

**Carmel River Lagoon Avian Monitoring Project Report
1999-2002**

**Ventana Wilderness Society's
Big Sur Ornithology Lab**

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INTRODUCTION

Population declines in riparian bird species, which are linked to the degradation and loss of riparian habitat, have received much attention in the public and scientific literature. Clearing of land for agriculture and development, disruption of natural waterways, over-grazing, and invasion of exotic species have all contributed to destruction of riparian areas and the subsequent decline in riparian bird species. Bird populations are widely considered to be an important indicator of the quality of habitat for all wildlife (Marzluff and Sallabanks 1998). For riparian-associated birds in California, a Partners in Flight (PIF) conservation plan exists that includes riparian focal species and provides specific management recommendations (RHJV 2000).

In coastal California, severe winter storms in 1995 resulted in substantial flooding of the Carmel River mouth and floodplain, spurring cooperative efforts by the California Department of Transportation (Draft Restoration Plan) and the California Department of Parks and Recreation (CDPR) to fund the restoration and enhancement of the Carmel River Lagoon as a Mitigation Bank (CRMB). In 1996 the Big Sur Ornithology Lab (BSOL) in collaboration with CDPR established an avian monitoring program near the mouth of the Carmel River to document bird diversity, population dynamics, and survivorship trends in conjunction with these riparian restoration efforts. Initial results of the monitoring program were detailed by BSOL in the Carmel River Report (Booker 1997). Standardization of the placement of nets and hours of operation began in 1999.

This report details the background, methods, and results of the Carmel River Lagoon avian monitoring program from 1999 to 2002 and discusses the present efficacy and future goals of the monitoring program. In addition we investigated population trends of seven PIF riparian focal species (Black-headed Grosbeak (*Pheucticus melanocephalus*), Common Yellowthroat (*Geothlypis trichas*), Swainson's Thrush (*Catharus ustulatus*), Warbling Vireo (*Vireo gilvus*), Wilson's Warbler (*Wilsonia pusilla*), Yellow Warbler (*Dendroica petechia*), and Song Sparrow (*Melospiza melodia*)), three cavity nesting species (Chestnut-backed Chickadee (*Poecile rufescens*), Downy Woodpecker (*Picoides pubescens*), and European Starling (*Sturnus vulgaris*)), a nest predator species (Western Scrub-Jay (*Aphelocoma californica*)), and a nest parasite species (Brown-headed Cowbird (*Molothrus ater*)). The objective of this study was to determine if populations of the above focal species were stable, increasing, or declining to better assess the success of the ongoing restoration efforts at the Carmel River Lagoon.

METHODS

Site Description.—The study area was located on the south bank of the Carmel River approximately 200 meters upstream from the river mouth, and 800 meters downstream from the Highway 1 bridge (Appendix 1). The 10-minute latitude-longitude block for the site was 363-1215; altitude for the site was 2 meters. The area enclosed a quadrilateral extending 200 meters along the river edge, and about 50 to 125 meters inland from the river. The study area was characterized by a structurally diverse riparian forest and a revegetated riparian area adjacent to the forest. Dominant plant species included arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), black cottonwood (*Populus trichocarpa*), black twinberry (*Lonicera involucrata*), poison oak (*Toxicodendron diversilobum*), and California blackberry (*Rubus ursinus*).

Mist-netting and banding.—We collected mist-net data approximately one day each week from May through October from 1999 to 2002 for a total of 81 survey days. We operated 14 mist-nets (12 m long and 2.5 m wide), which we checked every 30 to 40 min for five hours, beginning 15 min after sunrise. Operation of mist-nets and bird banding protocols followed procedures outlined by The Institute for Bird Populations' Monitoring Avian Productivity and Survivorship (MAPS) program (DeSante et al. 2000). All data from the avian monitoring project at the Carmel River Lagoon were reported annually to the Institute for Bird Populations in Point Reyes, California and to the national data repository at the Bird Banding Laboratory (BBL) in Washington D.C.

For each individual bird, we applied a uniquely numbered aluminum leg band issued by the BBL of the Biological Resources Division of the U.S. Geological Survey and recorded capture status, species, age and sex, ageing and sexing criteria (degree of skull pneumatization, presence or absence of external breeding characteristics, feather molt and wear, and plumage), fat levels, wing length, weight, and date, time, and net of capture. Determination of age and sex classes followed Pyle (1997). Hummingbirds and gamebirds were not banded but similar morphometric and phenological data were recorded. Net opening and closing times were recorded each day to allow for calculation of net hours. All data were recorded on a standardized datasheet (Appendix 2).

Net hours were separated into two groups for analyses of bird populations and diversity in climax versus restored plant communities: the “forest” nets (nets 1-5) and the “field” nets (nets 11-19) (Appendix 1). The “forest” nets were located within the riparian

corridor along the Carmel River mouth. This corridor of cottonwood and willow represented “climax” riparian vegetation unaffected by the storms of 1995 and the resulting restoration efforts. The “field” nets were located within the emergent vegetation in the lagoon, dominated by willows replanted and restored to the habitat over the past five years. Data collected from net 17 was removed from the final analyses of these data because the net placement – near the lagoon border with the ocean and river mouth – was not consistent with the “climax” or restored habitat of the other 13 nets.

Statistical Analyses.—Capture rates were standardized using captures/100 net hrs and used as our index of population size. We used paired *t*-tests to compare capture rates of focal species captured in the “forest” vs “field” nets (Ott 1993). We examined population trends of specific focal species using linear regression (Ott 1993). Significance was assumed at a level of $p < 0.05$ and marginal significance at $p < 0.1$.

RESULTS

Total annual net hours ranged from 919 in 1999 to 1,352 in 2002. In 1999 we captured and banded 42 species of 218 individuals for a capture rate (# individuals/100 net hrs) of 23.71. In 2000 we captured and banded 38 species of 309 individuals for a capture rate of 23.50. In 2001 we captured and banded 37 species of 338 individuals for a capture rate of 25.31. In 2002 we captured and banded 29 species of 332 individuals for a capture rate of 24.55 (Table 1).

In 1999 – 2000 “field” capture rates (25.37, 24.54, respectively) exceeded “forest” capture rates (21.27, 21.75, respectively). The following years, 2001 – 2002, “forest” capture rates (34.42, 33.53, respectively) exceeded “field” capture rates (19.60, 18.91, respectively) (Figure 1). Species diversity was greater in the “field” all four years, with 47 total species compared to 32 total species in the “forest” (Table 2 and Table 3).

Of the seven riparian focal species, Black-headed Grosbeak, Common Yellowthroat, Swainson’s Thrush, Warbling Vireo, Wilson’s Warbler, Yellow Warbler, and Song Sparrow, only Yellow Warbler capture rates differed significantly between the “field” and “forest” nets (Table 4). Yellow Warbler capture rates were significantly higher in the “field” ($p = .01$) (Table 4; Figure 2). Black-headed Grosbeak capture rates were also higher in the “field”, though with marginal significance ($p = .09$) (Table 4; Figure 3). Capture rates of cavity nesting species and the nest parasite (Brown-headed Cowbird) did not differ between the

different subhabitats (Table 4; Figures 4-5). The nest predator, Western Scrub-Jay, was captured more often in the “field” with marginal significance ($p = .08$) (Table 4; Figure 5).

Population trends for riparian focal species varied (Figure 2,3, and 5), except for a significant increase in Wilson’s Warbler capture rates ($r^2 = .92, p = .04$) (Figure 2) and a significant decline in Yellow Warbler capture rates ($r^2 = .95, p = .02$) (Figure 2) from 1999 to 2002. Brown-headed Cowbird capture rates varied; however sample size was very low ($n = 6$) (Figure 5). Western Scrub-Jay capture rates increased significantly from 1999 to 2002 ($r^2 = .98, p = .01$) (Figure 5).

DISCUSSION

This long term ongoing avian monitoring study revealed fluctuations over time (1999-2002) for species diversity and abundance in the entire study area as well as among the “field” and “forest” portions of the study area at the Carmel River Lagoon. Of the riparian focal species documented at the site only Wilson’s Warbler and Yellow Warbler showed significant trends over the four years (Figure 2). Wilson’s Warblers showed a positive population trend while Yellow Warblers showed a negative population trend. The positive trend in Wilson’s Warbler capture rates is remarkably similar to results obtained from a nine-year study (1993 – 2001) from the Big Sur Ornithology Lab’s study site along the Big Sur River (Hamilton et al. *in press*). These results from the Big Sur River riparian corridor in conjunction with our results from the Carmel River suggest that Wilson’s Warbler populations may be increasing in riparian habitats on a more regional level in coastal California. Wilson’s Warblers used the riparian habitat along the Carmel River during the breeding season and during migration. However, data on nesting success is needed to determine if the increase in population is correlated with the breeding population and/or the migrant population.

In contrast to Wilson’s Warbler populations, capture rates of Yellow Warblers declined significantly from 1999 to 2002 at the Carmel River Lagoon (Figure 2). Surveys along the Salinas River in Monterey County during the 1980’s reported a 50% decline in Yellow Warbler populations (Roberson and Tenney 1993). Results reported from Roberson and Tenney (1993) in conjunction with our results reflect what may be a general gradual decline in Yellow Warbler populations on a greater spatial and temporal scale than the scope of our four-year study on the Carmel River. Yellow Warblers are riparian obligate species

and a California species of special concern, suggesting that riparian habitats, such as the Carmel River Lagoon site, provide an invaluable stopover habitat for this long-distance migrant.

Having only four years of avian monitoring data, no data on nesting success, and no thorough understanding of the predator assemblage we can only speculate as to the causes associated with the year to year fluctuations in capture rates of species in and among the habitats at the Carmel River Lagoon study site. Year to year fluctuations may be related to weather patterns during the breeding and migration periods, the abundance of both avian and / or mammalian predators, the availability of quality cavity and open-cup nesting sites, or the continuing change in structural complexity of the restoration site. Additionally, nest predation by Western Scrub-Jays and nest parasitism by Brown-headed Cowbirds may be linked to fluctuations in capture rates of breeding species. To further address these possible reasons for fluctuations in avian species diversity and abundance, we would offer the following research recommendations:

- 1.) Nest monitoring and area search surveys.** Regular nest surveys throughout the breeding season would provide concrete data answering many of the speculations listed above, including breeding species diversity, nesting success / predation rates at the Carmel River Lagoon site, the significance of nest parasitism and predation, and the effectiveness of the restored riparian habitat in providing quality nesting sites for breeding species. The operation of remote cameras could provide additional information about nesting behavior, foraging habits, and nest predation, and color-banding in tandem with nest monitoring would provide more detailed information on breeding territories, survivorship, and inter-/intraspecies competition at the site. Area search surveys would also elucidate which species use the “field” and “forest” habitats, as opposed to birds that simply move through the area.
- 2.) Nest habitat documentation and vegetation analyses.** In addition to further research techniques detailing avian species, documentation of nest trees and the analysis of vegetation characteristics at nest sites would provide more definitive information on the importance of plant structural diversity and the success of the restoration attempts in providing necessary over- and understory plant species necessary for nesting and foraging.

3.) Additional years of monitoring through MAPS protocols. According to established MAPS protocols, at least five years of mist-netting and banding data are necessary to provide an effective basis for statistical analysis of population and survivorship trends (DeSante et al. 2000). In connection with the importance of further research techniques and monitoring strategies listed above, a long-term and multifaceted monitoring study would provide an essential basis for understanding more clearly the questions of bird diversity, population dynamics, and survivorship in relation to the riparian habitat restoration at the CRMB.

In conclusion, results from this research suggest that the Carmel River Lagoon be further studied in order to gain further insight towards enhancing the restoration efforts. Four years of avian monitoring at the site revealed that seven California PIF riparian focal species are captured regularly at the site, underscoring the importance of bird diversity at the CRMB, and the need for additional research in determining specific breeding and migration information at the site. The CRMB also provides an invaluable opportunity to study bird populations and survivorship within the context of climax plant communities versus restored riparian habitat at the site. Long-term monitoring, multiple research techniques focusing on bird and plant communities, and more detailed analysis of habitat characteristics at the site will provide a more complete picture of the restoration and enhancement attempts at the Carmel River Lagoon, as well as shed light on future restoration and enhancement required for healthy avian assemblages.

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Table 1. Capture rates (nets 1 – 5 and 11 – 19) at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

Species	1999	2000	2001	2002
*American Robin	0.44	0.15	0.07	0.00
Ash-throated Flycatcher	0.00	0.00	0.00	0.07
Barn Swallow	0.22	0.00	0.07	0.00
*Bewick's Wren	1.85	1.29	0.97	1.11
Blue-gray Gnatcatcher	0.00	0.23	0.07	0.00
Brown-headed Cowbird	0.11	0.15	0.22	0.00
*Black-headed Grosbeak	1.09	0.23	0.75	0.15
*Black Phoebe	0.33	0.68	0.15	0.30
*Brewer's Blackbird	0.22	0.99	0.15	0.00
*Bushtit	0.11	0.68	1.65	1.04
*California Towhee	0.11	0.15	0.00	0.30
California Thrasher	0.00	0.00	0.00	0.07
*Chestnut-backed Chickadee	2.07	3.04	2.55	3.33
Cedar Waxwing	0.54	0.00	0.15	0.07
*Cliff Swallow	0.44	0.38	0.00	0.15
*Common Yellowthroat	0.76	0.15	0.60	0.52
*Downy Woodpecker	0.11	0.61	0.30	0.44
*European Starling	0.54	1.67	0.07	0.30
Fox Sparrow	0.11	0.15	0.15	0.22
Golden-crowned Sparrow	0.22	0.00	0.00	0.00
Gambel's White-crowned Sparrow	0.33	0.00	0.00	0.00
Hermit Thrush	0.87	0.61	0.45	0.67
*House Finch	0.00	0.00	0.07	0.00
House Sparrow	0.00	0.08	0.00	0.00
House Wren	0.11	0.00	0.00	0.00
Hutton's Vireo	0.00	0.15	0.15	0.00
Lesser Goldfinch	0.11	0.00	0.00	0.00
Lincoln's Sparrow	0.22	0.00	0.00	0.15
Marsh Wren	0.00	0.08	0.00	0.07
MacGillivray's Warbler	0.11	0.00	0.00	0.00
Northern Waterthrush	0.00	0.08	0.07	0.00
*Northern Rough-winged Swallow	0.00	0.38	0.00	0.00
Orange-crowned Warbler	0.54	0.53	0.07	0.15
Olive-sided Flycatcher	0.33	0.00	0.00	0.00
Ovenbird	0.00	0.08	0.00	0.07
*Pacific-slope Flycatcher	1.20	0.46	1.20	1.11
Puget Sound White-crowned Sparrow	0.11	0.08	0.07	0.00
*Purple Finch	0.11	0.00	0.00	0.00
Ruby-crowned Kinglet	0.11	0.30	0.30	0.07
Red-shafted Flicker	0.00	0.00	0.07	0.15
*Red-winged Blackbird	0.33	0.76	0.90	0.30
Savannah Sparrow	0.00	0.00	0.07	0.00
*Song Sparrow	2.18	2.13	4.04	3.62
Spotted Towhee	0.11	0.00	0.00	0.07
*Swainson's Thrush	1.96	1.44	1.72	1.33
Tennessee Warbler	0.11	0.00	0.00	0.00

Table 1. Continued

Townsend's Warbler	0.00	0.00	0.07	0.00
*Tree Swallow	0.11	0.15	0.00	0.00
*Violet-green Swallow	0.22	0.30	0.00	0.00
Warbling Vireo	0.22	0.00	0.22	0.00
*Western Scrub-Jay	0.00	0.30	0.52	0.67
Willow Flycatcher	0.00	0.08	0.00	0.00
*Wilson's Warbler	1.09	1.52	3.37	3.77
Winter Wren	0.11	0.15	0.15	0.00
Western Wood-pewee	0.11	0.00	0.00	0.00
*Wrentit	0.76	0.15	0.52	0.30
Yellow-breasted Chat	0.00	0.00	0.07	2.07
Yellow-rumped Warbler	1.09	1.67	2.40	1.26
Yellow Warbler	1.96	1.44	0.82	0.67
**Total # of Species	42	38	37	29
Total # of individuals	218	309	338	332
Net Hours	919.40	1315.10	1335.50	1352.20
Capture Rate (# of indiv/100 net hours)	23.71	23.50	25.31	24.55

*Note: Species known to breed at the Carmel River Lagoon based on evidence of a brood patch, cloacal protuberance and/or nest

**Note: Subspecies, Myrtle Warbler and Audubon's Warbler, are reported as the species, Yellow-rumped Warbler; Gambel's White-crowned Sparrow and Puget-sound White-crowned Sparrow are reported separately and considered one species

Table 2. Capture rates (nets 1 – 5) at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

Species	1999	2000	2001	2002
Bewick's Wren	1.62	1.42	0.78	0.77
Blue-gray Gnatcatcher	0.00	0.00	0.19	0.00
Brown-headed Cowbird	0.00	0.41	0.19	0.00
Black Phoebe	0.00	0.41	0.00	0.38
Bushtit	0.00	0.81	1.94	0.57
Chestnut-backed Chickadee	2.96	2.64	4.47	4.79
Cedar Waxwing	1.35	0.00	0.39	0.19
Common Yellowthroat	0.54	0.41	0.58	0.57
Downy Woodpecker	0.00	0.81	0.19	0.38
Fox Sparrow	0.27	0.41	0.39	0.57
Hermit Thrush	2.15	1.22	0.97	1.34
House Finch	0.00	0.00	0.19	0.00
House Wren	0.27	0.00	0.00	0.00
Hutton's Vireo	0.00	0.20	0.19	0.00
Lincoln's Sparrow	0.00	0.00	0.00	0.19
MacGillivray's Warbler	0.27	0.00	0.00	0.00
Northern Waterthrush	0.00	0.20	0.19	0.00
Orange-crowned Warbler	0.81	0.81	0.19	0.38
Olive-sided Flycatcher	0.81	0.00	0.00	0.00
Pacific-slope Flycatcher	0.54	0.61	1.36	1.34
Purple Finch	0.27	0.00	0.00	0.00
Ruby-crowned Kinglet	0.00	0.61	0.19	0.00
Song Sparrow	1.08	2.85	5.45	4.98
Swainson's Thrush	2.69	2.03	3.50	2.68
Tennessee Warbler	0.27	0.00	0.00	0.00
Warbling Vireo	0.00	0.00	0.19	0.00
Wilson's Warbler	1.08	2.44	4.67	6.32
Winter Wren	0.00	0.41	0.39	0.00
Wrentit	1.88	0.41	1.17	0.77
Yellow-breasted Chat	0.00	0.00	0.19	4.41
Yellow-rumped Warbler	1.88	2.64	6.22	2.87
Yellow Warbler	0.54	0.00	0.00	0.00
*Total # of Species	19	20	24	18
Total # of individuals	79	107	177	175
Net Hours	371.50	492.00	514.20	521.90
Capture Rate (# of indiv/100 net hours)	21.27	21.75	34.42	33.53

*Note: Subspecies, Myrtle Warbler and Audubon's Warbler, are reported as the species, Yellow-rumped Warbler

Table 3. Capture rates (nets 11 – 19) at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

Species	1999	2000	2001	2002
American Robin	0.73	0.24	1.00	0.00
Ash-throated Flycatcher	0.00	0.00	0.00	0.12
Barn Swallow	0.37	0.00	0.12	0.00
Bewick's Wren	2.01	1.21	1.10	1.32
Blue-gray Gnatcatcher	0.00	0.36	0.00	0.00
Brown-headed Cowbird	0.18	0.00	0.24	0.00
Black-headed Grosbeak	1.83	0.36	1.22	0.24
Black Phoebe	0.55	0.85	0.24	0.24
Brewer's Blackbird	0.37	1.58	0.24	0.00
Bushtit	0.18	0.61	1.46	1.32
California Towhee	0.18	0.24	0.00	0.48
California Thrasher	0.00	0.00	0.00	0.12
Chestnut-backed Chickadee	1.46	3.28	1.34	2.41
Cliff Swallow	0.73	0.61	0.00	0.24
Common Yellowthroat	0.91	0.00	0.61	0.48
Downy Woodpecker	0.18	0.49	0.37	0.48
European Starling	0.91	2.67	0.12	0.48
Golden-crowned Sparrow	0.37	0.00	0.00	0.00
Gambel's White-crowned Sparrow	0.55	0.00	0.00	0.00
Hermit Thrush	0.00	0.24	0.12	0.24
House Sparrow	0.00	0.12	0.00	0.00
Hutton's Vireo	0.00	0.12	0.12	0.00
Lesser Goldfinch	0.18	0.00	0.00	0.00
Lincoln's Sparrow	0.37	0.00	0.00	0.12
Marsh Wren	0.00	0.12	0.00	0.12
Northern Rough-winged Swallow	0.00	0.61	0.00	0.00
Orange-crowned Warbler	0.37	0.36	0.00	0.00
Ovenbird	0.00	0.12	0.00	0.12
Pacific-slope Flycatcher	1.64	0.36	1.10	0.96
Puget-sound White-crowned Sparrow	0.18	0.12	0.12	0.00
Ruby-crowned Kinglet	0.18	0.12	0.37	0.12
Red-shafted Flicker	0.00	0.00	0.12	0.24
Red-winged Blackbird	0.55	1.21	1.46	0.48
Savannah Sparrow	0.00	0.00	0.12	0.00
Song Sparrow	2.92	1.70	3.17	2.77
Spotted Towhee	0.18	0.00	0.00	0.12
Swainson's Thrush	1.46	1.09	0.61	0.48
Tree Swallow	0.18	0.24	0.00	0.00
Violet-green Swallow	0.37	0.49	0.00	0.00
Warbling Vireo	0.37	0.00	0.24	0.00
Western Scrub Jay	0.00	0.49	0.85	1.08
Willow Flycatcher	0.00	0.12	0.00	0.00
Wilson's Warbler	1.10	0.97	2.56	2.17
Winter Wren	0.18	0.00	0.00	0.00
Western Wood-pewee	0.18	0.00	0.00	0.00
Wrentit	0.00	0.00	0.12	0.00

Table 3. Continued

Species	1999	2000	2001	2002
Yellow-rumped Warbler	0.55	1.09	0.00	0.84
Yellow Warbler	2.92	2.31	1.34	1.08
Total # of Species*	33	32	27	26
Total # of individuals	139	202	161	157
Net Hours	547.90	823.10	821.30	830.30
Capture Rate (# of indiv/net hours)	25.37	24.54	19.60	18.91

*Note: Subspecies, Myrtle Warbler and Audubon's Warbler, are reported as Yellow-rumped Warbler; Gambel's White-crowned Sparrow and Puget-sound White-crowned Sparrow are reported separately

Table 4. *T*-test statistics for determining differences in capture rates of focal species from the “forest” vs “field” nets at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

Species	<i>t</i>	<i>p</i>
Black-headed Grosbeak	-2.43	0.09
Common Yellowthroat	0.16	0.89
Swainson's Thrush	0.98	0.4
Warbling Vireo	-1.18	0.32
Wilson's Warbler	-2.23	0.11
Yellow Warbler	-5.35	0.01*
Chestnut-backed Chickadee	1.95	0.15
Downy Woodpecker	-0.29	0.79
European Starling	-1.85	0.16
Song Sparrow	0.98	0.4
Brown-headed Cowbird	0.35	0.75
Western Scrub-Jay	-2.57	0.08

*significance at $p < 0.05$

Figure 1. Capture rates compared between the forest nets (nets 1 – 5) and the field nets (nets 11 – 19) at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

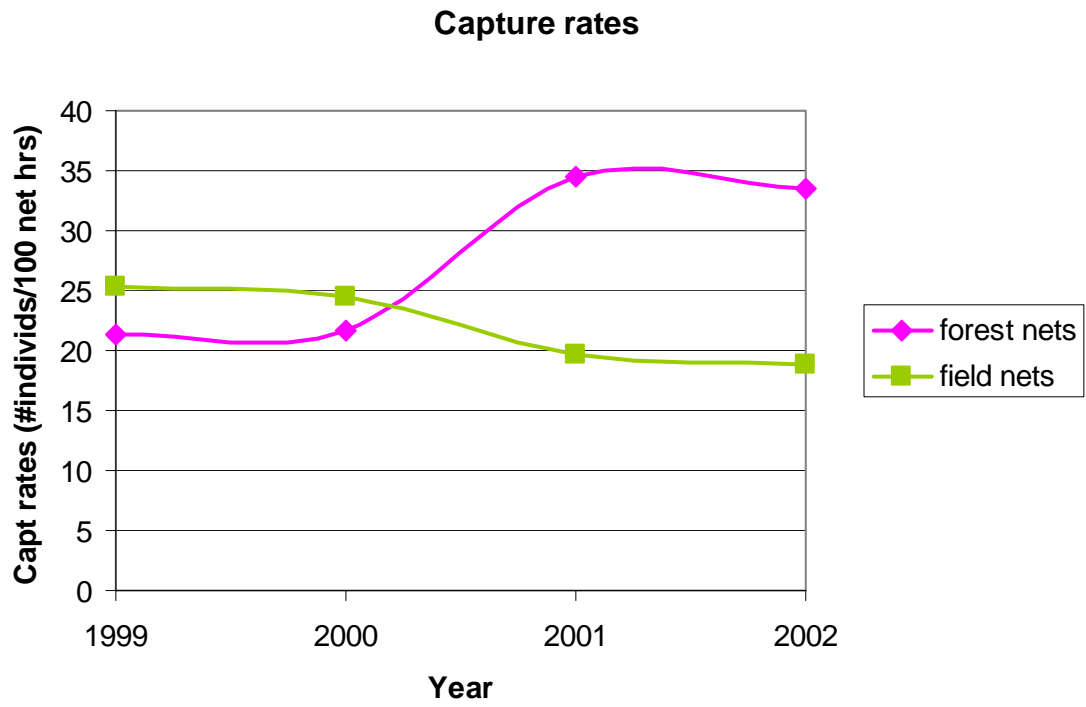


Figure 2. Warbling Vireo, Wilson's Warbler, and Yellow Warbler capture rates at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

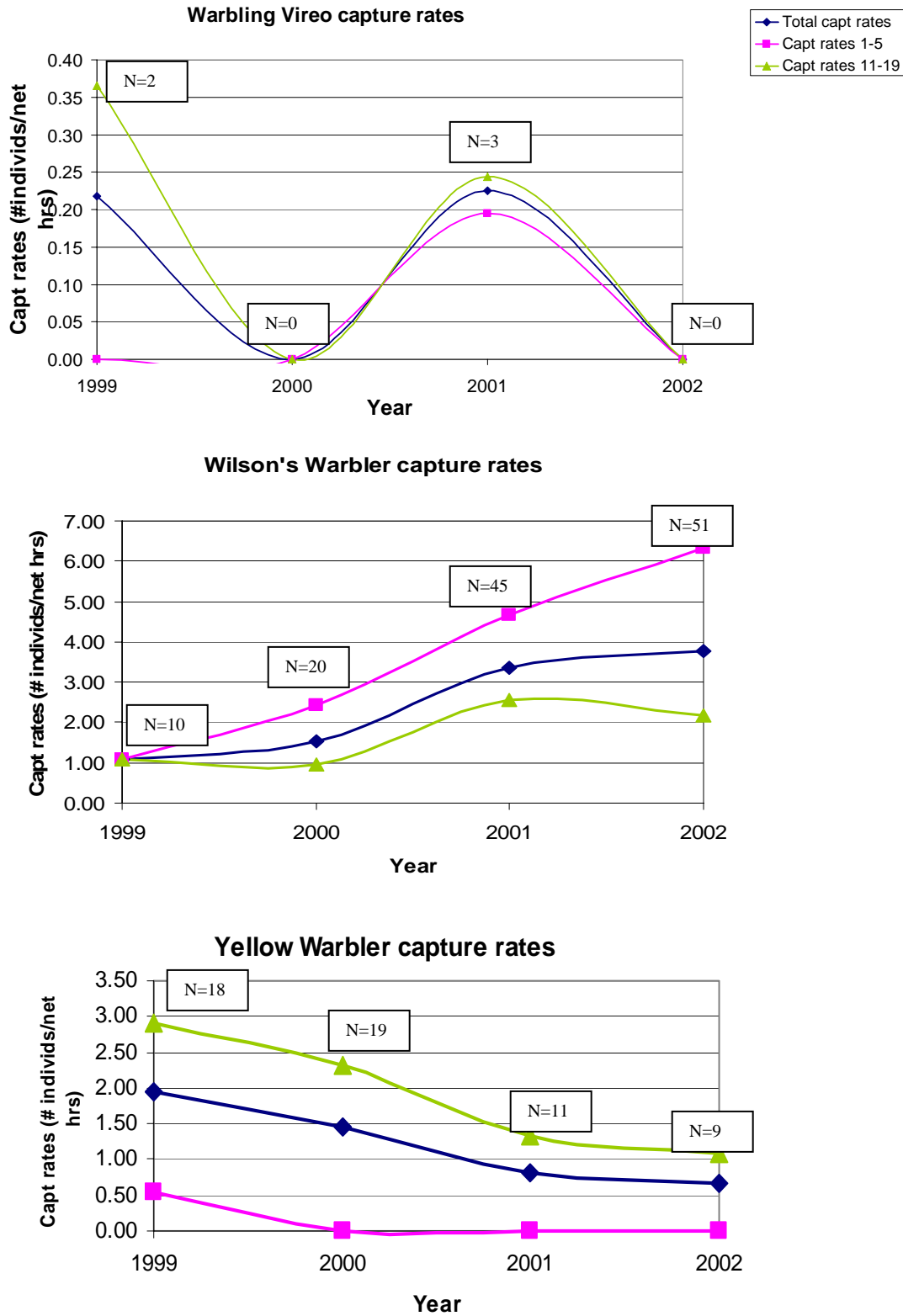


Figure 3. Black-headed Grosbeak, Common Yellowthroat, and Swainson's Thrush capture rates at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

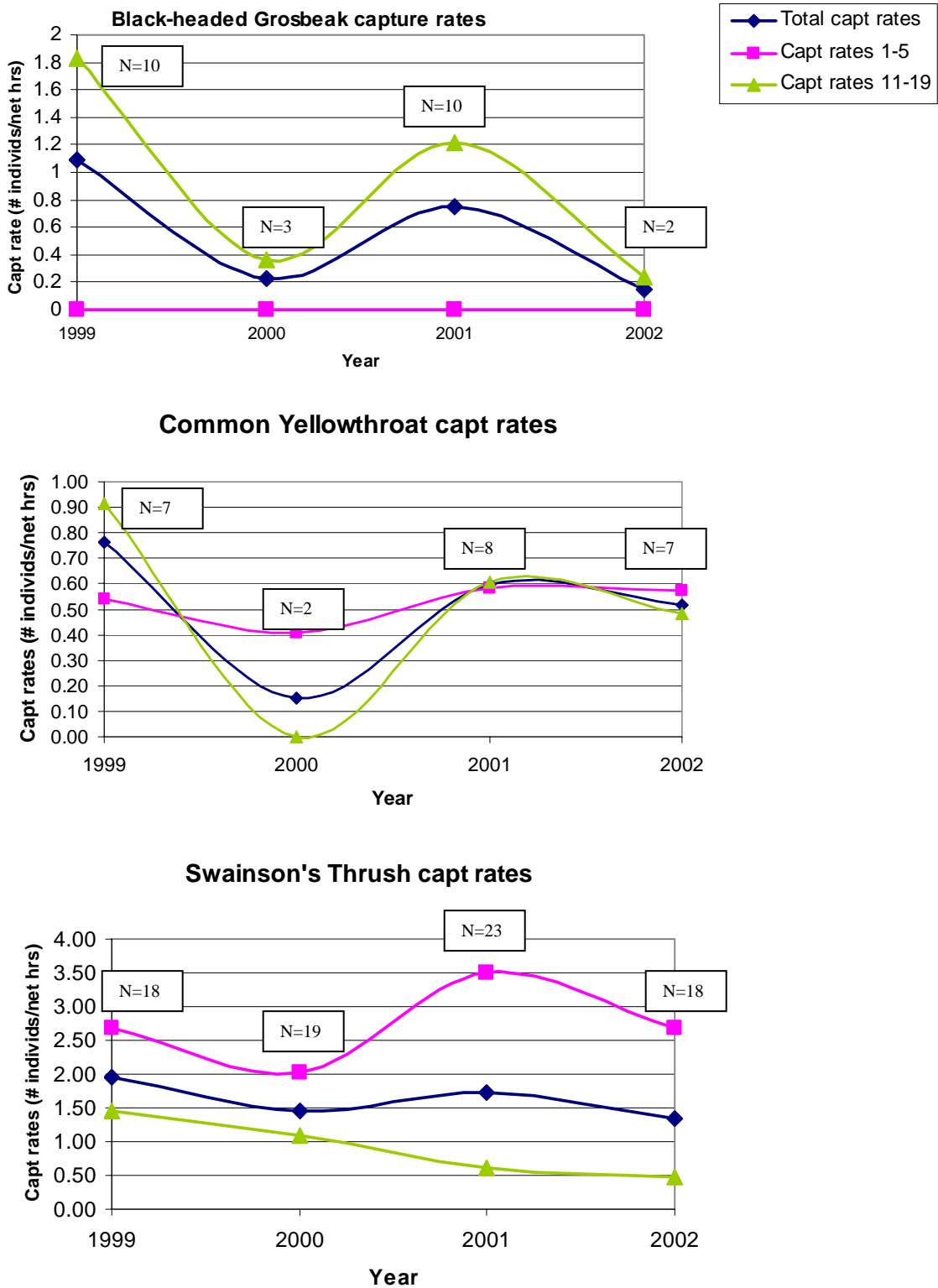


Figure 4. Chestnut-backed Chickadee, Downy Woodpecker, and European Starling capture rates at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.

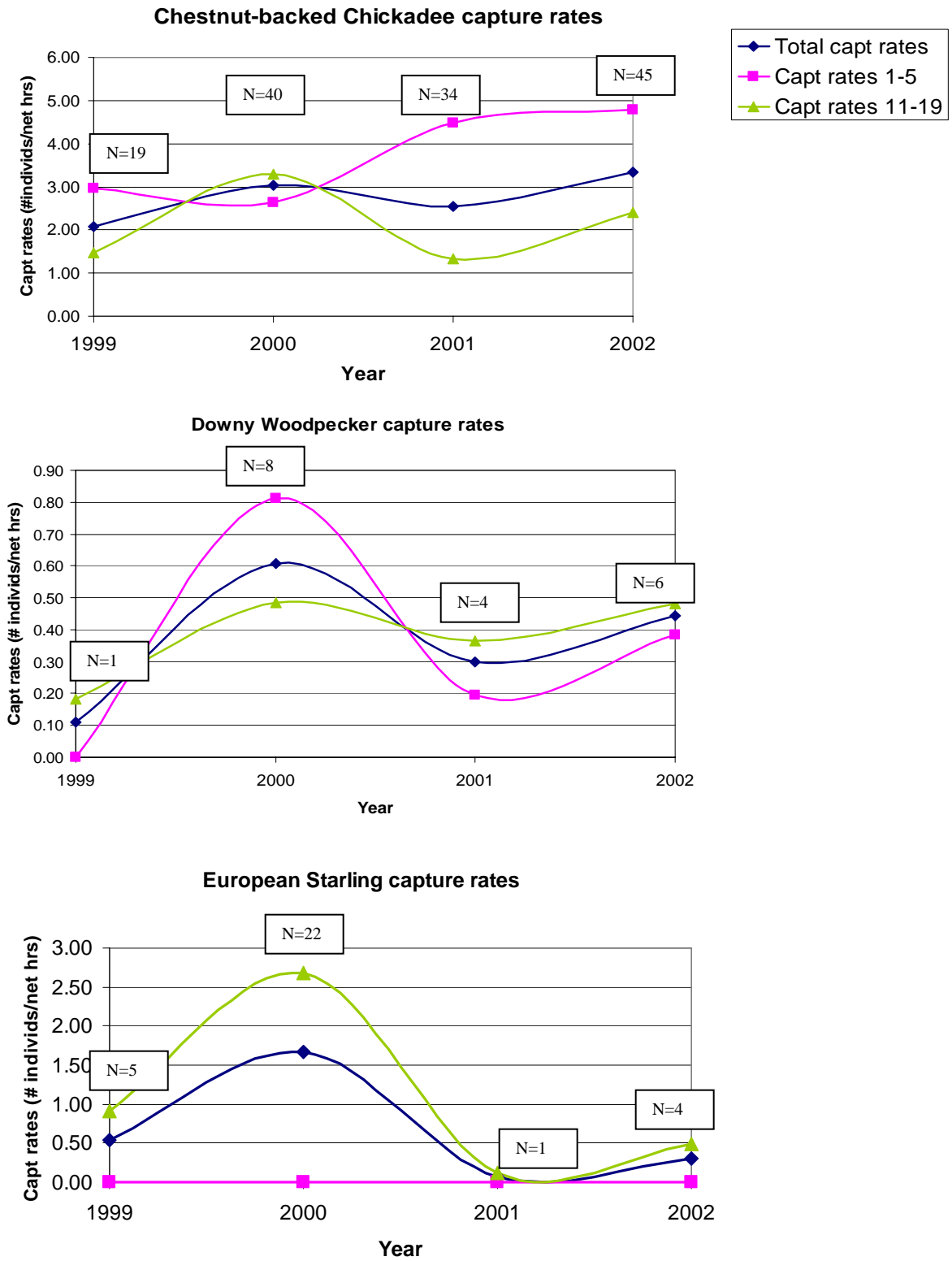
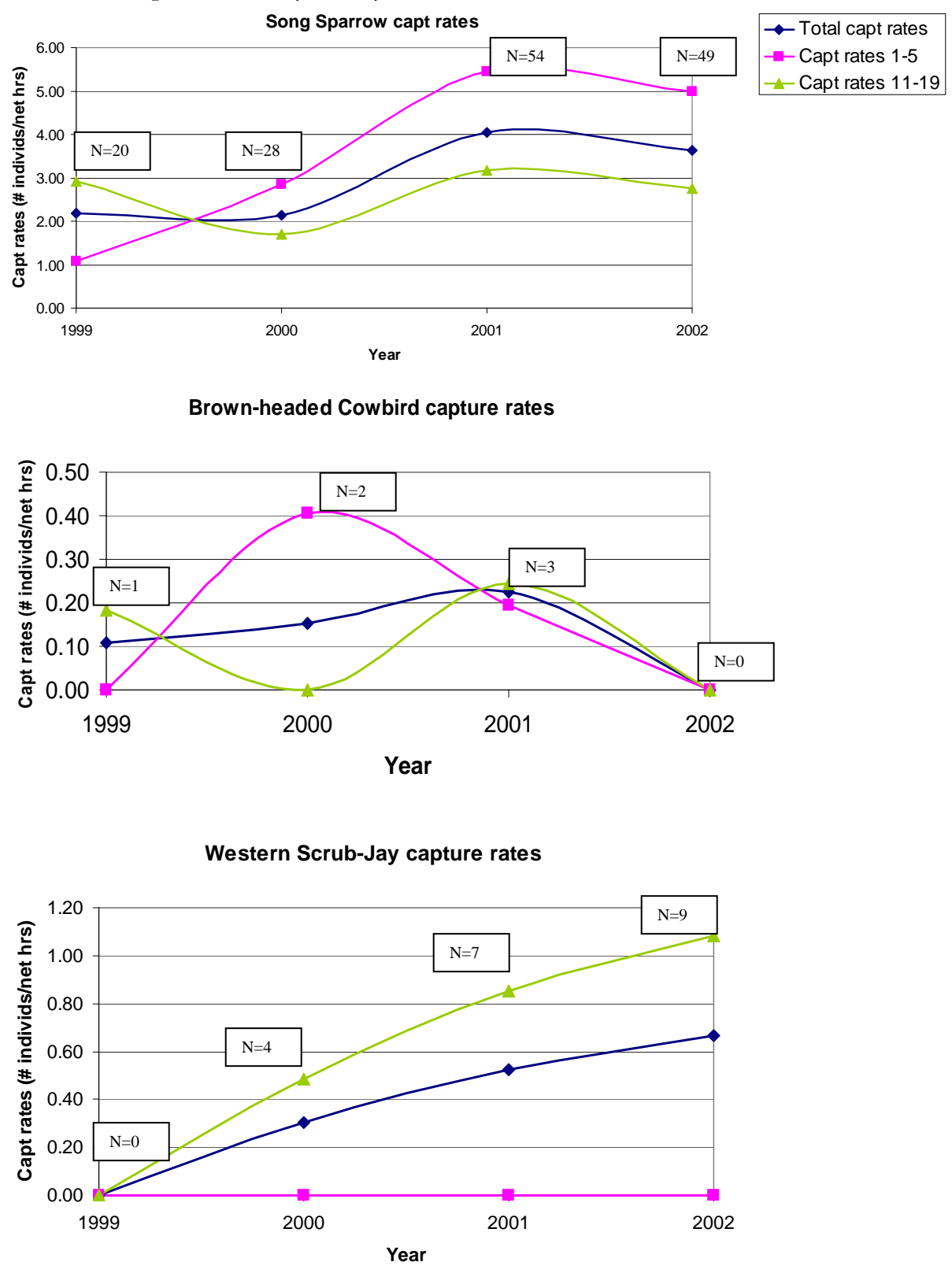


Figure 5. Song Sparrow, Brown-headed Cowbird, and Western Scrub-Jay capture rates at the Carmel River Lagoon, Monterey County, California from 1999 to 2002.



*Please note: Appendices A and B are located in hard copies.