

Now endemic to the pine forests of the Sierra Madre Occidental in Mexico, this parrot formerly ranged into and probably bred in the U.S.A. and has done so recently owing to a major and ingenious reintroduction project. Extensive deforestation has occurred throughout its Mexican range, none of which enjoys protection. Because it is nomadic in response to variations in cone abundance, it requires the preservation of substantial areas of pine in different parts of its range if it is to be secure.

DISTRIBUTION The Thick-billed Parrot ranges through the Sierra Madre Occidental of north-west Mexico principally in the states of Chihuahua and Durango (the only states for which breeding has been proved), with smaller or occasional populations in Sonora, Sinaloa, Jalisco and Michoacán and, formerly, in the the U.S.A. in the states of Arizona and New Mexico; the species is now being reintroduced to Arizona, and has bred there.

Mexico In the following text, records are arranged approximately from north-west to south-east, with coordinates taken from OG (1956a) and indicating the approximate locations of certain sites only otherwise to be found on the map in Lanning and Shiflett (1983).

Sonora Records are all from the mountainous north-east region in: the Sierra de Madera, 30°20'N 108°52'W, an extension of the Sierra de Nácori, present by reliable local report made in 1931 (Scheffler 1931; hence van Rossem 1945); the Sierra Huachinera, 30°16'N 108°45'W, Sierra de Oposura, 29°55'N 109°29'W, and Sierra de Nácori (not listed in OG 1956a), all in the 1950s (Marshall 1957, from whose map the last-named is roughly at 29°50'N 108°45'W).

Chihuahua Records extend throughout the mountainous westerly side of the state, and it is evident that the species ranges widely on both slopes of the Sierra Madre Occidental (as indicated, e.g., by Bergtold 1906, Lanning and Shiflett 1981, 1983), specific localities including: Janos, February 1920 (skin in UMMZ); southward from 60 km west of Casas Grandes (Bergtold 1906), thus immediately embracing the following sites down to Madera; Pacheco (Colonia Pachaco, Pachico, Tachico) and environs, where nesting proved (Salvin and Godman 1888-1904, Allen 1893, Thayer 1906), including río Gavilán, 12 km south-west of Pacheco (specimen in MVZ) and Azules, where breeding proved (Lanning and Shiflett 1983); Colonia García, 29°59'N 108°20'W (see Remarks 1 under Imperial Woodpecker *Campephilus imperialis*), and environs, where nesting proved (Thayer 1906; skins from 1948 in MVZ); “Chuichupa”, i.e. Chuhuichupa, 29°38'N 108°22'W, and southward (Bergtold 1906), but also eastward to Ojo Negro, where breeding proved (Lanning and Shiflett 1983); Babicora, June 1902 (specimens in FMNH); Madera, where breeding proved (Lanning and Shiflett 1983); Arroyo Mesteño, 29°26'N 107°04'W, in the Sierra del Nido, August 1961 (specimen in MVZ); Arroyo del Nido, 29°36'N 106°38'W, also in the Sierra del Nido, June 1957, one bird with a brood-patch (specimens in MNHUK, MVZ); Cebadilla, where breeding proved (Lanning and Shiflett 1983, from whose map the site must lie 20 km north-west of the next; see Remarks 2); “Yaguirachic”, i.e. Yahuirachic, 28°35'N 108°09'W, July 1957 (specimens in MVZ), and Vallecillo, where breeding proved (Lanning and Shiflett 1983, from whose map the site appears identical to the preceding; see Remarks 3); near the village of Tutuaca, 28°29'N 108°12'W, in the 1970s (V. Emanuel *in litt.* 1992, with coordinates from OG 1956a; this the site of the “sizeable population” on the border with Sonora reported in King 1978-1979); Pinos Altos, June/July 1888 (van Rossem 1934), 28°15'N 108°17'W (the same locality as for Imperial Woodpecker: see relevant account); Bravo, evidently nearby as also July 1888 and recorded by the same collector (van Rossem 1934); Cumbre at the top of the Barranco de Cobre (Cerro Cobre at 27°01'N 108°39'W) on the border with Sonora and Sinaloa, May 1950 (Stager 1954); Jesús María, the only likely site of this name being 26°52'N 107°39'W, undated (van Rossem 1934); mountains west of Parral (Bergtold 1906), i.e. presumably modern-day Hidalgo del Parral; Laguna Juanota, 26°30'N 106°29'W, July 1937 (specimen in MLZ); Guadalupe y Calvo, August and September 1898 (specimens in USNM) and adjacent Cerro Mohinora, 26°06'N 107°04'W, where breeding proved (*Condor* 40 [1938]: 189; also Hubbard and Crossin 1974, Lanning and Shiflett 1983); Los Frailes, 25°39'N 106°55'W, on the state line with Durango, June 1937 (specimens in MLZ). Vagrancy must account for a record from Ciudad Chihuahua (mentioned in Bent 1940).

Durango Records are scattered throughout the west and south of the state in the Sierra Madre Occidental, thus: Cócono, where breeding proved (Lanning and Shiflett 1983, whose map suggests 26°15'N 106°10'W); Vacas, where breeding proved (Lanning and Shiflett 1983, whose map suggests 26°10'N 106°W); Arroyo del Buey, May 1903, and San Andrés, November 1903 (both untraced, but in the north-west, the former being described as in the Sierra del Candella, the latter apparently close to the Sonora border) (Miller 1906); Camellones, where breeding proved (Lanning and Shiflett 1983; see Remarks 4); Nevado, where breeding proved (Lanning and Shiflett 1983, whose map suggests 25°10'N 105°40'W; but see Remarks 4); Laguna del Progreso, untraced but c.80 km west-north-west of Ciudad Durango, June 1950 (specimen in FMNH); Coyotes, September 1904 (specimen in FMNH), the only localities given by OG (1956a) in the state being just north of Ciudad Durango at 24°15'N 104°42'W or south-west (perhaps more probable given the records below) at 23°49'N 105°20'W; (near) Ciudad Durango and to the south-west on the road to Mazatlán (Salvin and Godman 1888-1904); by local report in winter at El Salto (also on this road) and at Rancho Las Margaritas and west of Rancho El Cortijo, 1950s, although not observed in the summers (Fleming and Baker 1963); over the canyon of the río San Juan (untraced but some 30 km south-west of Ciudad Durango), spring 1931 (Bailey and Conover 1935).

Coahuila Scarlet-fronted birds have been seen in flocks of Maroon-fronted Parrots in winter at San Antonio de las Alazanas, and possibly were wanderers from the Sierra Madre Occidental (see Remarks 1 under the latter species).

Sinaloa The species has been recorded from only two areas, both at the border with Durango, 10 km west of Palmito: at Rancho Carrizo, April 1972, and Rancho Liebre, May 1964 (Hubbard and Crossin 1974) and January 1982, at 2,100 m (B. M. Whitney *in litt.* 1991), the only Palmito traceable to near Sinaloa in OG (1956a) being in Durango at 25°11'N 106°59'W; and at 10 km east of Santa Lucía, 23°27'N 105°53'W, May 1959 (specimen in WFVZ).

Jalisco Records are confined to the Nevado (Volcán[es]) de Colima (twin peaks of Volcán de Fuego and Volcán de Nieve) in the south of the state, with skins from April 1892 (in USNM) and February 1904 (in AMNH), and observations in January 1972, birds then suspected of being winter visitors although local breeding was possible (Schnell *et al.* 1974), and February 1981, at 1,880 m (B. M. Whitney *in litt.* 1991).

Michoacán Records are from one main area, around Uruapan: to the west, on the Cerro de Tancítaro (“Tancitarío” in TAW 1986), July 1940 and July 1941 (Blake and Hanson 1942); and 7 km to the east, at Rancho La Cofradia, June 1939 (specimen in MLZ). However, there is an old record from Anganguero in the extreme east of the state (van Rossem 1945).

México There is a single record of the species from Popocatepetl on the border with Puebla in the last century (Sumichrast 1881, Salvin and Godman 1888-1904). Given the relative proximity of this mountain to Anganguero in Michoacán, it seems likely that the record refers to Thick-billed and not Maroon-fronted Parrot *Rhynchopsitta terrisi* (see relevant account).

Veracruz Records are from Cofre de Perote (Sumichrast 1881; skins mentioned by van Rossem 1945; see Remarks 5); and Pico de Orizaba (Volcán Citlaltépetl) at the (apparently no longer thus named) village of Moyoapam (Sumichrast 1881) and from around the peak at the border with Puebla, where “during the summer of 1891” Cox (1895) saw a flock of parrots “above the deep pine forest about midway between upper and lower timber lines”, these being attributed by Loetscher (1940) to this species. Ridgely (1981a) thought these records might pertain to Maroon-fronted Parrots, as indeed they may; but owing to the stronger evidence of wandering in the Thick-billed Parrot, and given the records above from Michoacán and México states, there remains an equally good chance that records from Veracruz involved Thick-bills. If the specimens referred to could be traced, the matter might be resolved.

U.S.A. The Thick-billed Parrot was at first thought to be an irregular, invasive visitor, irrupting across the Mexican border into south-eastern Arizona (notably the Chiricahua Mountains, which remain the key area for the species) and south-western New Mexico, remaining some months or even over a year or more, but then draining back into Mexico (Vorhies 1934, Wetmore 1935); this view certainly prevailed over comment by Lusk (1900) and Smith (1907) that the species might be resident or at least much more regular than supposed. However, while irruptive behaviour certainly existed (and probably accounts

entirely for records from New Mexico, the most recent of which was in autumn 1964 on Animas Peak: Woodard 1980), interviews with old-timers indicated that the species was formerly “an every-year resident” (presumably therefore a year-round resident) in at least one part of southern Arizona (the Chiricahuas), with lack of breeding reports being possibly no more than an observational artefact (Snyder and Wallace 1988, Snyder and Johnson 1989). Thus, apart from evidence that in the immediate pre- and post-Columbus periods the species apparently occurred as far north as Flagstaff (Wetmore 1931, Hargrave 1939; see Remarks 6), recent interviews have revealed its presence at the start of the twentieth century, seasonally at least, in the Catalina, Rincon, Galiuro, Santa Rita, Patagonia and Chiricahua mountain ranges (Johnson and Snyder 1987; other records from this period in Phillips *et al.* 1964). Modern records of introduced birds are dealt with under Measures Taken.

POPULATION The overall status of any parrot species is difficult to assess owing chiefly to its unpredictably wide-ranging behaviour, but this bird is particularly problematic. If indeed it is highly nomadic both within and between years (see Ecology), as much evidence suggests, this has two dangers: first, that it inflates its range in a manner that makes it appear generally (and permanently) more widespread and numerous than it is; and second, it creates the impression of a high numerical representation at certain sites as if this were a permanent condition. Thus Marshall (1957) often saw the species in his study areas in the Sierra Madre Occidental in 1951 and 1952 (including flocks of 50 and 60), but in 1955 saw birds only twice; whereas in the Sierra Huachinera (an outlier of the main massif) he saw none in 1953 and many in 1954. Hubbard and Crossin (1974) considered overall numbers to have declined in the decade or more prior to their own review, citing Fleming and Baker's (1962) failure to find birds in Durango in the summers of 1957-1961, and other anonymous reports; yet birds have subsequently been found breeding widely in Durango (Lanning and Shiflett 1981, 1983). Records from the south of the range, e.g. of the species being “moderately abundant” at Cerro de Tancítaro, Michoacán (Blake and Hanson 1942), and of flocks up to 120 on the Nevado de Colima, Jalisco, in 1972 and 1973 (Schnell *et al.* 1974) and of over 250 there in 1981 (B. M. Whitney *in litt.* 1991), may well refer to temporary populations (even though present for several years), or perhaps temporary augmentations of permanent but small local populations; but it is to be noted that Beebe (1905) found the species “abundant” on the Nevado de Colima in early 1904.

One construction that can be placed on the evidence is that there may be certain core areas, perhaps those with greatest diversity of acceptable food-plants (so that birds there can compensate for temporary loss of one source by exploiting another), which host important populations virtually permanently, but that otherwise many populations (in some years doubtless inflated by one or more years of breeding success) move widely through the Sierra Madre Occidental in search of fruiting stands of pine, breeding opportunistically wherever and for as long as conditions are favourable. Given the longevity and learning ability of parrots in general, and the capacity to traverse large distances rapidly in this species, sometimes merely in response to impending adverse weather (see Measures Taken for evidence of this), the birds probably develop a broad knowledge of massive areas of habitat.

Despite limited ability to judge the overall situation, it must be true that the numbers of this species have declined, given the extent of habitat conversion reported under Threats. Moreover, irruptions into the U.S.A. have not taken place since around 1920, and observers no longer refer to such phenomena as an “immense flock... estimated at from 700 to 1000” (Smith 1907) or mountains being “alive with these parrots” (Bergtold 1906). How serious the decline has been remains obscure, and it is not possible to judge whether Monson's (1965) pessimism over the species's future is justified or not.

ECOLOGY The Thick-billed Parrot inhabits temperate conifer forests, i.e. (with increasing altitude) mature pine-oak, pine, and fir forests, from roughly 1,200 to 3,600 m (but most usually between 2,000 and 3,000 m), where it occurs in locations varying from plateau-like tops of mountains with open pine or pine-oak woodland and parkland, to thick pine and fir stands below high cliffs or rimrock outcrops used for roosting (Sumichrast 1869, Marshall 1957, Monson 1965, Hubbard and Crossin 1974, Schnell *et al.* 1974, Woodard 1980, Lanning and Shiflett 1983); in winter it is a bird of the snow zone (Snyder and Johnson 1989). At one locality, Cerro Tancítaro in Michoacán, in July of successive years birds were found to

range from the lowlands (tropical deciduous forest) to the highlands (pines), roosting in the former and feeding in the latter (Blake and Hanson 1942), but this seems anomalous.

Food is principally the seeds of various pines, supplemented at certain times with acorns. In the one detailed study of the species, Arizona pine *Pinus arizonica* and Mexican white pine *P. ayacahuite*, the two common pines of north-west Mexico, were the usual food sources, although birds were also seen to eat the smaller seeds of Aztec pine *P. teocote* on occasion (Lanning and Shiflett 1983). Irruption birds in Arizona, 1917-1918, fed chiefly on Chihuahua pines *P. leiophylla* until the crop was consumed, then switched to acorns, probably of all four oaks *Quercus* represented in the area, and in very cold weather the birds that remained behind took food from the ground in places where the wind had blown away the snow-layer; in previous invasions they were reported to have eaten pinyon *P. edulis* and/or Mexican pinyon *P. cembroides*, but no-one could substantiate newspaper claims that cultivated crops were attacked (Wetmore 1935, Cottam and Knappen 1939). In 82 feeding observations of released birds in this same region of Arizona, 1986, 34 were on Chihuahua pine, 25 on Mexican pinyon, 15 on Apache pine *P. latifolia*, six on Douglas fir *Pseudotsuga taxifolia* (cones and terminal buds) and one each on ponderosa pine *Pinus ponderosa* and Arizona white oak *Quercus arizonica*, although the ponderosa pine may have been under-recorded as it is a species of high altitudes (to which birds were seen to fly); birds usually started each day on Mexican pinyon, possibly because its large seeds provided a rapid increase in energy reserves (Snyder and Wallace 1988). Elsewhere (Cerro de Tancitaro, Michoacán) birds have been recorded taking "pinyon" seeds but also fruits of a cherry *Prunus capuli* and legume seeds (Blake and Hanson 1942), and (in Barranca de Cobre, Chihuahua) the terminal buds of Chihuahua and Lumholtz pines *P. lumholtzii* (Stager 1954). Feeding can be solitary, but is usually a group activity (mean size eight) (Lanning and Shiflett 1983). Feeding bouts of released birds commonly lasted 1-2 hours and took place irregularly through the day, birds rarely staying in one place for more than two hours (Snyder and Wallace 1988). Released birds sometimes drank before feeding in the morning, and often did so before roosting at night (Snyder and Wallace 1988); Wetmore (1935) reported birds sometimes drinking at a river before roosting, Arizona, and in the north-west Sierra Madre Occidental Marshall (1957) was told of a waterfall to which thousands came to drink.

The breeding season is timed to coincide with peak abundance in pine seeds (Lanning and Shiflett 1983), and this may lead to some variation: in August 1905 nests with fresh eggs and nests with young were found, and in two cases two large young and one fresh egg were found in the same nest (Thayer 1906); much the same schedule was noted by Bergtold (1906), although he found a nest with half-fledged young on 5 October; and Lanning and Shiflett (1981, 1983) noted in 1979 that birds returned to their breeding areas in April and May, egg-laying occurred between mid-June and the end of July, young hatched from mid-July to late August and fledged when about two months old, between mid-September and late October. On the other hand, Smith (1907) and Wetmore (1935) reported birds in juvenile plumage in late August, suggesting egg-laying in late May, and Bent (1940) gave a laying date of 10 May; Lusk (1900) collected a juvenile as early as mid-June. Cliffs within the Sierra Madre Occidental are mostly rhyolitic and contain few holes (Lawson and Lanning 1981), therefore unlike its close relative the Maroon-fronted Parrot the Thick-bill nests in cavities in trees, primarily pines: 42 of 55 nests found, 1979, were in the two species of pine that were also the chief source of food (see above), Arizona and Mexican white; nine were in quaking aspen *Populus tremuloides* and four in Douglas fir; standing dead pines (pine snags) provided cavities in 32 cases (Lanning and Shiflett 1981, 1983); other descriptions, including evidence that the species utilized old holes of the possibly extinct Imperial Woodpecker (see relevant account), are in Bergtold (1906) and Thayer (1906). Nests were found between 2,300 and 3,070 m; 28 (51%) were on north or north-east slopes, where the largest trees were often located; the 10 cavities in live pines were in parts of the tree that had died from lightning strike, disease or age (Lanning and Shiflett 1981, 1983). Cavities in the 1979 study were 8-28 (mean 17) m above ground, and most had probably been excavated by Common Flickers *Colaptes auratus* or other woodpeckers; of 12 re-examined in 1980, one held young, indicating some re-use in successive seasons (Lanning and Shiflett 1981, 1983). Nesting density was variable, apparently dependent on nest-site availability: in 1979 a pine and an aspen each held two simultaneously active nests, although pairs were usually more scattered, and in 14 cases no other nests were found within a kilometre radius (Lanning and Shiflett 1981, 1983). Although Thayer (1906) reported

a clutch-size of 1-3, Lanning and Shiflett (1981, 1983) found 2-4 eggs per nest, with three being commonest, and 1-3 young fledging, a fairly high success rate; they summarized captive breeding studies (but see, e.g., Witt 1978), where birds laid up to three eggs at 2-3 day intervals, incubation starting with the first egg and lasting 25-28 days per egg, while Snyder *et al.* (1989b) reported on a pair that laid two eggs on 14 and 19 August that hatched on 10 and 12 September, giving incubation periods of 27 and 24 days respectively.

As typical of parrots, birds remain in pairs, so that flocks are commonly even-numbered, members of pairs flying very close to each other (Bergtold 1906, Leopold 1937). Roosting is gregarious and may take place in cliffs (see above), but reintroduced birds, Arizona, used trees, invariably densely crowned pines or firs providing good protection from nocturnal predators; on one occasion they changed the site after encountering a Goshawk *Accipiter gentilis* en route to roost (Snyder and Wallace 1988). In the 1917-1918 invasion of Arizona, birds flew up the mountains to roost in the summer and autumn, but came as low as 1,500 m in the coldest weather (Wetmore 1935). The problem of this species's movements is discussed under Population, and more information on food and breeding is given under Measures Taken.

THREATS The loss of the Thick-billed Parrot from the United States avifauna (see the last paragraph in this section) has created considerable sensitivity about its fate in Mexico, beginning with Leopold (1937), who feared that an impending programme of road construction would result in the loss of the species, and continuing with Monson (1965), who saw it as unable to outface an expanding human population and its guns, sawmills, cattle and goats. However, Tavistock's (1929) report that the bird was disdained by local people as neither good to keep (a point confirmed by Low 1972) nor good to eat holds true today, with Lanning and Shiflett (1981) discovering that use as a food resource or for pets (locally) is minimal. The explanation of the decline in numbers of this species is therefore chiefly habitat destruction, although international trade has played a part in recent years, and other factors may have been important.

Habitat destruction Marshall (1957) was perhaps first to point out that "almost all" the Sierra Madre Occidental, at least in Chihuahua, was being logged, "but somewhat selectively". Vincent (1966-1971) saw that removal of large trees would be particularly damaging to the species, and his concern was shared by Hubbard and Crossin (1974) and by Schnell *et al.* (1974), who in 1973 discovered a new road through pristine pine forest on Nevado de Colima, Jalisco, with a lumbering facility operating along it. Commercial logging of live pines for lumber and dead pines for pulp began in the early 1900s and has grown steadily: a pulp mill operating in Chihuahua since the mid-1960s, when reported on in 1980, had the capacity to process 1,800-3,600 pine snags every day (this seems inconceivable), and another mill, this time in Durango, was due to open in the early 1980s (Lanning and Shiflett 1981, 1983). All dead pines that can be extracted invariably are; and old residents of the region testified to the disappearance of the parrot with the disappearance of their nest trees, so that in 1979 large areas could be traversed in which no suitable nest-sites existed (Lanning and Shiflett 1981, 1983). In a re-examination of 12 nest-sites from the previous year, one held dead chicks apparently as a result of logging disturbance of the area, and two trees had been lost owing to logging (Lanning and Shiflett 1983), i.e. in one year 25% of nest-sites were affected adversely by man. Under overnment regulations, living pines are selectively cut only when their breast-height diameters exceed 40-50 cm; and only one of the 42 nests in pines in 1979 was in a tree with a diameter under 50 cm (Lanning and Shiflett 1981, 1983).

Trade Although over 100 birds were imported into the U.K. in the early 1970s, trade thereafter dropped sharply both there and in the U.S.A. (Lanning and Shiflett 1981). However, in 1985 and 1986 there was an enormous increase in illegal Thick-bills entering the U.S.A., with numbers estimated varying from several hundred to several thousand (Snyder and Wallace 1988, Snyder and Johnson 1989, N. F. R. Snyder *in litt.* 1992). In summer 1988 U.S. Customs confiscated 37 in Texas (Johnson *et al.* 1989, Snyder *et al.* 1989b).

Other (including natural) factors The absence of the Imperial Woodpecker from Texas was indicated as the reason the Thick-billed Parrot did not nest in the state, since the latter uses the former's old nest-holes (Phillips *et al.* 1964). If such an association were real, the decline and disappearance of the woodpecker (owing, apparently, chiefly to hunting: see relevant account) must have affected the parrot, by reducing the number of nest-sites available; but the parrot's successful use of old flicker holes suggests it

did not (N. F. R. Snyder *in litt.* 1992). Widespread failures of pine cone crops have also been blamed (Hubbard and Crossin 1974), although this could only be problematic in combination with other factors. Natural causes of nest failure may include rain in the cavity (Lanning and Shiflett 1983). Hawks are a major threat to wild birds (see Measures Taken) and are much feared (Wetmore 1935).

Causes of disappearance in the U.S.A. Although regarded as poor food in Mexico (see above), mounting evidence from interviews has suggested that in southern Arizona around the turn of the century this and many other species were greatly reduced in numbers through subsistence hunting by woodsmen and miners, and this, combined with considerable logging to provide props and track for the mining industry, may have depleted the (resident) parrot populations to zero (Johnson and Snyder 1987, Johnson *et al.* 1989, Snyder and Johnson 1989, Snyder *et al.* 1989a). It is worth noting here that birds apparently unfamiliar with man showed extraordinary tameness, as witness the photograph in Smith (1907) and the remark by Beebe (1905) that “it is either a very stupid bird or controlled by its curiosity, for the flocks followed us everywhere as we made our way over the slippery ground”.

MEASURES TAKEN The Thick-billed Parrot is listed as Endangered under U.S. law and is on Appendix I of CITES (Lanning and Shiflett 1983). However, it is not known whether the species occurs, at least on a regular basis, in a single protected area in Mexico. The survey of the species in 1979, much as urged by Jeggo (1975), were funded by RARE (then the Rare Animal Relief Effort) (Lanning and Shiflett 1981, 1983).

Reintroduction into U.S.A. The only real steps to provide for this bird have come in the form of a reintroduction scheme in south-eastern Arizona under the auspices of the Arizona Fish and Game Department, the U.S. Fish and Wildlife Service, the U.S. Forest Service, and Wildlife Preservation Trust International, with the active cooperation of the Avicultural Breeding and Research Center, the Wild Bird Sanctuary, and many zoos; the following account of this project is conflated from Johnson and Snyder (1987), Koschmann and Price (1987), Snyder and Wallace (1987), Snyder and Johnson (1988, 1989), Johnson *et al.* (1989), Snyder *et al.* (1989a,b) and Johnson *et al.* (1991), with corrections and additions by N. F. R. Snyder (*in litt.* 1992).

Sufficiently large numbers of confiscations had followed the illegal importations of birds in 1985-1986 (see Threats: Trade) for a programme of release into the wild to be developed and initiated during 1986, based in the Chiricahua Mountains, Arizona, not only the major source of U.S. records of the species but also an area largely under the jurisdiction of the U.S. Forest Service and managed for recreation, wildlife and watershed. The release of 29 confiscated wild-caught birds took place (after considerable preparation, including imping damaged feathers and conditioning birds to improve their flight capacity) in Cave Creek Canyon in September and October 1986, some birds being fitted with radio transmitters to monitor their movements. Seven were quickly lost (probably to hawk predation: a major problem for adjusting birds not yet up to full flying strength during the first week of freedom), and in early November the remaining birds split into two groups of 14 and eight, the latter flying south, apparently into Mexico not to be seen again, the former disappearing for three weeks in December to the Pinaleño Mountains (these movements predicting by a day the arrival of low pressure systems in the area); they spent the winter in Cave Creek Canyon, foraging and roosting from 1,600 to 2,700 m, until the following June, during which time their number fell by one, while in the spring five more birds were released to join them (see Remarks 7), one of these falling victim probably to a Goshawk.

On 14 June 1987 the 17 birds flew north-west to Tonto Creek north-east of Phoenix on the Mogollon Rim, some 320 km from the release site, foraging almost exclusively on ripening Douglas fir cones through July. A bird was found dead in Oak Creek Canyon along the Verde River, 100 km north-west of Tonto Creek, and an impeded feather was found in the White Mountains close to the New Mexico border, indicating still wider dispersal of the birds. No breeding was proved. In September five birds returned to the release site (see Remarks 8), and a bird was released to join them; in October another four returned. Throughout October, the 10 birds fed on ponderosa pines at lower elevations (1,600-2,000 m), then moved up the mountains to feed chiefly on Aztec pines, one bird dying in December; four months later they were down again, again feeding on Chihuahua pines, with four strong pairs now evident. Meanwhile, in mid-November two experimental releases of hand-reared captive-bred birds failed owing to

their inability to flock, watch for predators, or (despite long conditioning) recognize food sources, although one bird, parent-reared, performed much better and was integrating into the flock when it was taken by a predator.

On 10 April 1988 three wild-caught birds were released to join the flock of nine, but by June one had been lost. In mid-June, only four days off the previous year's date, eight birds flew again to the Mogollon Rim, while in the same month a pair of birds was released to join the three left behind, these five staying in the Chiricahuas over the summer. The eight in the Tonto basin fed on abundant ponderosa and pinyon pine cones, and exhibited much mating activity; but they then disappeared, and were only rediscovered in the basin in late September when first eight and then 12 birds were present, this increase being due to two incomers that had split from the five in the Chiricahuas and, most significantly, two young birds bred by one pair. These two offspring were among nine birds that returned to the Chiricahuas in November and wintered there, feeding on an abundant cone crop.

Early in February 1989 another bird was released and quickly integrated, but one of the wild-bred young disappeared at this time. By late spring there were eight birds present in the flock, and seven of these survived the spring migration to the Tonto basin (three pairs breeding, all in ponderosa snags). At this stage it was recognized that stocks in the wild needed further bolstering as soon as possible, since this species seems particularly dependent on flocking as an anti-predator mechanism. Unfortunately, no birds were available for immediate release, and by late summer the effects of an extremely severe drought were being seen in a near-total loss of pine cones in the region. This food failure was the primary cause of breeding failure in all three active pairs in 1989, and the birds soon adopted erratic movements in an apparent search for food, migrating back to the Chiricahuas in early September, back up to the Tonto basin a few days later, then soon back to the Chiricahuas again, where they were able to subsist on a marginal crop of Douglas fir for several weeks. However, they again soon left the mountains and, with the loss of the last bird with a radio transmitter, became impossible to track. The crop failure continued through 1990; although at least some birds are known to have survived this period, they did not regroup in former areas and their present status is unknown.

Food supplies were somewhat better in 1991, and at the end of November 18 birds (eight believed wild-caught, 10 captive-reared) were released into the Chiricahuas, all at least one year old and all having been subjected to rigorous flight conditioning. Nevertheless, within three days five were killed by Goshawks *Accipiter gentilis*, two died of starvation, one died of unknown causes, one was lost to radio contact and one was recaptured because it failed to join the eight survivors, which soon began flocking cohesively and foraging well. However, after a month these birds were taken back into captivity, partly because of the predation factor and partly because the wild cone crop was proving inadequate to sustain the birds. Further releases will concentrate on integrating parent-reared captive-bred birds with wild-caught birds, once more favourable food conditions return.

MEASURES PROPOSED The preservation of a number of very large tracts of forest where the species occurs in several parts of its range (to allow for periodic local failure of cone crops) has been deemed urgent (Monson 1965, Woodard 1980). Any such initiatives would best be taken only after considerable research into the status of this and two other extremely rare endemics of the same region, the Eared Trogon *Euptilotis neoxenus* and Imperial Woodpecker (see relevant accounts), so that all three (if the last survives at all) can be catered for, along with other significant species such as the near-threatened Spotted Owl *Strix occidentalis*; nevertheless, it is clear that this is indeed a pressing and important undertaking with major ramifications, and one which ought to excite the interest and commitment of conservationists and agencies on both sides of the Mexican border. Lanning and Lawson (1981, 1983) called for the adoption of forest management practices that allow five or more dead pines to be left standing per hectare, with perhaps some small reserves to protect optimal primary forest habitat.

REMARKS (1) The Thick-billed Parrot is here treated as a distinct species from the Maroon-fronted Parrot *Rhynchopsitta terrisi* (see Remarks 1 under that species). Because both members are threatened, so is the genus. (2) OG (1956a) gives a Cerro Cebadilla at 28°49'N 108°17'W. (3) OG (1956a) gives a Cerro el Vallecillo at 28°32'N 107°38'W. (4) Possibly the map in Lanning and Shiflett (1983) transposes the sites of Camellones and Nevado, since OG (1956a) places the only Nevado (Cerro Nevado) in the state at 25°02'N 106°05'W. (5) Sclater's (1859a) record from "Jalapa" is attributed to the virtually adjacent Cofre de Perote by Salvin and Godman (1888-1904) and Loetscher (1941). (6) Hargrave (1939) found remains of four birds at an Indian site occupied between 700 and 1300 AD on the San Francisco Mountain near Flagstaff, but warned these might have been traded; however, Wetmore's (1931) evidence from 1593 suggests they were not. (7) Snyder and Johnson (1989) said three birds augmented the wild flock at this date, but this appears to be a slip for June 1988; indeed, this paper adds a 1989 postscript that entirely omits reference to proof of breeding during 1988. (8) Johnson and Snyder (1987) considered the returning flock of five was a remnant of the eight that flew south into Mexico the year before; but this view is not expressed in any of the other papers.