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ODONATA RECORDS FROM NAYARIT AND SINALOA, MEXICO, WITH COMMENTS ON NATURAL HISTORY AND BIOGEOGRAPHY

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Although the odon. fauna of the Mexican state of Nayarit has been considered well--known, a 7-day visit there in Sept. 2001 resulted in records of 21 spp. new for the state, bringing the state total to 120 spp., fifth highest in Mexico. Records from a 2-day visit in Aug. 1965 are also listed, many of them the first specific localities published for Nayarit, and the first records of 2 spp. from Sinaloa are also listed. The biology of most neotropical spp. is poorly known, so natural-history notes are included for many spp. A storm-induced aggregation and a large roost of dragonflies is described. The odon. fauna of Nayarit consists of 2 primary elements: a large number of neotropical spp. reaching their northern known limits, and a montane fauna of the drier Mexican Plateau. At least 57 spp. of tropical origin reach their northern distribution in the western Mexican lowlands in or N of Nayarit, and these limits must be more accurately defined to detect the changes in distribution that may be taking place with global climate change.

INTRODUCTION

Although Nayarit has been considered a "well-known" Mexican state (GONZALEZ SORIANO & NOVELO GUTIERREZ, 1996), almost the entire published record from the state consists of records from the 19th century (CALVERT, 1899, 1901-08). Only a few subsequent papers have mentioned specimens from Nayarit (BELLE, 1987; BORROR, 1942; CANNINGS & GARRISON, 1991; COOK & GONZALEZ SORIANO, 1990; DONNELLY, 1979; GARRISON, 1994a, 1994b; PAULSON, 1994, 1998), and each of them has listed only a record or two from the state. The most recent Mexican Odonata checklist (GONZALEZ SORIANO & NOVELO GUTIERREZ, 1996) lists 96 species known to occur in Nayarit. Four species not included in that total are known from literature records: *Aphylla protracta* [as *Gomphoides ambigua*] and

Orthemis levis (CALVERT, 1901-1908), *Coryphaeschna diapyra* (PAULSON, 1994), and *Orthemis discolor* (PAULSON, 1998). *Argia fissa* should be removed from that list, as it does not occur in Mexico; instead the species is *A. anceps* (GARRISON, 1996), for which there is no published record. Thus the total should be 99 species. However, only 58 of those species are known from a specific locality, the others in GONZALEZ SORIANO & NOVELO GUTIERREZ (1996) included there from unpublished records, including many from the 1965 trip documented herein.

I collected Odonata in Nayarit on 26-27 August 1965 (with M.L. Paulson) and 13-19 September 2001 (with N. Smith), and the number of interesting records gathered on these two brief visits justify their publication. I take this opportunity to cite the first published Nayarit localities for numerous species. Many specimens from the 1965 visit have been deposited in the Florida State Collection of Arthropods; the remaining specimens are all in my collection.

LIST OF LOCALITIES

Collections were made at the following localities (elevations are given in feet, as they were taken):

(1) Slow-flowing rocky and muddy stream with many pools 18.1 mi NE San Blas, 250 ft; 26-VIII-1965
(2) Slow-flowing rocky and muddy stream with many pools 16.0 mi NE San Blas, 300 ft; 26-VIII-1965
(3) Small muddy pond surrounded by low forest 15.0 mi NE San Blas, 250 ft; 26-VIII-1965
(4) Small muddy rain pond and flooded weeds 14.6 mi NE San Blas, 200 ft; 26-VIII-1965
(5) Large pond surrounded by weeds and shrubs 5.3 mi NE San Blas, 100 ft; 26-VIII-1965
(6) Road through low forest 5.1 mi NE San Blas, 200 ft; 26-VIII-1965
(7) Large rocky river 14.5 mi NE San Blas, 300 ft; 26-VIII-1965
(8) 20.8 mi SE Tuxpan turnoff on Mex. 15, 700 ft; 27-VIII-1965
(9) Shrub-bordered pond near stream 15.0 mi SE Tuxpan turnoff on Mex. 15, 200 ft; 27-VIII-1965
(10) Rain pond bordered by fields (covered with *Lemna*) 1.3 mi SE Tuxpan turnoff on Mex. 15, 100 ft; 27-VIII-1965
(11) Rain pond 31.8 mi S Acaponeta, 100 ft; 27-VIII-1965
(12) Small rocky and muddy river 20.1 mi S Acaponeta, 200 ft; 27-VIII-1965
(13) *Pistia*-covered pond in open at Singaita, 13-IX-2001
(14) Narrow road through second growth and forest patches, muddy stream and trickle nearby at Singaita, 13/14-IX-2001
(15) Coast road through mangroves, fields, marshes and woodland, Matanchen, sea level, 13-IX-2001
(16) Pond, swamp and forest in San Blas, sea level (21°32.09'N, 105°16.91'W), 13, 15-IX-2001
(17) Forest road and shade coffee groves at La Bajada, 15-IX-2001
(18) Rocky river at La Palma, 100 ft (21°29.36'N, 105°11.04'W), 15-IX-2001
(19) Rio Santa Cruz at Balneario Nuevo Chapultepec, just E Tecuitata, 600 ft, (21°27.19'N, 105°08.30'W), 15-IX-2001
(20) Slow rocky stream 7.4 km N turnoff to Platanitos on Santa Cruz-Las Varas road, 100 ft (21°23.19'N, 105°11.82'W), 16-IX-2001
(21) Rio Chico at Ixtapa de la Concepción, 16-IX-2001
(22) *Pistia*-covered pond in Peñita de Jaltemba, sea level (21°02.61'N, 105°14.62'W), 16-IX-2001
(23) Pond at Nuevo Vallarta (just N of Puerto Vallarta), sea level, 16-IX-2001
(24) Rincón de Guayabitos, sea level, 17-IX-2001
(25) Stream at San Pedro Lagunillas, 4000 ft (21°12.73'N, 104°45.40'W), 17-IX-2001
(26) Laguna San Pedro, E end, 4100 ft (21°11.84'N, 104°13.39'W), 17-IX-2001
(27) Rocky stream in low forest just W Mex. 15 at La Galinda, 3800 ft (21°18.60'N, 104°39.88'W), 17, 19-IX-2001
(28) Laguna Santa Maria, 2500 ft (21°21.72'N, 104°34.44'W), 17/18-IX-2001

(29) Roadside in second growth 2.7 road km E of Laguna Santa Maria on road to La Cofradia, 2400 ft (21°22.79'N, 104°32.79'W), 17-IX-2001
(30) Rocky/sandy stream and pond 1.7 road km E of Laguna Santa Maria on road to La Cofradia, 2200 ft (21°23.20'N, 104°33.61'W), 17/18-IX-2001
(31) Rio El Limón, 6.3 road km W Santa Maria del Oro, 3600 ft (21°20.43'N, 104°37.92'W), 18/19-IX--2001
(32) In hotel in San Blas, sea level, 19-IX-2001

ANNOTATED LIST OF RECORDED SPECIES

Numbers after species names refer to localities listed above; those followed by "s" are sight records, not represented by specimens, of species I consider easily recognizable in the field. Species indicated by two asterisks (**) are first records for Nayarit; those by one asterisk (*) are apparently the first published localities for the state. Comments about the significance of records are restricted to the species not listed by GONZALEZ SORIANO & NOVELO GUTIERREZ (1996), and state records cited are from that publication unless otherwise indicated.

Hetaerina americana (Fabricius) – 1, 2, 19, 25, 31.

**Hetaerina capitalis* Selys – 19, 27. At the forested Rio Santa Cruz, this species occurred on a small tributary stream, while *H. americana* and *H. occisa* flew over the much wider rocky river.

**Hetaerina cruentata* (Rambur) – 30.

**Hetaerina occisa* Hagen – 1, 18, 19.

**Hetaerina titia* (Drury) – 7, 12, 14, 18, 21. This species is characteristic of larger rivers.

Archilestes grandis (Rambur) – 1, 19, 27, 30, 31.

***Lestes sigma* Calvert – 11.

Lestes tenuatus Rambur – 3.

Mecistogaster ornata Rambur – 14s, 17. A female at Singaita foraged low along a narrow road through disturbed forest. It flew in both sun and shade, mostly <1 m above ground, in a very slow flight, in and out of herbaceous vegetation and along a shrubby edge. It proceeded along the edge of the road to where it exited the forest, then turned back after foraging briefly in weeds right out in the open and flew along the nearest forest edge. It perched twice, at 1 m and 0.2 m above the ground. The male captured at La Bajada flew rapidly through open areas over a road and among shrubs in a shade-coffee plantation, covering much more ground than the female watched foraging; perhaps it was searching for females.

**Palaemnema domina* Calvert – 18. At least eight males were seen on this rocky river in one 4-m long area of brushy tangle with high dirt bank, under a tree canopy; three tandem pairs were perched in the same area. No others were seen in similar-looking areas, and other species of *Palaemnema* are known to aggregate at mating and oviposition sites (GARRISON & GONZALEZ SORIANO, 1988).

**Protoneura cara* Calvert – 1, 2, 3, 18, 20s, 28. At La Palma, in one sheltered area below a high vertical wooded bank, almost an overhang, there were many rootlets in the water and pairs of zygopterans ovipositing there, including this species, *Argia oenea*, and *A. pulla*. Pairs of *P. cara* hovered in tandem for long periods (certainly >1 min), then settled on surface rootlets and immediately begin ovipositing. All three species oviposited right next to each other with no inter- or intraspecific conflict. I noted three pairs of *P. cara* in the air at once hovering in an air-space of <0.1 m^3.

**Apanisagrion lais* (Brauer) – 25, 27, 28.

***Argia anceps* Garrison – 19, 25, 27, 30, 31. This species has not officially been recorded from Nayarit, although it is surely the same as *A. fissa* Selys listed by GONZALEZ SORIANO & NOVELO

GUTIERREZ (1996).

Argia extranea (Hagen) – 25, 27, 30, 31.

****Argia funcki*** (Selys) – 31. Males were present in small numbers at the Rio El Limón, mostly perching on twigs and other structures well above (to 8 m up) and often at some distance from the river. On only a few occasions did a male fly down and perch on rocks near the shore, where four other species of *Argia* were seen. The males of this large species had a bouncy flight over the river typical of *Argia*, then would glide down to a perch on set wings raised at about a 45° angle; I interpreted this as a display flight. Two females were seen at the Rio El Limón, a brown one in tandem with a red male, and one with bright blue thorax that from its size was surely this species; neither could be collected. The blue female foraged by flycatching from twig tips 3-5 m above the ground. A male photographed, shown on the cover of Argia 13 (4), 2002, and on the World Wide Web at http://www.ups.edu/biology/museum/ArgfunM01-127.jpg, is typical of those seen at this location, all of which were conspicuously red. No other species of *Argia* shows red coloration except for a series of red-eyed, copper-thoraxed species typified by *A. oenea* and *A. cuprea*, so this is a chromatically unique species in this very large genus. *A. funcki* was described as largely black, although SELYS (1865) described the pale colors of the type as "marron" (= chestnut). CALVERT (1901-08), who examined large series, made no mention of red coloration. A male in my collection from Chiapas is largely black, with all pale areas brown and much less extensive than in the red individuals from Nayarit. However, several colleagues (S. Dunkle, R. Garrison, E. González, R. Novelo, in litt.) reported red as well as black specimens of the species, although the two types apparently have not been collected together. The differently colored individuals seem identical in size and structure, and if they are not different species, then they represent a fascinating case of geographic or ecological variation.

Argia harknessi Calvert – 12.

Argia oculata Hagen – 14, 19, 27, 30. At the Rio Santa Cruz, *A. oculata* was seen only at a small tributary stream. A pair of *A. oenea* was taken on the same stream, while that species and *A. anceps* were common on the main river; *A. pulla* also occurred on the river but was more common on a narrow, still overflow channel above it.

Argia oenea Hagen – 18, 19, 21s, 31. At La Palma and other localities, this species and *A. tezpi* usually perched on rocks, *A. pulla* on vegetation.

****Argia pallens*** Calvert – 31.

Argia pulla Hagen – 1, 3, 5, 14, 18, 19, 20, 28, 30. It was widespread but was typical of smaller, even heavily overgrown streams.

Argia tezpi Calvert – 1, 12, 18, 21s, 28. This species occurred mostly on the larger rivers.

****Argia** cf. *ulmeca* Calvert – 27, 31. It was associated with a forested stream and woody vegetation adjacent to a larger river, where it perched in shrubs higher than males of most other species. It is much like *A. ulmeca* (CALVERT, 1901-08) in structure and coloration but is distinct in being larger (hindwing 26-29 mm vs. 23-25 mm in *ulmeca*); the antehumeral stripe is narrower and shorter, approaching as a point but not extending to the upper margin of the mesepimeron (wider and to the upper margin in *ulmeca*); and 4 of the 5 males captured have conspicuous black anteapical spots on each side of abdominal segment 8 (only rarely present and smaller in *ulmeca*).

Enallagma novaehispaniae Calvert – 1, 2, 9, 12, 18, 20, 31.

Enallagma praevarum (Hagen) – 31.

Ischnura hastata (Say) – 11, 28.

Ischnura ramburii (Selys) – 15s, 16, 20, 26s. The tall grass and *Scirpus* beds of Laguna San Pedro were inhabited by huge numbers of this species, including hundreds of pairs seen during a visit between 11:00 and 12:00 on 17 September. No other zygopterans were seen.

Leptobasis vacillans Hagen – 1, 5, 9, 10, 15, 32.

****Telebasis filiola** (Perty) – 13. This is the northernmost record of the species on the west coast of Mexico, although it is known north to Tamaulipas on the Gulf coast.

****Telebasis griffinii** (Martin) – 22. Males were fairly common, and a tandem pair collected, at a *Pistia*-covered pond very near the coast, bordered by mangroves but apparently fresh. This is the northernmost record of the species on the west coast of Mexico, although it is known north to San Luis Potosí on the Gulf coast.

****Telebasis isthmica** Calvert – 16. A tandem pair oviposited in *Lemna*, and numerous tenerals arose from the duckweed-covered water of this swamp. This is the northernmost record of the species in Mexico, as it was previously known only from Chiapas (GONZALEZ SORIANO & NOVELO GUTIERREZ, 1996). That record is based on specimens from a pond 1.6 mi SE Tonalá, 200 ft, 25-VII-1965, D.R. Paulson, DRP collection.

Telebasis salva (Hagen) – 4, 5, 10, 11, 19s, 27.

Aeshna psilus Calvert – 30, 31.

****Aeshna vazquezae** Gonzalez Soriano – 27. Three males were collected at this locality on 19 September, in midafternoon as they flew over and along the edge of a long narrow muddy pool in the stream. Clearly searching for females, they flew as slowly and methodically as any *Aeshna* I have seen, examining every nook and cranny along the shore. The species was previously known only from the original description of two males collected in Guerrero in 1983 (GONZALEZ SORIANO, 1986).

****Anax junius** (Drury) – 15s, 16s, 20s, 26s, 28s, 31. Small numbers of males were seen in sexual patrol flight at several coastal ponds and the Rio El Limón, 13-19 September. Ovipositing pairs were seen on a small stream on the Santa Cruz-Las Varas road at 100 ft and the large Laguna San Pedro at 4100 ft, where males were more common than at any other localities. Interestingly, no individuals of this migratory species were seen during the August 1965 visit.

Coryphaeschna adnexa (Hagen) – 13s, 22s. Blue-faced males were seen at both ponds that were covered with *Pistia stratiotes*; this species seems highly associated with dense beds of floating vegetation.

Coryphaeschna diapyra Paulson – 14s; 15s. A few females were seen cruising over fields and roads in the San Blas area; none could be caught, but the species is easily recognized, the females with green thorax and reddish-brown abdomen.

****Gynacantha helenga** Williamson & Williamson – 28. An immature male and female were taken as they flew just above the ground along a narrow lane at dusk near Laguna Santa Maria; no others were seen. This is the northernmost record on the Mexican west coast, although it is recorded north to San Luis Potosí on the Gulf coast.

Remartinia luteipennis (Burmeister) – 14s, 16s, 27. I had never seen this species below 1800 ft in Mexico and 2000 ft in Costa Rica, but several large aeshnids seen at close range at San Blas and Singaita, near sea level, were surely *Remartinia* from their thoracic and abdominal coloration, and I think they were *luteipennis*, which we collected at higher elevation a few days later. However, there is a possibility they could have been *R. secreta* Calvert, known in Mexico only from Veracruz and San Luis Potosí.

****Triacanthagyna caribbea** Williamson – 16. One individual was captured among the much more numerous *T. septima* discussed below. This is the northernmost record on the Mexican west coast, although it is recorded north to Tamaulipas on the Gulf coast.

****Triacanthagyna septima** (Selys) – 16. Both sexes were common roosting from 1-3 m above the ground in dense to open forest near an extensive seasonally flooded swamp. This is the northernmost record on the Mexican west coast, although it is recorded north to Veracruz on the Gulf coast.

Aphylla protracta (Hagen) – 26, 28s. Males were very common at Laguna San Pedro, where they perched in tall grasses over the water, in shrubs at the shore, or on the ground where the shore was

open. As many as three or four were often visible in the air at once as we flushed them. Only a few males were seen at Laguna Santa Maria, which did not have as extensive grass beds.

Erpetogomphus bothrops Garrison – 9.

****Erpetogomphus crotalinus*** (Hagen) – 31.

Erpetogomphus elaps Selys – 27, 31.

****Erpetogomphus sipedon*** Calvert – 31. This was by far the most common species of its genus at the Rio El Limón, where only a few *E. crotalinus* and *E. elaps* were seen. Males of all three species perched on the solid rock shore, facing the river.

Phyllocycla elongata (Selys) – 9, 14s.

Phyllogomphoides apiculatus Cook & Gonzalez – 27.

Phyllogomphoides pacificus (Selys) – 2, 19, 27, 28, 30, 31. Although 4 species of *Phyllogomphoides* are recorded from Nayarit, *P. pacificus* was obviously the common species of its genus in the localities we visited, as 14 of the 15 *Phyllogomphoides* captured were that species. However, COOK & GONZALEZ (1990), in their description of *apiculatus*, examined 44 specimens of that species from Nayarit and only 3 *pacificus*. One male *P. apiculatus* and one male *P. pacificus* were taken at the same time and place on the La Galinda stream. *Phyllogomphoides* were seen at several other localities but could not be specifically identified.

Anatya guttata (Erichson) – 16. Following DE MARMELS (1992), I consider *A. normalis* CALVERT (previously recorded in Mexico) a synonym of *A. guttata*. The situation in this species, with the length and curvature of the male cerci bimodal (short and relatively straight or long and sharply upcurved), and both types occurring at the same site in Venezuela, is quite unusual. DE MARMELS (1992) reported an intermediate specimen, but I have seen none among the 124 male "*normalis*" from Mexico and Central America and the 12 male "*guttata*" from South America in my collection.

Brachymesia furcata (Hagen) – 26, 27, 28s.

Brachymesia herbida (Gundlach) – 5, 15s, 16s.

****Brechmorrhoga pertinax*** (Hagen) – 31. This is the northernmost record on the Pacific slope of Mexico, although there are records north to Veracruz on the Gulf slope and Chihuahua on the plateau.

Brechmorrhoga praecox (Hagen) – 1, 30, 31.

****Brechmorrhoga vivax*** Calvert – 31. This is the northernmost record on the Pacific slope of Mexico, although there are records north to San Luis Potosí on the Gulf slope.

Cannaphila insularis Kirby – 14. Two mature females captured were both roosting on hanging branches or vines, with body almost vertical and parallel to the perch.

Dythemis maya Calvert – 29.

Dythemis nigrescens Calvert – 1, 9, 12, 20s, 28, 31.

Dythemis sterilis Hagen – 1, 9, 14, 16, 20s, 27.

Erythemis attala (Selys) – 13s, 14, 16s.

Erythemis plebeja (Burmeister) – 5, 10, 16, 22s.

Erythemis vesiculosa (Fabricius) – 4, 5, 9, 10, 14s, 15s, 16s, 18s, 19, 21s, 23s.

Erythrodiplax basifusca (Calvert) – 19, 27.

****Erythrodiplax fervida*** (Erichson) – 14s. A male and a few females of this distinctive species were seen at Singaita, but none could be captured. This is the northernmost record on the west coast of Mexico, but there are records as far north as Tamaulipas on the Gulf coast.

Erythrodiplax funerea (Hagen) – 1, 3, 4, 9, 10, 12, 14, 15s, 16s, 17s, 23, 31.

Libellula croceipennis Selys – 13, 14, 18s, 19s, 27s, 31. Ovipositing females consistently splashed drops of water onto the shore.

****Libellula saturata** Uhler – 25.

***Macrothemis hemichlora** (Burmeister) – 29.

Macrothemis inacuta Calvert – 2, 8, 28. Although this species is typically found on rivers, it flies along the shore of large lakes as well. The few males seen at Laguna Santa Maria would fly back and forth along shore over a beat ca 5 m long, then loop up over the grass and weeds back from shore, either cruising for food (presumably) or landing flat on an upside-down boat. *Macrothemis* seem much more likely than *Brechmorrhoga* to land flat (rather than hanging), usually on leaves. Although the bottom of the boat was 1 m above the ground, it seemed equivalent to the dragonfly's landing flat on the ground, something I have never seen in either genus.

Macrothemis inequiunguis Calvert – 19, 20, 21s. At the Rio Santa Cruz, males flew very short beats (no more than 3 m in length) about 1 m over the water along herbaceous and shrubby vegetation at the shore of the river.

Macrothemis pseudimitans Calvert – 1.

Miathyria marcella (Selys) – 15, 22s, 26s, 31. This was the most abundant dragonfly in swarms at Matanchen (see below), but otherwise it was only sparsely recorded, with a few individuals at each of the three other localities at which it was seen.

****Miathyria simplex** (Rambur) – 15. A few individuals were seen in the dragonfly swarms at Matanchen (see below), and one was captured. This is the northernmost record of this species on the west coast of Mexico, but it is recorded north to Tamaulipas on the Gulf coast.

Micrathyria aequalis (Hagen) – 16.

Micrathyria didyma (Selys) – 14, 16.

Micrathyria hageni Kirby – 16s. Male seen at close range in pond at edge of forest.

***Micrathyria ocellata** Martin – 24s. Male seen at close range in marsh.

Micrathyria schumanni Calvert – 3.

Orthemis discolor (Burmeister) – 1, 14, 16, 21s, 29s, 30, 31. At 30, males were abundant at a muddy pond about 6 m in diameter formed by overflow from a small stream. The pond was surrounded by large elephant ears (*Alocasia* or *Colocasia*), and males perched all around it and chased one another constantly. Up to four females were seen ovipositing at the same time, with males in attendance. Small, shallow, muddy ponds seem to have great attraction for most species of *Orthemis*. As in its close relative, *O. ferruginea*, ovipositing females of *discolor* face the shore and splash water drops onto it from 1-2 dm away. Although this species and *O. ferruginea* often occur in the same area (PAULSON, 1998), I have the impression that *O. discolor* is more likely to be associated with forested wetlands, either ponds or pools in slow streams, and *O. ferruginea* is more common in more open habitats. Both *discolor* and *ferruginea* were common at a river 3.4 km E Concordia, Sinaloa, on Mex. 40, 600 ft (23°17.73'N, 106°02.20'W), on 10 September 2001. *O. ferruginea* was more common on an open section of the river, *discolor* on a quiet backwater with wooded margins. *O. discolor* was also found at a nearby forest pond, and *ferruginea* was not seen there. This is the first record for *discolor* from Sinaloa and its northernmost record on the Mexican west coast.

Orthemis ferruginea (Fabricius) – 3, 4, 9, 13s, 14, 15s, 16, 17, 18s, 23s, 25, 26s, 29s, 31. Numerous immature individuals of this species were captured, but no immature *O. discolor* were seen, even where that species was common, so perhaps *O. ferruginea* has a longer flight season in this area, as it appeared to at one locality in Costa Rica where both species were common (PAULSON, 1998). At several localities, only mature *discolor* and immature *ferruginea* were seen.

Orthemis levis Calvert – 1, 2, 9, 14, 16s, 20s, 21s. We found *O. levis* also at a river 3.4 km E Concordia, Sinaloa, on Mex. 40, 600 ft (23°17.73'N, 106°02.20'W), on 10 September 2001, establishing a new northern limit of its known range on the west coast of Mexico.

***Pachydiplax longipennis** (Burmeister) – 16. A single male was taken in a swamp in San Blas,

and the only other record for the state known to me is another male collected at a pond 24 mi S Las Varas, Nayarit, on 5 September 1976, D.R. Paulson, DRP collection. Although this species ranges south to Belize (San Pedro, Ambergris Cay, 18 October 1987, D.R. Paulson, DRP collection), it has not been recorded from most southern Mexican states, and it appears to be much less common in Mexico than farther north, as DUNKLE (1976) noted.

**Pantala flavescens* (Fabricius) – 15, 18s, 24s, 31s. Many tandem pairs oviposited in a swimming pool on hotel grounds at 08:00 on 17 September; sunlight had not yet reached the pool.

**Pantala hymenaea* (Say) – 6, 15, 18s, 20s, 21s, 24. This was the most abundant dragonfly in a mass movement of dragonflies at Matanchen (see below).

**Perithemis domitia* (Drury) – 19, 20.

Perithemis intensa Kirby – 5, 9, 25s, 26, 27, 30s.

Pseudoleon superbus (Hagen) – 1, 9, 10, 18s, 27s, 30.

**Tauriphila azteca* Calvert – 6, 13s, 14, 22. Males were common at both 13 and 22, flying over solid mats of *Pistia stratiotes*. A pair copulated briefly in flight. Species of both *Tauriphila* and *Miathyria* seem to be strongly associated with floating vegetation in the New World Tropics, as are most *Telebasis*, some *Erythemis*, and *Coryphaeschna adnexa*.

***Tramea calverti* Muttkowski – 15s, 16s. This species was not collected, but males were seen in sexual patrol flight at these two localities among much larger numbers of *T. onusta*. Their narrow wing bands, golden wings, and striped thorax were clearly seen.

Tramea onusta Hagen – 10, 15s, 16s, 20s, 21s, 23, 27s, 31s.

DISCUSSION

This list includes 21 species never before recorded from Nayarit, bringing the total known for the state to 120 species. The four Mexican states with more species known from them are all considerably larger than Nayarit (Tab. I), which supports a very diverse odonate fauna for its size. Collecting there has still been spotty, and numerous additional species should be found with further field work.

MASS MOVEMENT AND ROOSTING OF DRAGONFLIES

During sunny weather at midafternoon on 15 September 2001, thousands of dragonflies flew along the west side of Matanchen Bay, just south of San Blas, heading north into a light northerly breeze. They all flew in same direction with no deviation and steady, slow forward movement, from ground level to about 10 m up, both along the shore and out over the water to about 50 m from shore. *Pantala hymenaea* was the most abundant species; *Erythemis vesiculosa*, *Pantala flavescens*, and *Tramea onusta* were all common; and there were a few *Brachymesia herbida*, *Erythrodiplax funerea*, *Miathyria marcella*, *M. simplex*, *Orthemis ferruginea*, and *Tramea calverti*. Perhaps 5/sec passed us at maximum, down to 1/sec at slower times, for the 15 minutes we watched this flight from one spot on the beach. Using 3/sec as an average figure, in 15 minutes we would have been passed by 2700 dragonflies, and that estimate seems about right to me. The flight was already under way when we arrived at the beach and continued after we left, so the number of individuals involved in it was surely much

higher than several thousand.

There were also scattered swarms of hundreds of dragonflies back from the beach, each holding stationary at treetop level, including very dense swarms of *M. marcella*, often with a few *P. flavescens* in them. Near one of these swarms was a dense roost of 400 or more dragonflies hanging in rows from the leafless branches of a fallen tree in a clearing near the beach, most of them *M. marcella* but with a few *P. flavescens* and fewer *M. simplex*. Interestingly, no other species was seen in the roost. The dragonflies hung vertically and closely spaced, often the abdomen tip of one individual extending over the head of the next. I have never seen such a roost before. CORBET (1999) listed dragonfly roosts as occurring when flight was inappopriate (as at night or in the absence of food during the dry season) or impossible (because of adverse weather conditions). This roost satisfied none of these conditions, as it was in midafternoon of a fine day, during the rainy season when prey is abundant and many dragonflies were feeding. The roost gradually dispersed as I approached it to take photographs and identify the species, the dragonflies merely flying up and joining other individuals of their species in the swarms above. I felt the dragonflies were exceptionally unwary, as I was able to approach within a few decimeters of many individuals to photograph them. Could they have been tired? Other than being diurnal, this roost seemed most like that described by CORBET (1999: 316) for dragonflies making transit stops at night during migration.

Table I

Odonata species diversity in five Mexican states, Based on information in GONZALEZ SORIANO & NOVELO GUTIERREZ (1996) and subsequent publications

State	Area (sq km)	Species	Sp/Area x 100
Veracruz	72815	212	0.29
Chiapas	73888	162	0.22
Oaxaca	95364	129	0.14
San Luis Potosí	62849	125	0.20
Nayarit	27620	120	0.43

In addition, anisopterans were also present at all fresh and brackish ponds along the same road; *E. vesiculosa*, *E. funerea*, and *T. onusta* were abundant, *O. ferruginea* common, with smaller numbers of most of the species that made up the flight. All dragonflies captured or seen at close range appeared to be mature. Two days later, there was no beach flight, no stationary swarms, and no roost, and the ponds were almost free of dragonflies (we saw a few *E. vesiculosa* and *O. ferruginea* and one male *A. junius*). I interpret this spectacular assemblage of dragonflies to be a response to a big storm that came through the San Blas area on the afternoon of 14 September, with very strong winds and torrential rain, that concentrated the dragonflies, and by two days later they had moved on. CORBET (1999: 400-408) discussed "traveling assemblages" of migrating dragonflies that included all of the genera listed above but *Orthemis*. In addition, I have seen aggregations on the Gulf Coast of Mexico and/or in the Pacific lowlands of Costa Rica of all of the species listed above except *M. simplex* and *O. ferruginea*. More evidence is needed before *Orthemis* is included in the list of confirmed or strongly suspected migrants.

Table II

Northern known limits of tropical-lowland Odonata in western Mexico (species for which there are no records in southwestern USA west of Texas), based on information in GONZALEZ SORIANO & NOVELO GUTIERREZ (1996) and the present paper

Species	Northern limit				Species	Northern limit			
	Nay	Sin	BCS	Son		Nay	Sin	BCS	Son
Hetaerina occisa	x				*Progomphus clendoni*	x			
Hetaerina titia	x				*Anatya guttata*	x			
Lestes sigma				x	*Brachymesia herbida*		x		
Lestes tenuatus	x				*Cannaphila insularis*	x			
Mecistogaster ornata		x			*Dythemis multipunctata*	x			
Neoneura amelia				x	*Erythemis attala*	x			
Protoneura cara				x	*Erythemis mithroides*	x			
Argia cuprea	x				*Erythemis plebeja*		x		
Argia oculata	x				*Erythrodiplax fervida*	x			
Argia pulla				x	*Erythrodiplax umbrata*	x			
Argia translata		x			*Libellula gaigei*		x		
Enallagma novaehispaniae				x	*Macrothemis inacuta*		x		
Ischnura capreolus	x				*Macrothemis inequiunguis*			x	
Leptobasis vacillans		x			*Macrothemis pseudimitans*			x	
Nehalennia minuta	x				*Miathyria marcella*				x
Neoerythromma gladiolatum		x			*Miathyria simplex*	x			
Telebasis filiola	x				*Micrathyria aequalis*			x	
Telebasis griffinii	x				*Micrathyria atra*	x			
Telebasis isthmica	x				*Micrathyria didyma*			x	
Anax amazili		x			*Micrathyria hagenii*			x	
Coryphaeschna adnexa		x			*Micrathyria ocellata*	x			
Coryphaeschna diapyra	x				*Micrathyria schumanni*	x			
Gynacantha helenga	x				*Orthemis discolor*		x		
Gynacantha nervosa		x			*Orthemis levis*		x		
Triacanthagyna caribbea	x				*Tauriphila australis*	x			
Triacanthagyna septima	x				*Tauriphila azteca*		x		
Aphylla protracta		x			*Tholymis citrina.*	x			
Phyllocycla elongata		x			*Tramea calverti*			x	
Progomphus mexicanus		x							

BIOGEOGRAPHY

Biogeographically, Nayarit has two distinct odonate elements and possibly more. One element consists of tropical species of more southerly origin that occur in the coastal lowlands. This group is the most diverse element. The state represents the northernmost known locality on the Mexican west coast for 28 of these species (Tab. II) and indicates a substantial faunal break at that latitude. Another 29 tropical-lowland species are known to extend farther north, their northern limit in Sinaloa, Sonora, or Baja California Sur (Tab. II). Much more collecting between San Blas and the USA border will be necessary to define these northern limits precisely, but it would be timely

to do so, as neotropical species appear to be spreading northward, perhaps as a response to global warming (BEHRSTOCK, 2000; PAULSON, 2001).

A second element comprises widespread Mexican highland species, many of them probably originating on the Mexican Plateau, that occur in the relatively dry Nayarit interior. This group includes *Hetaerina americana*, *Apanisagrion lais*, *Argia extranea*, *A. funcki*, *A. nahuana* Calvert, *A. pallens*, *Dythemis maya*, *D. nigrescens*, *Erythrodiplax basifusca*, *Libellula saturata*, and *Perithemis intensa*. Nayarit represents the southernmost known records for *Aeshna persephone* Donnelly and *Sympetrum signiferum* Cannings & Garrison of this group. A third element, harder to categorize and the most poorly known, consists of species of the southern Mexican Plateau (some of them occur also at lower elevations, and a few occur across the Isthmus of Tehuantepec in Chiapas and Guatemala). This group includes *Argia harknessi*, *A. variabilis* Selys, *Aeshna vazquezae*, *Erpetogomphus sipedon*, *Phyllogomphoides apiculatus*, *P. pacificus*, and presumably *P. nayaritensis* Belle.

The common name for Odonata among the human residents of San Blas is *tibirichi*.

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