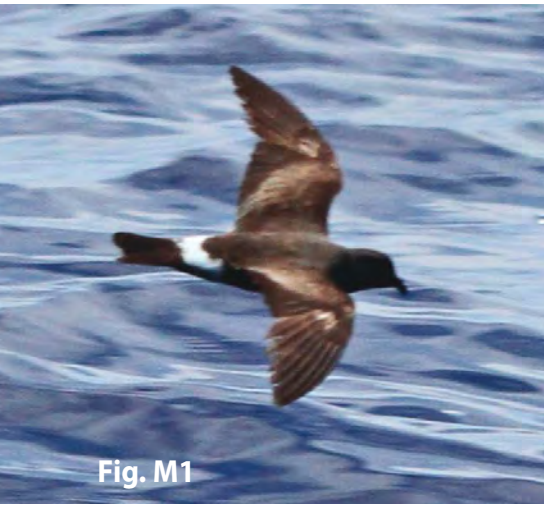
Fig. M1


Fig. M2


Fig. M3

Off Kaua'i, September 4, 2015 (**Figs. M1, M2**) and September 10, 2015 (**Fig. M3**). *Photos by © Deron S. Verbeck–Cascadia Research Collective.*


Fig. N1


Fig. N2

Off Kona, Hawai'i, October 27, 2013 (**Fig. N1**) and October 29, 2011 (**Fig. N2**). *Photos by © Robin W. Baird (Fig. N1) and Daniel L. Webster (Fig. N2)–Cascadia Research Collective.*

bird may be typical of more-worn plumage. Note also the distinctive bracketed shape to the distal ends of both the dark rump and the white upper-tail–covert patch, perhaps reflecting these patterns on the longer central feathers in these tracts. We have noticed this bracketed shape in other Hawaiian Band-rumped Storm-Petrels (see Fig. M3) and have found it useful at times in identification.

FIGS. M These are worn Hawaiian **Band-rumped Storm-Petrels.** The bird in Fig. M1 appears to be a one-year-old commencing its second prebasic molt; note the pointed and brown outer primary tips and the relatively forked tail, perhaps reflecting longer and narrower juvenile outer rectrices (see Fig. H). The initiation of molt in September is also earlier than typical of breeding adults. Note that the adult in Fig. M2 retains an indistinct upper-wing ulnar bar, whereas the adult in Fig. M3 has almost no apparent bar. This bar appears to become less distinct with wear and may be particularly variable in adults during summer and fall.

FIGS. N Fresh juvenile Hawaiian **Band-rumped Storm-Petrels** have been photographed in Hawaiian waters from late September to early November; see also photos of grounded chicks in Pyle and Pyle 2009 (tinyurl.com/P-P-Band-rump). Note the sooty plumage and distinct upper-wing ulnar bars, which become whitish caudally, including the tertial edgings and tips to the humerals, identifying these as juveniles at this time of year (see Fig. C). The upper-wing bar appears more distinct on fresh juveniles and adults than on worn birds.

FIGS. O These are fresh adult Hawaiian **Band-rumped Storm-Petrels.** Note that the bird in Fig. O1 is completing molt with growth of the outer primary, and it appears that the Band-rumped Storm-Petrel in Figs. O2 and O3 (both are the same bird) may just be completing outer primary growth as well. The upper-wing ulnar bar is distinct, as seems typical of fresh birds; note that it can fall short of the bend of the wing in some birds (Fig. O1) but extend to this area in others (Fig. O2); see also Figs. J, M, and N.

The under-wing lesser and median coverts in Fig. O3 are dark brown, contrasting with the paler greater coverts, a feature we associate with Band-rumped Storm-Petrel; Leach's tends to show less contrast here. Note also in Fig. O3 the lack of white wraparound to the under-tail coverts and the appearance of a moderately forked tail at this photo angle and position of the bird in flight. (The bird in Figs. O2 and O3 was carefully identified as a Band-rumped Storm-Petrel rather than a Leach's Storm-Petrel based on all 53 images taken of this bird.)

Off Kona, Hawai'i, April 25, 2015 (**Fig. O1**) and April 27, 2015 (**Figs. O2, O3**). *Photos by © Deron S. Verbeck (Fig. O1) and Daniel L. Webster (Figs. O2, O3)–Cascadia Research Collective.*


Fig. O1

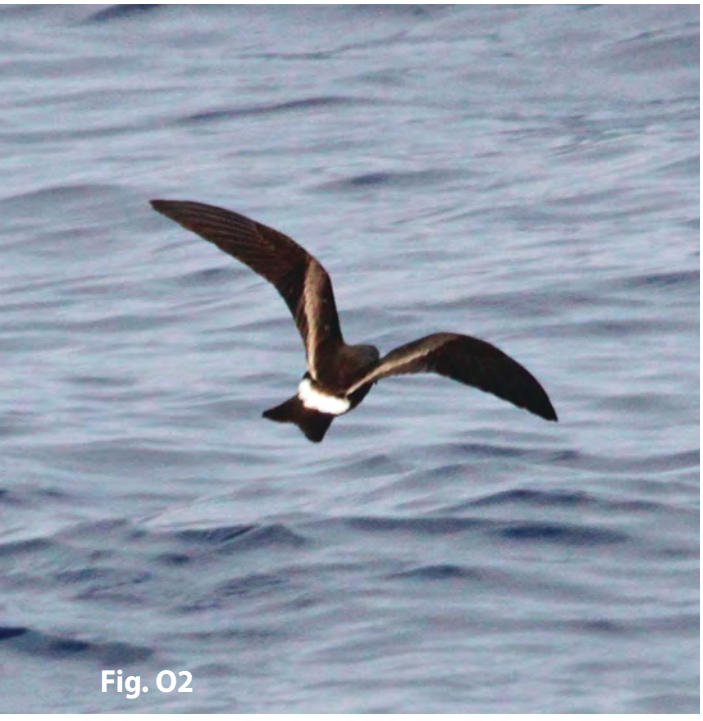
Fig. O2


Fig. O3