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Analysis of California Migration Patterns Using NEXRAD and On-the-ground Data

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Patterns of Avian Migration in California: An analysis and comparison of results from NEXRAD Doppler Weather Radar and Multiple Mist-net Stations

A collaborative project of PRBO Conservation Science
and the Clemson University Radar Ornithology Lab

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INTRODUCTION

Migration is a critical and potentially population-limiting time period for birds, and given that many migratory bird species are in decline, advancing our knowledge and understanding of the spatiotemporal distribution patterns of migration is crucial to conservation endeavors (Gauthreaux 1992, Newton 1998, Ballard 2003, Ruth 2007). This includes improving our knowledge of vital stopover sites relied upon by birds during migration, especially amidst rapid and ongoing habitat loss (Hutto 1998). Furthermore, understanding the spatiotemporal patterns of migration is necessary to reduce avian mortality resulting from impacts with human structures, such as aircraft, communication and power transmission towers, and wind turbines (Allan 2000, Manville 2005). In order to better understand these migration processes and to improve our overall understanding of spatiotemporal migration patterns, it is important to determine what the most effective means are for studying migration, at both the local and regional scale.

There are numerous challenges to developing an effective means for studying migration patterns from the local scale to the regional scale. On a site-specific scale, migrants can be observed directly from the ground during brief stopover visits along migration routes. Standardized mist-netting and banding, a technique widely used to monitor migration, can provide indices on migratory bird species such as species-specific presence, abundance, age-structure, and sex ratios (Ralph 1981, Ralph et al. 1993, Humple et al. 2001, and Humple and Geupel 2002). Long-term mist-netting at a particular site can also show population changes over time (Ballard et al. 2003).

While the data provided by mist-netting is important for informing population processes and patterns, it has limitations in monitoring large-scale migration patterns, particularly because mist nets sample migration on a site specific scale. Another constraint of mist-netting is that it only samples the portion of the migratory bird population that is in the midst of stopping over to rest and refuel, and thereby does not provide data on the birds migrating aloft or how birds are distributed in airspace over time.

Studying the spatiotemporal patterns of migrants in flight is challenging given that waterfowl, shorebirds, and most passerines migrate exclusively at night (Berthold 1993). An early method used to quantify nocturnal migration patterns was to count the number of birds silhouetted against disk of the full moon or by observing birds in flight from an aircraft (Nisbet 1959, Lowery 1966, Bellrose 1971). However, the development of automated technologies, such as radar, acoustic sensing, and infrared technology has largely opened this avenue of research (Millikin 2005). Each of these automated technologies has its strengths and limitations, depending on the particular research objective. For example, short-range radar can provide information on local "traffic rates", which can be used for conducting site impact assessments (e.g. the potential impact of towers and wind turbines). Acoustic technology, on the other hand, can also provide species specific data. However, both short-range radar and acoustic sensing technology are applicable at only a relatively local scale (Millikin 2005).

However, NEXRAD ("Next Generation Radar") Doppler weather radar (hereafter referred to as WSR-88D, for Weather Surveillance Radar 88 Doppler), has been shown to be an effective tool for studying nocturnal spatiotemporal migration patterns across a broad geographic range (Gauthreaux 1992, Gauthreaux 1998, Gauthreaux 2003b, and Diehl 2005). WSR-88D can provide data on relative migration density, velocity, and direction of flight for flying vertebrates (birds and bats) within a radius of up 240 km radius around the radar station (Gauthreaux 2003a). Under the appropriate conditions, WSR-88D can potentially indicate areas where migration is concentrated, which may help identify important stop-over or roosting sites (Russell 1998, Diehl 2005).

To investigate the spatiotemporal avian migration patterns throughout California at both the regional and local scale, we examined and compared two methods used to monitor migration: standardized mist-netting and WSR-88D. Using both methods, we compiled data for the spring and fall migration periods over a 5 year period (2000 – 2004). The results of this study may help inform the development of future migration monitoring projects throughout California.

METHODS

Data from WSR-88D (NEXRAD) Doppler Weather Radar

The Clemson University Radar Ornithology Lab (CUROL) compiled and analyzed WSR-88D (NEXRAD) Doppler radar data to show peak density of nocturnal migration and the direction of migration movement during spring and fall for a 5 year period (2000 – 2004). Details of their methods, analysis, and results can be found in Supplement A. For the purpose of this analysis, CUROL defined "spring" as 15 March – 31 May, and "fall" as 15 August – 15 November. To provide optimum coverage of California, radar data was compiled from 14 different WSR-88D stations: 10 stations were located in California, 1 in southern Oregon, 1 in western Arizona, and 2 in western Nevada (Table 1). For each station, the maximum relative reflectivity values in decibels of reflectivity (dBZ) were recorded for each day during the spring and fall periods 2000 – 2004. The dBZ values from the WSR-88D came in discrete bins: 5 dBZ, 10 dBZ, 15 dBZ, 20 dBZ, and 25 dBZ; these values were transformed into nightly peak migration density categories of 59, 71, 109, 227, and 602 birds/km^3, respectively (Gauthreaux and Belser 1998). To illustrate peak migration periods using the WSR-88D radar data, CUROL classified migration densities as low (59-109 birds/km^3), medium (227 birds/km^3), and high (602 birds/km^3) for 3 of the WSR-88D stations (KMAX, KHNX, and KYUX). There were some days on which radar data was not available or could not be included due to precipitation, radar malfunction, ground clutter, strobing, or large amounts of insect contamination.

Further details of the WSR-88D methods and data analysis, including a discussion of directional patterns, can be found in Supplement A.

Table 1. WSR-88D radar stations that cover the state of California, with stations arranged geographically from north (top) to south (bottom).

WSR-88D Station Code	Location
KMAX	Medford, OR
KBHX	Eureka, CA
KRGX	Nixon, NV
KBBX	Sacramento, CA
KDAX	Davis, CA
KMUX	Los Gatos, CA
KHNX	Hanford, CA
KESX	Las Vegas, NV
KEYX	Edwards AFB
KVBX	Orcutt, CA
KVTX	Los Angeles, CA
KSOX	Santa Ana Mts, CA
KNKX	San Diego, CA
KYUX	Yuma, AZ

Data from mist nets

We pooled data from 30 standardized mist-netting stations operated throughout California (Fig. 1, Appendices A and B). While mist-netting always followed standardized effort protocols within a season, in pooling these 30 stations there is much between-season variation in effort. This is due to many of the stations falling under different projects, each with their own unique objectives, project duration, and funding constraints during the period of evaluation. Each station was within range (240 km) of at least one WSR-88D station (Appendix B). In general, each standardized mist-netting station consisted of 10 mist-nets; the exceptions were the Palomarin Field Station (PN), where we operated 20 mist-nets, and Redwood Creek (RECR), where we operated 11 nets. Net locations were fixed and therefore did not vary between visits. At most sites, stations were run once per week in fall and once per ten days in winter; at the Palomarin Field Station, during the migration seasons nets were run six days per week in May an autumn, and three days per week in March and April. Nets were opened 15 minutes after local sunrise, were checked for birds approximately every 30 minutes, and were left open between 5 – 6 hours per day depending on region-specific protocols. The number of

hours that each net was open for was tracked for analysis purposes, as nets sometimes had to be closed for inclement weather or other purposes. All birds captured were identified to species and were fitted with a uniquely numbered federal aluminum band (unless a band was already present from a previous capture). Data collected from each bird included age, sex, molt, fat scores, and morphometrics, with birds released shortly afterwards. For full details of mist-netting and banding protocols, see Taylor et al 1993, Ralph et al. (1993), Humple et al. (2001), Humple and Geupel (2002), Ballard et al. 2003.
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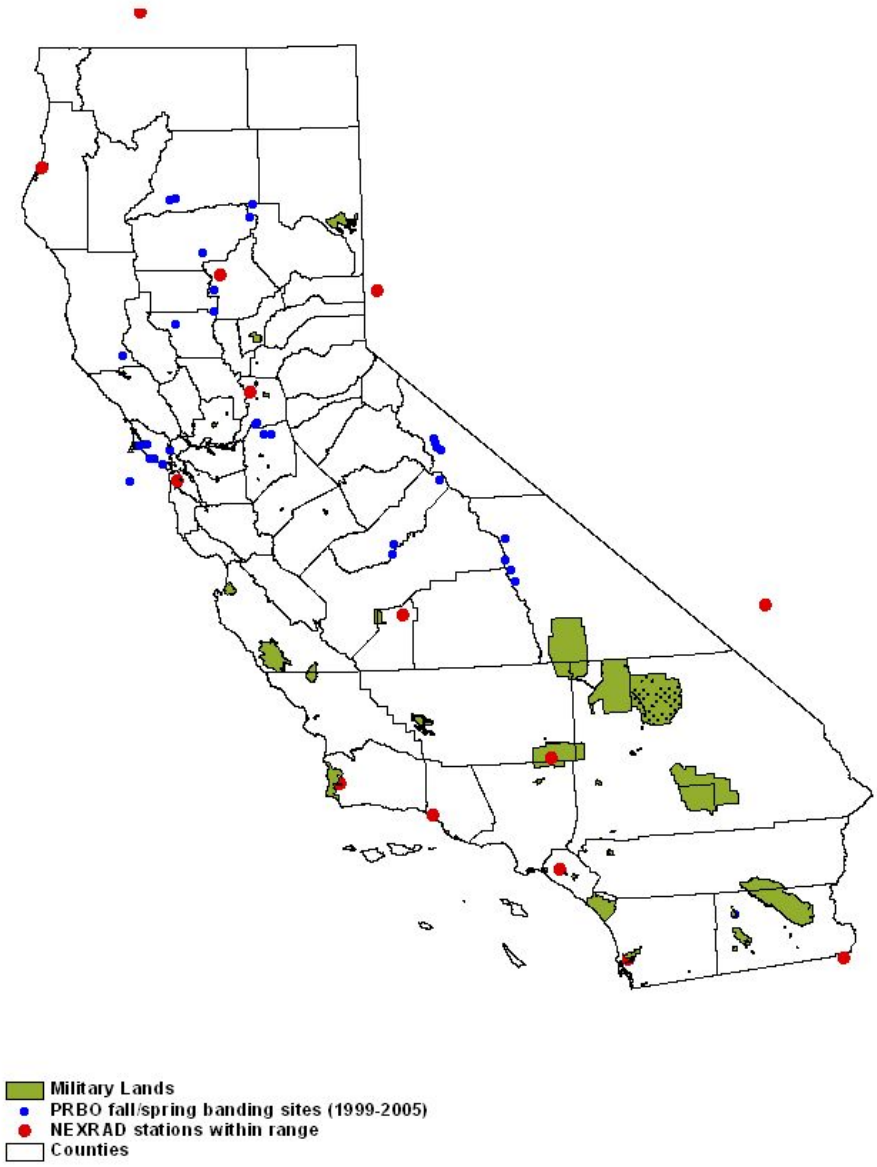
To investigate the timing and volume of migratory patterns, we calculated the capture rates for each mist-netting station. This was expressed as the number of birds per 100 net-hours in order to standardize for the number of hours (or nets) open at a given site or on a given day. One net hour is a single hour of operation for one single-stacked net. For determining capture rates, we included only the migratory species from the mist-netting data and filtered out all resident, non-migratory bird species. The migrant species included long, medium, and short distance migrants. The vast majority of the bird species captured were passerines (songbirds), although a small percentage represented raptors, woodpeckers, and hummingbirds. Birds that were previously captured, banded, and then recaptured were counted only for their first capture of each season. Therefore, a bird that was captured several times in one fall would only be counted once on the date of its first capture that particular fall, but would be counted again independently if captured the following fall. The few birds that were released unbanded were not included in our analyses.

Data from Southeast Farallon Island

The Southeast (SE) Farallon Island is a located in the Pacific Ocean 48 km west of San Francisco and 30 km south of Pt. Reyes. The island provides a unique location to study migration because the island is close enough to the coast that it is regularly used as a

Figure 1. Map showing location of PRBO mist netting stations, WSR-88D radar stations, and Department of Defense lands.



stopover by nocturnal migrants, yet far enough from shore that little daytime passage to or from the coast occurs (Pyle et al. 1993). Since 1968, biologists have conducted daily bird censuses of the island, known as "Daily Estimated Totals" or DETs, in which they record the total number of landbirds on the island each day using multiple surveys and opportunistic netting to keep track of new arrivals (Richardson 2003). We compiled the Farallon census data for the spring and fall over the 5 year study period (2000-04). As with data form other sites we only included migrant landbird species, which were predominantly passerines but also included a small fraction of raptors, woodpeckers, and hummingbirds.

STATISTICAL ANALYSIS

Temporal Migration Patterns: WSR-88D data

We followed CUROL's migration density classification system for categorizing migration as low (59-109 birds/km^3), medium (227 birds/km^3), and high (602 birds/km^3) for all WSR-88D stations. The dates when "high" migration occurred were noted in Table 2, however we also noted dates of "medium" migration densities if "high" migration densities did not occur at any time for a given NEXRAD station. To provide an additional metric of peak migration timing, we also calculated the mean date of "medium" migration levels (using Julian dates), including standard errors.

Comparing WSR-88D data with on-the-ground data

We used linear regression models to determine if there were statistically significant correlations between migration densities measured by WSR-88D and on-the-ground data (capture rates from mist-netting stations and daily estimated totals from the SE Farallon Island). In the regression models, we used the WSR-88D data (representative of migration density movements) one night prior to when the on-the-ground data were collected. All regressions were calculated in the statistical software *R*, version 2.6.1 (2007-11-26).

To ensure we had adequate sample sizes, regression analysis was restricted to mist-netting stations that had at least 20 days of migration data over the 5 year period. This included 6 mist-netting stations in the Point Reyes National Seashore area (all within ~20 km of each other), 4 stations San Joaquin Valley, 2 stations in the southern Sacramento Valley, and 2 stations in the northern Sacramento Valley (Appendices A and C). Bird census data (DETs) from the SE Farallon Island were also included in the regression analysis. In each case, the predictor variable was WSR-88D migration density, and the response variable was capture rate. We used WSR-88D data from the nearest radar station to each mist-netting station analyzed. Of the subset of mist-netting and radar stations analyzed, distances varied from 27 to 114 km between mist-netting and radar stations (WSR-88D captures bird movement within a 240 km radius; Appendix B).

To account for the possibility that migration measurements by WSR-88D versus on-the-ground census techniques may not be temporally aligned or in synchrony with each other, we also compared mist-net/census data and radar data in aggregates of 10 day periods. Rather than comparing the data on a day-by-day basis, we compared 10-day average capture rates against and birds/km^3 from the same 10-day period. Additionally, we looked for a seasonal cumulative effect between on-the-ground data and radar data by aggregating the data into seasonal averages (e.g., average spring capture rate vs. average birds/km^3 in the spring). The 10-day and seasonal average analysis was limited to the 6 mist-netting stations in the Point Reyes area, where the nearest WSR-88D station was KMUX (Appendix B).

Comparing on-the-ground data with each other

We also investigated how closely on-the-ground data tracked each other within a localized region of multiple mist-netting stations by qualitatively comparing the capture rates and peak migration times among the 6 mist-netting stations in the Point Reyes area and the SE Farallon Island. We selected these stations because they were the most consistently run between years, and due to their proximity to SE Farallon Island. The mist-netting stations are all within a 20 km radius of each other, and the SE Farallon Island is approximately 35 km from the mist netting stations; therefore if migration

proceeds evenly on a relatively local scale, then we would expect these sites to experience similar temporal migration patterns.

RESULTS

Spring Temporal Patterns assessed with WSR-88D Doppler radar

The seasonal temporal patterns of spring migration in California are shown in Appendix C and summarized in Table 2. In general, low migration densities are detected throughout California during the month of March. In instances where distinct spring migration "peaks" were evident, the peaks occurred in the third week of April through the third week of May, with most spring migration peaks occurring in the last week of April and in the first week of May (Table 2). The mean date of medium migration density consistently occurred between the last week of April and the first week of May.

Six out of the 14 radar stations indicated at least one night of high-level migration density during the spring (defined as at least 602 birds/km^3), and 11 out of the 14 radar stations indicated nights with medium-level migration densities (227 birds/km^3, Table 2). The stations at Medford, OR (KMAX) and Los Gatos, CA (KMUX) both had the highest number of high-level migration densities (3 nights); additionally the Los Gatos station also detected the highest number of medium-level migration densities (26 nights). The Nixon, NV (KRXG) station consistently detected low migration densities, and also had the most number of days recording zero migration (Table 2). The WSR-88D station in Yuma, AZ (KYUX) was somewhat of an outlier in that although it did not show any medium migration density nights, it had one night of high migration density on 18 April, the earliest date for any radar stations to have high-migration density (Table 2).

Table 2. Spring migration summary for California NEXRAD stations, with stations arranged from north (top) to south (bottom). The number of days each station detected migration between 15 March – 31 May 2000-04 are given, with migration movements classified as light (59-109 birds/Km^3), medium (227 birds/Km^3), and high (600 or greater birds/Km^3). The number days for which NEXRAD data were either unavailable or not used are shown under "Data n/a" column.

Code	Location	# of days within spring period (15 Mar-31 May), 2000-04*					Peak Migration Dates	Mean Date of Medium Migration w/ std error
		Data n/a	No migration	Light migration	Med. migration	High migration		
KMAX	Medford, OR	189	62	122	14	3	4/29/03,5/11/00, 5/11/03	29 April (± 2.27 days)
KBHX	Eureka, CA	178	36	173	3	0	4/25/03, 4/29/03, 5/4/03	29 April (± 2.60 days)
KRGX	Nixon, NV	172	126	92	0	0	N/A	N/A
KBBX	Sacramento, CA	175	1	203	10	1	5/17/2000	28 April (± 4.01 days)
KDAX	Davis, CA	150	4	231	5	0	4/30/01, 5/3/00, 5/6/02, 5/7/03, 5/8/00	5 May (± 1.53 days)
KMUX	Los Gatos, CA	103	30	228	26	3	5/08/03, 5/20/02, 5/18/04	1 May (± 2.57 days)
KHNX	Hanford, CA	252	18	120	0	0	N/A	N/A
KESX	Las Vegas, NV	221	19	148	2	0	4/24/01, 5/12/02	3 May (± 9 days)
KEYX	Edwards AFB	110	81	198	1	0	4/24/01	24-Apr
KVBX	Orcutt, CA	152	21	202	14	1	4/30/2001	1 May (± 3.16 days)
KVTX	Los Angeles, CA	91	17	273	9	0	**	28 April (± 3.75 days)
KSOX	Santa Ana Mts, CA	97	22	246	25	0	**	1 May (± 2.19 days)
KNKX	San Diego, CA	129	11	235	13	2	5/1/00, 5/9/00	30 April (± 2.74 days)
KYUX	Yuma, AZ	210	6	173	0	1	4/18/2004	N/A

* Total number of days included during the spring migration period 2000-04 = 390

** Peak migration not well defined.

Table 3. Fall migration summary for California NEXRAD stations, with stations arranged from north (top) to south (bottom). The number of days each station detected migration between 15 August – 15 November 2000-04 are shown, with migration density movements classified as light (59-109 birds/Km^3), medium (227 birds/Km^3), and high (600 or greater birds/Km^3). The number of days for which NEXRAD data were either unavailable or not used is shown under "Data n/a" column.

Code	Location	# of days within fall period (15 Aug-15 Nov), 2000-04*					Peak Migration Dates	Mean Date of Medium Migration w/ std error
		Data n/a	No migration	Light migration	Med. migration	High migration		
KMAX	Medford, OR	206	119	140	0	0	N/A	
KBHX	Eureka, CA	155	22	282	6	0	9/3/03, 9/3/00, 9/9/01, 9/20/01,9/22/03, 10/20/00	18 Sep ± 7.33 days
KRGX	Nixon, NV	199	155	111	0	0	N/A	
KBBX	Sacramento, CA	195	2	250	18	0	**	5 Oct ± 5.20 days
KDAX	Davis, CA	216	4	243	2	0	9/16/00, 9/28/01	22 Sep ± 5.50 days
KMUX	Los Gatos, CA	111	64	288	2	0	9/13/00, 9/17/02	15 Sep ± 1.50 days
KHNX	Hanford, CA	161	4	300	0	0	N/A	
KESX	Las Vegas, NV	280	55	130	0	0	N/A	
KEYX	Edwards AFB	156	75	233	1	0	9/14/2000	14 Sep
KVBX	Orcutt, CA	188	39	238	0	0	N/A	
KVTX	Los Angeles, CA	120	44	301	0	0	N/A	
KSOX	Santa Ana Mts, CA	104	34	327	0	0	N/A	
KNKX	San Diego, CA	201	40	224	0	0	N/A	
KYUX	Yuma, AZ	283	12	169	1	0	9/25/2000	25 Sep

* Total number of days included during the fall migration period 2000-04 = 465

** Peak migration not well defined.

Fall Temporal Patterns with WSR-88D Doppler radar

The seasonal temporal patterns of fall migration in California are shown in Appendix D and summarized in Table 3. Overall, fall migration temporal patterns were much less defined than spring migration. Furthermore, fall migration densities were lower than those observed in the spring. Out of the 14 WSR-88D stations examined, none registered a high migration density in the fall, and only 6 registered nights of medium migration density (Table 3). Due to the overall low migration densities, peak migration times were difficult to define. Of the 5 radar stations that indicated peak migration days, the peaks fell within September, with the exception of one peak day on October 20th. The mean date of medium migration density was generally from mid to late September, with the exception of the Sacramento station (KBBX), which had a mean medium migration density date of 5 October.

Spring Temporal patterns: Mist-netting and SE Farallon census data

The spring temporal patterns of migration for the Palomarin field station and the SE Farallon Is. are shown in Figures 2 and 3, respectively; these two sites have the most contiguous migration data sets, and are therefore ideal to display graphically. The dates of peak spring migration are described for all mist-netting stations in the Pt. Reyes area and for the SE Farallon Is. in Table 4. The data show that spring migration is quite variable within this region. Peak migration dates varied considerably, both among sites within the same year and within the same site among different years (Table 4). For the Palomarin station (PN), spring migration peaks occurred between the third week of April and the third week of May, similar to the pattern observed with the WSR-88D data. The temporal patterns shown in Figure 2 and 3 suggest that migration can occur in periodic waves, though the waves appear to be local as they are not observed at the same time across other sites within the region (Table 4).

Table 4. Peak migration dates for mist-netting and census stations in western Marin County and for the SE Farallon Is; two dates were entered for years when the peak migration number was observed on two separate days.

Station	2000		2001		2002		2003		2004	
	spring	Fall	spring	fall	spring	fall	spring	fall	spring	fall
PN	4/23/00	11/8/00	4/21/01	10/14/01	5/19/02	10/12/02	5/2/03	9/12/03	5/8/04	10/15/04
PGUP	3/30/00	10/31/00	4/16/01	10/14/01	4/5/02	10/12/02	4/3, 4/11/03	10/23/03	4/9/04	11/1/04
LACR	n/a	n/a	n/a	10/28/01	5/14, 5/24/02	10/8/02	5/23/03	8/27/03	5/6, 5/12/04	10/12/04
MUHO	5/26/00	9/23/00	5/16/01	10/12/01	4/10/02	10/4/02	4/1/03	11/11/03	3/22/04	10/8/04
PIGU	4/12/00	11/9/00	4/5/01	10/25/01	5/15,5/30/02	10/2/02	4/8/03	11/6/03	5/5/04	11/12/04
RECR	n/a	n/a	n/a	9/12/01	5/11/02	8/20/02	5/15/03	9/13/03	5/3/04	9/9/04
SEFI	4/3/00	10/22/00	5/12/01	11/9/01	4/3/02	11/15/02	3/29/03	11/10/03	5/25/04	9/29/04

Figure 2. Palomarin banding station mist-net capture rates of migrants during spring (15 Mar. - 31 May), 2000-04. Note: Dates on which data were not collected are shown as "-1" (no bar showing).

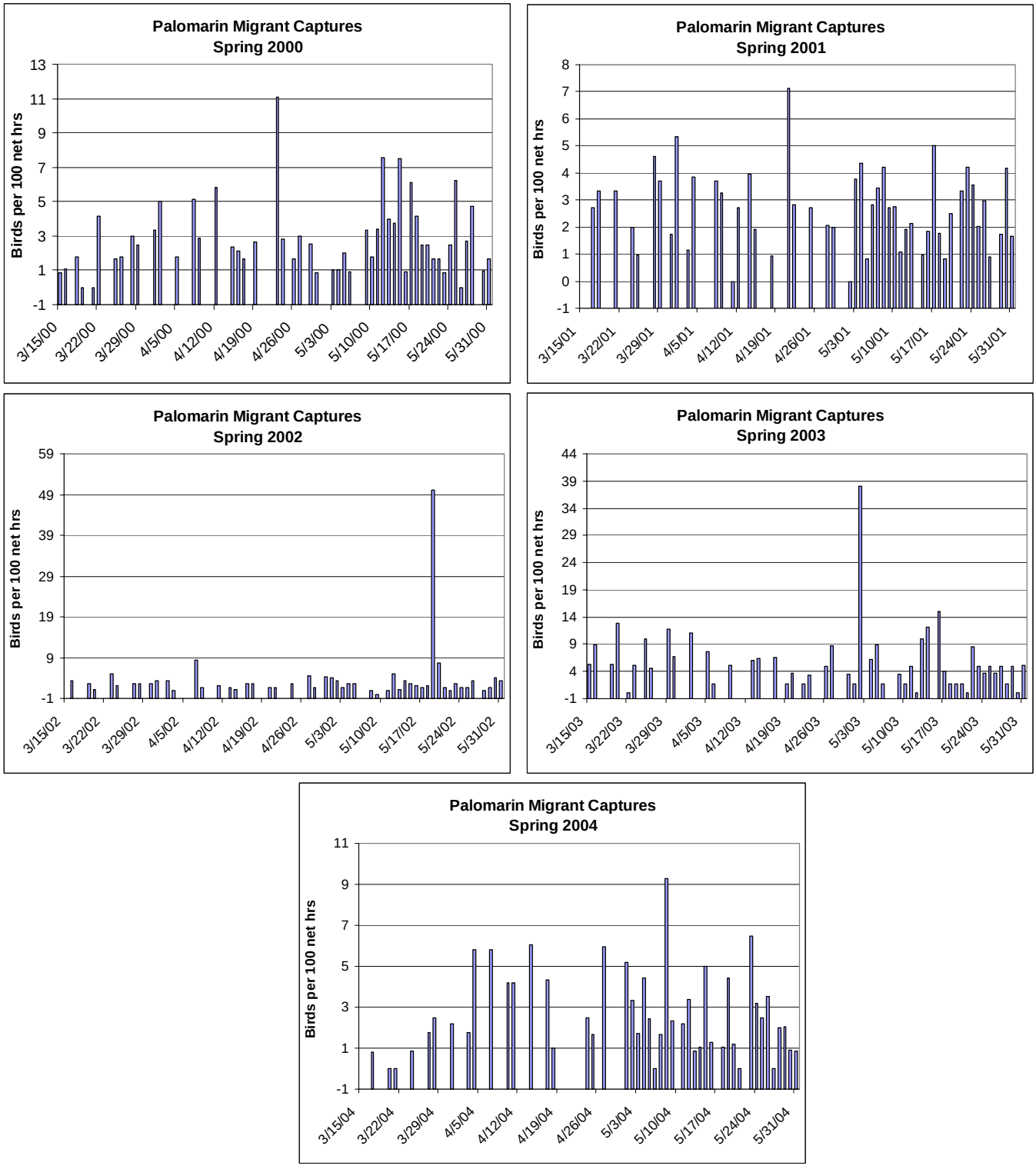
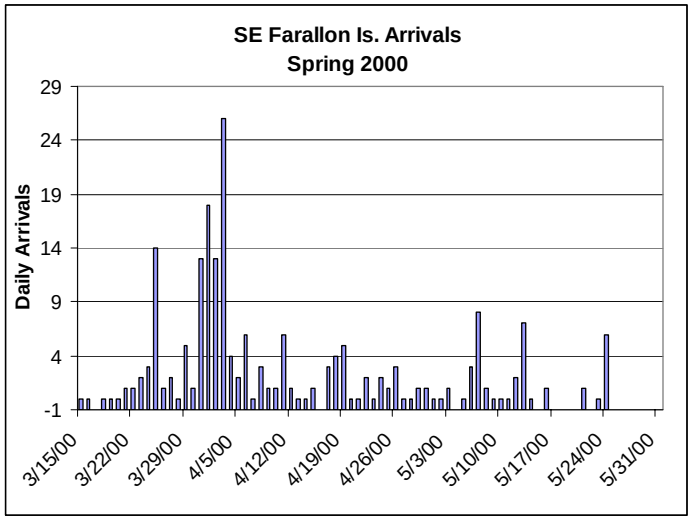
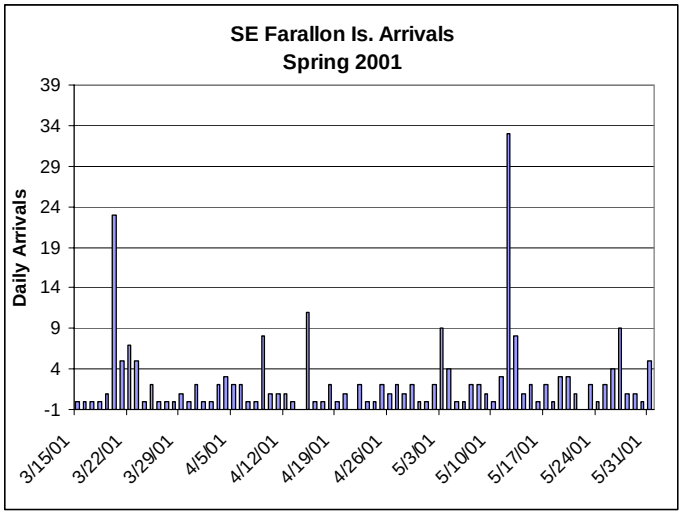
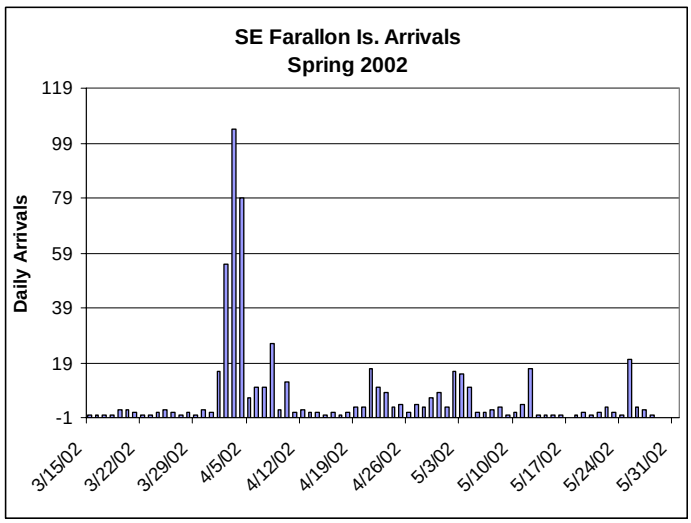
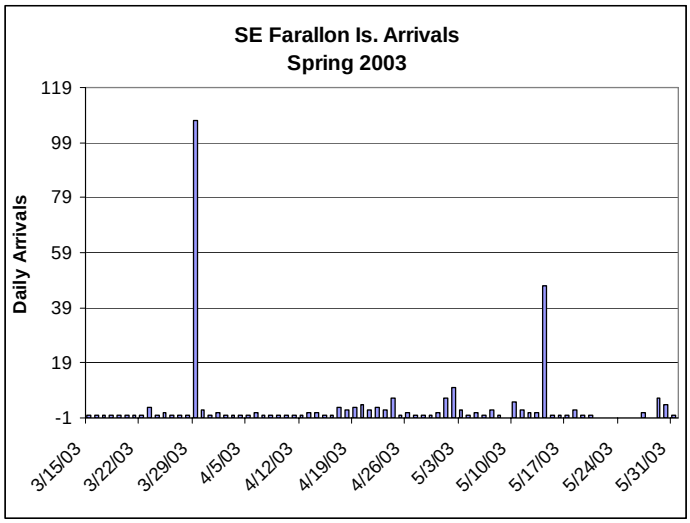


Figure 3. Landbird arrivals on the Southeast Farallon Island during spring (15 Mar. – 31 May), 2000-04. Note: Dates on which data were not collected are shown as "-1" (no bar showing).









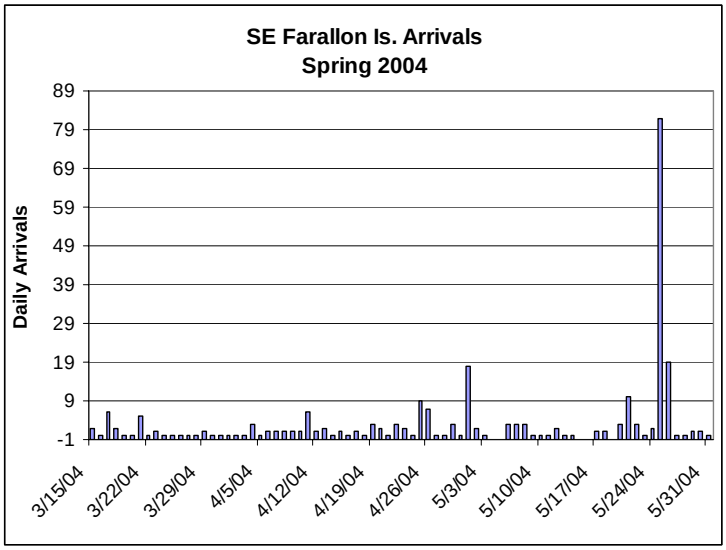


Figure 4. Palomarin banding station mist-net capture rates of migrants during fall (15 Aug. - 15. Nov), 2000-04. Note: Dates on which data were not collected are shown as "-1" (no bar showing).

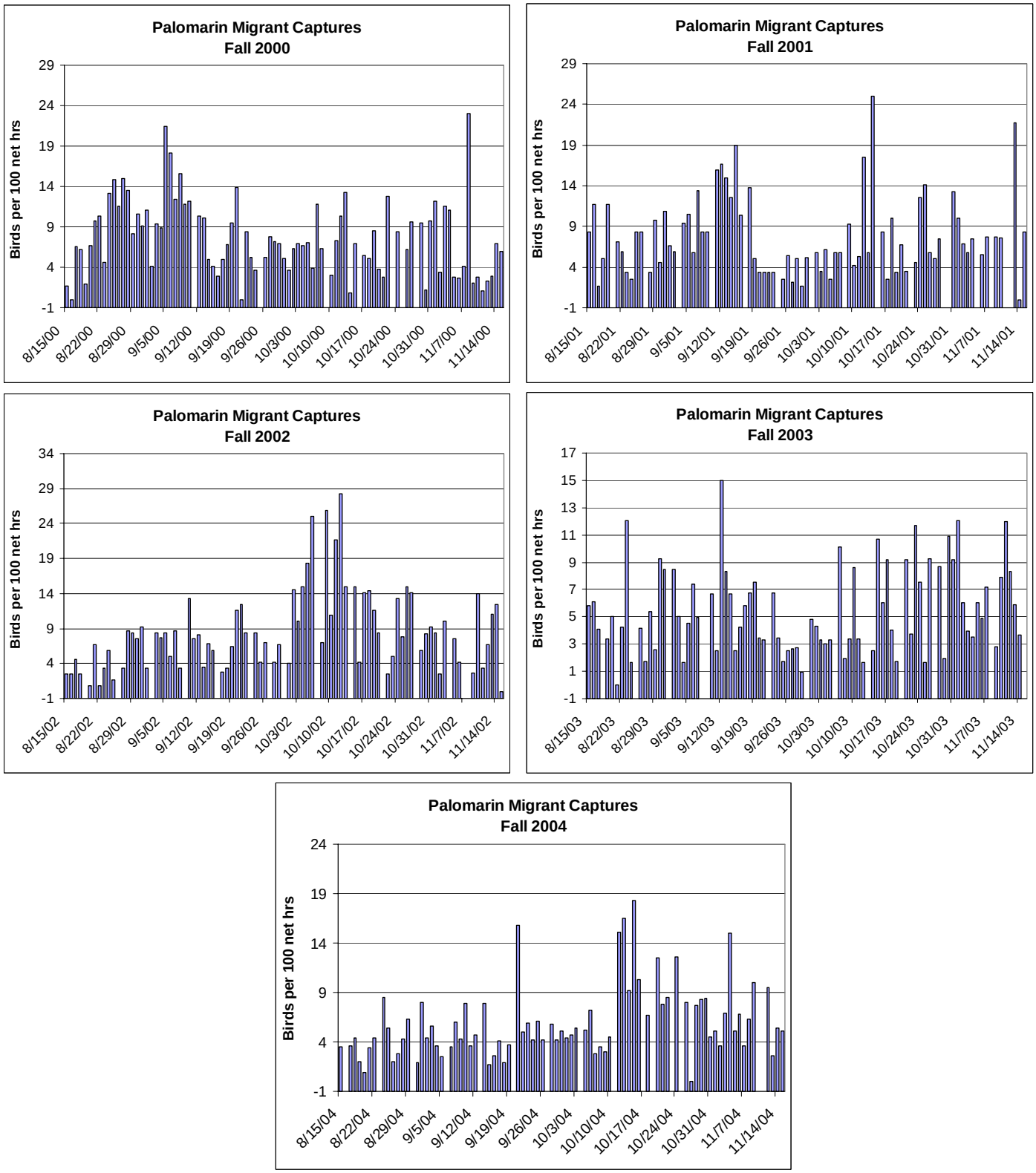
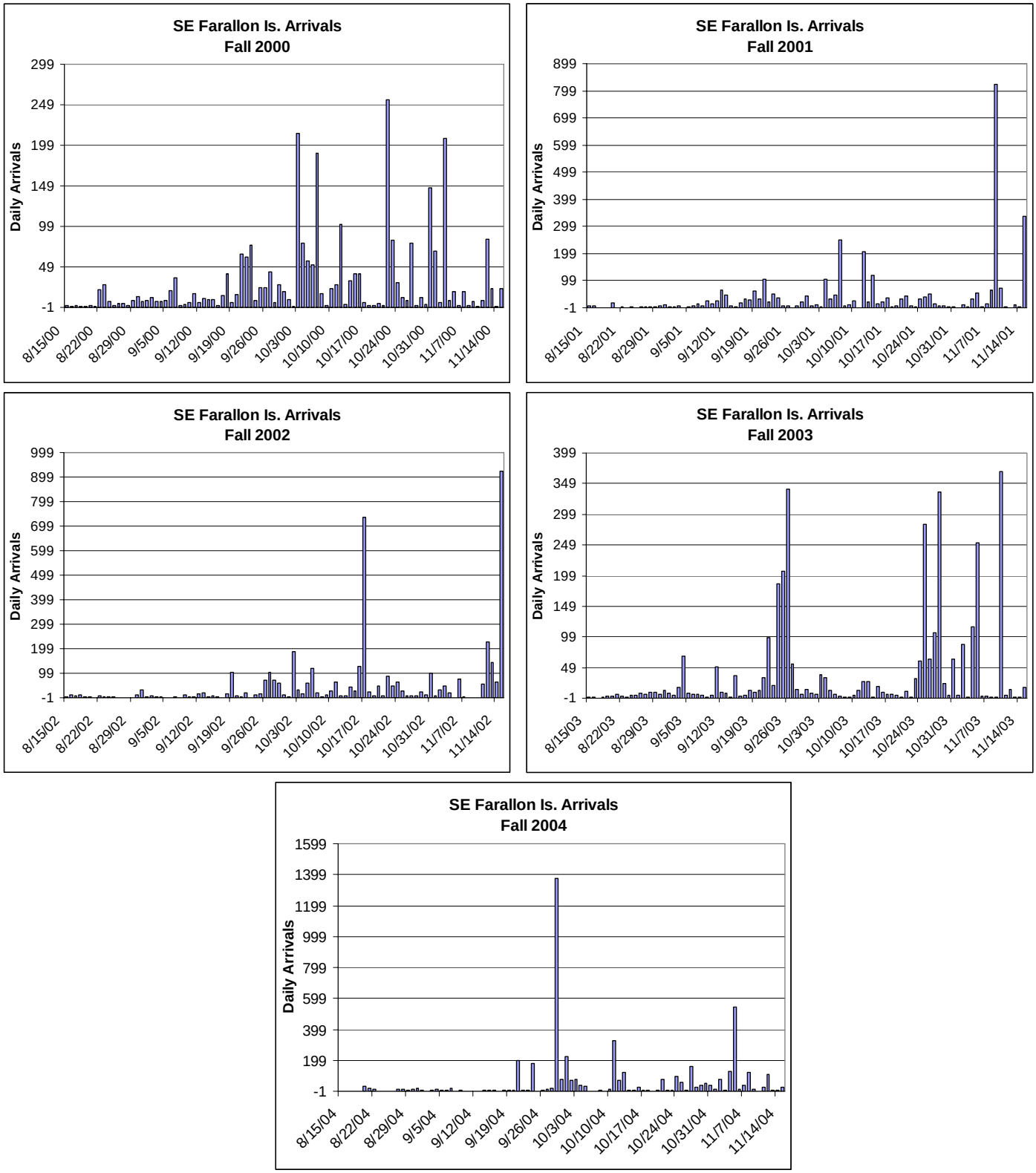


Figure 5. Landbird arrivals on the Southeast Farallon Island during fall (15 Aug. – 15 Nov), 2000-04. Note: Dates on which data were not collected are shown as "-1" (no bar showing).



Fall Temporal patterns: Mist-netting and Farallon census data

The fall temporal patterns of migration for the Palomarin field station and the SE Farallon Island are shown in Figures 4 and 5, respectively. Fall captures at Palomarin show somewhat of a bi-modal distribution for most years, where migration picks up steadily through September, drops in early October, then picks up again in mid to late October (Figure 4). Fall migration on the SE Farallon Island appears much more episodic, particularly from late September through mid November. The dates of peak migration throughout the Point Reyes area and the SE Farallon Island nearly span the range of the fall migration period (20 August – 15 November); however, roughly half of the peak dates occurred within October, which is slightly later than what the WSR-88D data indicated for the region.

Relationships between WSR-88D Doppler Radar and on-the-ground data

Results from the linear regression models between mist-netting stations, the SE Farallon Is, and their closest WSR-88D stations are shown in Appendices E – I. Out of the 22 crosswise tests, only two tests had p-values < 0.05 (Appendix E). The regressions between daily birds/km^3 from WSR-88D station KMUX and the daily capture rate (birds/100 net hours) from the Palomarin field station (PN) for both spring and fall were significant at the 0.05 level (Appendix E). However, considering the low R-square values (0.008 and 0.013), the apparent significance of this relationship appears spurious, and may be an artifact of the large sample size for Palomarin (n=250 in spring, 401 in fall, where n=number of capture days). Furthermore, the slopes of these regressions were negligible (indicated by relatively flat regression lines). The remaining 20 crosswise comparisons did not indicate any relationships between daily on-the-ground migration data and WSR-88D migration data.

We had similar results with the regression models using capture rates and radar densities aggregated into 10-day averages (Appendix J). The Palomarin mist-netting station (PN) showed a significant relationship for the spring ($p<0.005$), and the r-square was higher compared to the previous regression that used daily data (r-square of 0.193 vs. 0.008).

Fall capture rates (in 10-day averages) from the mist-netting station Muddy Hollow (MUHO) also appeared weakly correlated with radar data (Appendix J). It may be possible that aggregating the data into 10 day periods created better temporal alignment between the radar and mist netting data, however this did not increase the correlations in the remaining 10 crosswise comparisons. Regressions between the overall seasonal average capture rates and the seasonal migration densities from radar data did not produce any significant relationships (Appendix K).

DISCUSSION

The results of this study show that 1) WSR-88D Doppler weather radar can be used to detect and measure bird (and bat) migration in California over a wide geographic area and 2) that on-the-ground data collection is an important component to migration monitoring because it measures more precise bird population metrics, such as reproductive success, survivorship, and population trends at the species specific level (Ralph et al. 1993, Ballard et al. 2003).

Our examination of the 14 WSR-88D stations around California has shown that migration appears to be rather evenly distributed throughout the state, and there do not appear to be any distinct migratory "pathways". However, there may be less migration over the Great Basin desert, east of the Sierra Nevada mountains; the Nixon, NV radar station, KRXG, appeared to show the lowest migration densities (Appendices C and D).

The on-the-ground mist-netting data illustrated that the temporal patterns in migration can vary considerably within a relatively local area. For example, the 6 mist-netting stations that were within approximately 20 km of each other, each showed very different temporal patterns from each other.

We found essentially no direct correlation between the WSR-88D migration densities and our on-the-ground data from mist-netting and censuses. There are three hypotheses for why this was observed.

1) Doppler radar and mist netting may assess non-overlapping groups of species. Whereas mist-netting accounts mostly for small migratory songbirds, Doppler radar registers all biological targets aloft (after the insects are filtered out of the data, it registers all "flying vertebrates"). These include migratory songbirds, but also can include all other types of birds, such as waterfowl, shorebirds (N. Warnock, pers. com). Bats may also make up an appreciable amount of the biological targets captured by WSR-88D, and there is currently no method for sorting them out from the birds.
2) When a large number of nocturnal migrants are aloft and detected by Doppler radar, there may be fewer birds on the ground in the days that follow because of the preceding exodus. We did not, however, detect evidence of this effect with the data we examined.
3) The Doppler radar may be overshooting many of the migrants that are detected by on-the-ground methods. This may be particularly true for California, where many of the WSR-88D stations are located on the tops of mountains. Furthermore, the further away from the radar station, the higher the radar beam is. For example, the KMUX station, which was the nearest radar station for many of our mist-netting stations, is situated on a mountain over 3,000 ft above the surrounding landscape. Given the distance between our mist-netting stations and KMUX, the radar beam sweeping above our mist-netting sites would have been several thousand feet above the ground (see Gauthreaux and Besler 1998). This is potentially higher than most passerines migrate (Bellrose 1971, Cooper and Ritchie 1995, Millikin 2005).

Migration can be monitored through various methods, and each method has its applications and limitations. WSR-88D Doppler weather radar can provide information migration movement densities over a very wide geographic area, expressed as birds/km^3. This technology has been demonstrated to be useful for tracking long-range movements, determining direction of flight, and in some instances, for locating important roosting or stopover sites (Gauthreaux and Besler 1998; Russel and Gauthreaux 1999). An additional benefit of WSR-88D is that it is an automated and unobtrusive method for studying migration. The major limitation of WSR-88D is that it does not provide any

species specific information or information about individuals. Furthermore, the radar may overshoot birds migrating below the radar range (Gauthreaux and Belser 2003).

On-the-ground migration monitoring, such as mist-netting, provides much more precise information. On-the-ground censusing, such as area searches, can provide data on the relative number of a certain species at a given time and place. Long-term mist-netting and banding stations can also provide key demographic data, such as survivorship and productivity. This is particularly important for special status species. However, this on-the-ground method has limitations in that it is labor intensive and has a spatially narrow geographic scope. Furthermore, because these methods tend to be labor intensive, it is difficult to collect data continuously through spring and fall migration seasons.

RECOMMENDATIONS

Given the strengths and weaknesses of both automated monitoring technologies (e.g. WSR-88D) and on-the-ground monitoring methods (e.g. mist-netting and banding), a pragmatic approach to developing a migration monitoring program would be to integrate multiple methods, both automated and on-the-ground, through a combined approach.

Mist-netting/banding combined with area search methods would provide the most precise information at the site level. These intensive monitoring techniques are crucial for assessing and conserving targeted areas as migratory stopover sites.

However, these on-the-ground techniques fail to capture how birds use the airspace aloft, nor do they provide a broad-scale view of spatiotemporal migration patterns. As previously discussed, WSR-88D may be too broad of a tool for capturing birds aloft over a localized area, especially if the birds are flying below the WSR-88D radar beam. Other new automated monitoring technologies may play an important role here, such as combined marine radar and acoustic protocols that detect birds at lower elevations; these include BirdCast® and Expanding hemispheres™ (Millikin 2005). These technologies have been successfully used to conduct site impact assessments for towers and wind

turbines (Harmata 1999, Millikin 2005). These approaches are particularly useful for conservation purposes as they can be used to indentify birds to species based on vocalizations. These approaches, combined with on-the-ground survey methods, can be used to identify important stopover sites of special status species, an important conservation objective that will aid in species recovery (Ruth et al. 2005).

CONCLUSIONS

While WSR-88D Doppler radar and standardized on the ground data collection (primarily mist nets) yield interesting and important results, the correspondence between the two methods was relatively weak. To enhance our knowledge of migration in California and identify important stopover sites for conservation, we need to increase both on-the-ground data collection and the use of radar technology that detects and identify birds at lower elevations. An intensified and coordinated effort of relatively low-tech bird counts, such as eBird, coupled with an automated and portable acoustic-marine radar system targeted at key sites would provide the information necessary to identity important landscape features and sites that concentrate migrants. These sites may then be targeted for restoration, protection and management, which will be crucial steps in the conservation and recovery of California's and the new world's unique avifauna.

ACKNOWLEDGMENTS

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LITURATURE CITED

Allan, J.R. 2000. The costs of bird strikes and bird strike prevention. *In* Clark, L., Hone, J., Shivik, J.A., Watkins, R.A., Vercauteren, K.C., and Yoder, J.K., eds., Human conflicts with wildlife – economic considerations: Proceedings of the Third NWRC Special Symposium, Fort Collins, Colorado, USDA National Wildlife Research Center. 147-153.

Ballard, G., G.R. Geupel, N. Nur, and T. Gardalli. 2003. Long-term declines and decadal patterns in populations of songbirds in western North America, 1979-1999. Condor 105: 737-755

Bellrose, F.C. 1971. The Distribution of Nocturnal Migrants in the air space. The Auk. 88: 387-424.

Berthold, P. 1993. Bird Migration: a general survey. Oxford University Press. Oxford. 239 pages.

Cooper, B.A. 1995. The altitude of bird migration in east-central Alaska – a radar and visual study. Journal of Field Ornithology. 66: 590-608

Diehl, R.H., and Larkin, R.P., 2005. Introduction to the WSR-88D (NEXRAD) for ornithological research. *In* Ralph, C.J. and Rich, T.D., eds. Bird conservation implementation and integration in Americas. Proceedings of the Third International Partners in Flight Conference, V 2. Albany, California. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-191. 876-888.

Gauthreaux, Jr., S.A. 1971. A radar and direct visual study of passerine spring migration in southern Louisiana. The Auk. 88:343-365

Gauthreaux, Jr., S.A. 1992. The use of weather radar to monitor long-term patterns of trans-gulf migration in spring. *In* Hagan, J.M. and Johnston, D.W., eds. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press. Washington D.C. 96-100

Gauthreaux, Jr., S.A., and Belser, C.G. 1998. Displays of bird movements on the WSR-88D- patterns and quantification: Weather and Forecasting. 13:453-464

Gauthreaux, Jr., S.A., Belser, C.G. 2003a. Bird movements on Doppler weather surveillance radar: Birding. 35:616-628

Gauthreaux, Jr., S.A., Belser, C.G. 2003b. Overview- Radar ornithology and biological conservation. The Auk. 120:266-277

Harmata, A.R., Prodruzny, K.M., Zelenak, J.R., and Morrison, M.L. 1999. Using marine surveillance radar to study bird movements and impact assessment. The Wildlife Society Bulletin. 27:44-52

Humple, D. L. , N. Nur, G. R. Geupel, and M. P. Lynes. 2001. Female-biased sex ratio in a wintering population of Ruby-crowned Kinglets. Wilson Bulletin 113(4):419-424.

Humple, D. L. and G. R. Geupel. 2002. Autumn populations of birds in riparian habitat of California's Central Valley. Western Birds 33:34-50.

Hutto, R.L. 1998. On the importance of stopover sites to migrating birds. The Auk. 115(4): 823-825

Lowery, Jr., G.H., and Newman, R.J. 1966. A continent-wide view of bird migration on four nights in October. The Auk. 83:547-586

Manville III, A.M. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines- state of the art and state of the science, next steps toward mitigation. *In* Ralph, C.J. and Rich, T.D., eds. Bird conservation implementation and integration in Americas. Proceedings of the Third International Partners in Flight Conference, V 2. Albany, California. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-191. 876-888.

Millikin, R. L. 2005. Migration Monitoring with Automated Technology. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/860-870.pdf

Newton, I. 1998. Population Limitation in Birds. Academic Press. New York, NY. Pp. 287-317.

Nisbet, I.C.T. 1959. Calculation of flight directions of birds observed crossing the face of the moon. The Wilson Bulletin. 71(3)237-243

Pyle, P., N. Nur, R.P. Henderson, and D.F. DeSante. 1993. The effects of weather and lunar cycle on nocturnal migration of landbirds at Southeast Farallon Island, California. The Condor. 95: 343-361

Ralph, C.J. 1981. Age ratios and their possible determining autumn routes of passerine migrants. Wilson Bulletin. 93(2): 164-188.

Ralph, C. John; Geupel, Geoffrey R.; Pyle, Peter; Martin, Thomas E.; DeSante, David F. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144-www. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 41 p.

Richardson, T.W., P. Pyle, R. Burnett, and P. Capitolo. 2003. The occurrence and seasonal distribution of migratory birds on Southeast Farallon Island, 1968-1999. Western Birds. 34(2): 58-96.

Russel, K.R., and Gauthreaux, Jr., S.A. 1998. Use of weather radar to characterize movements of roosting purple martins. Wildlife Society Bulletin. 26:5-16

Ruth, J.M., editor. 2007. Applying radar technology to migratory bird conservation and management: strengthening and expanding a collaborative. Fort Collins, Colorado. U.S. Geological Survey, Biological Resources Discipline, Open-File Report 2007-1361.

Ruth, J.M., Barrow, W.C., Sojda, R.S., Dawson, D.K., Diehl, R.H., Manville, A., Green, M.T., Kreuper, D.J., and Johston, S. 2005. Advancing migratory bird conservation and management by using radar: an interagency collaboration. Fort Collins, Colorado. U.S. Geological Survey, Fort Collins Science Center. *http://www.fort.usgs.gov/products/publications/21469/21469.pdf*

Taylor, D. M. D. F. DeSante, G. R. Geupel, and K. Houghton 1993. Autumn populations of landbirds along central coastal California: 1976-1986. Journal of Field Ornithology. 65:169-185.

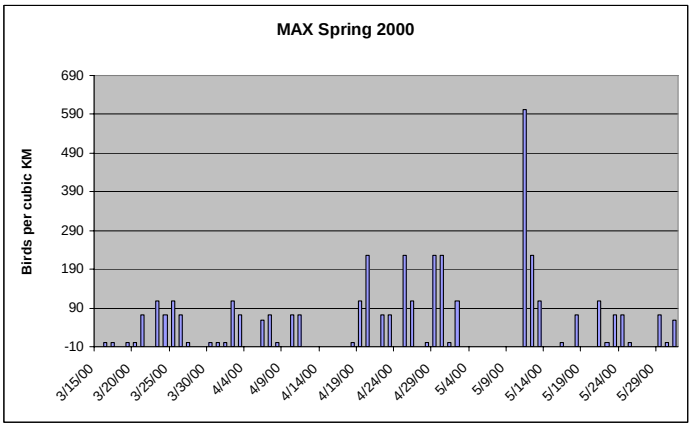
Appendix A: Banding and other monitoring stations included in this study with the number of days data were collected for spring (15 Mar - 31 May) and fall (15 Aug – 15 Nov), 2000-04; there were 78 days in the spring period, and 93 days in the fall period. PN (Palomarin; a banding station) and SEFI (Southeast Farallon Island; a site where daily estimated totals were tallied from observations) had the most contiguous data sets. Stations that were used in the analysis with WSR-88D data are in bold.

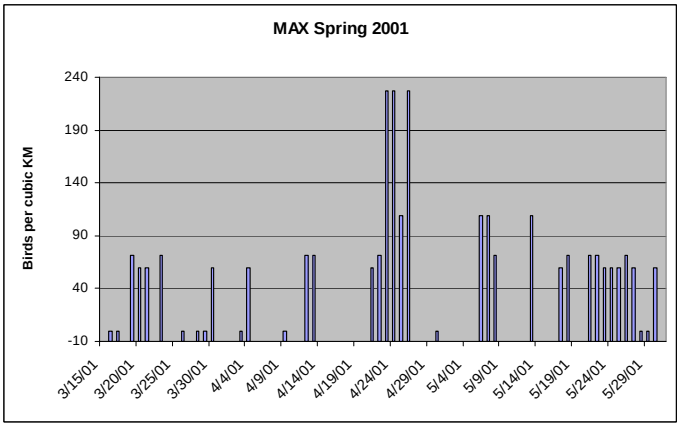
Station Code	**Region**	**Nearest town**	2000		2001		2002		2003		2004	
			spring	fall	spring	fall	spring	fall	spring	fall	spring	fall
BAIR	Eastern Sierra	Independence, CA	3	0	0	0	0	0	0	0	0	0
DEPO	Eastern Sierra	Mammoth Lakes, CA	0	0	0	0	1	0	1	0	2	0
INDE	Eastern Sierra	Independence, CA	4	0	0	0	0	0	0	0	0	0
LEEV	Eastern Sierra	Lee Vining, CA	3	0	3	0	3	0	3	0	3	0
MILL	Eastern Sierra	Mono City, CA	3	1	3	0	3	0	3	0	3	0
RUSH	Eastern Sierra	Lee Vining, CA	2	1	3	0	3	0	3	0	3	0
TABO	Eastern Sierra	Independence, CA	3	0	0	0	0	0	0	0	0	0
TUTT	Eastern Sierra	Lone Pine, CA	3	0	0	0	0	0	0	0	0	0
WILS	Eastern Sierra	Mono City, CA	3	0	3	0	3	0	3	0	3	0
GUCR	Lassen	Mineral, CA	2	0	2	0	2	0	2	0	2	0
TAFO	S. Sacramento Valley	Galt, CA	0	0	0	0	3	0	0	0	3	0
WELE	S. Sacramento Valley	Galt, CA	0	0	3	0	3	0	3	0	3	0
NAKA	S. Sacramento Valley	Stockton, CA	0	0	0	0	0	0	0	22	3	14
WOOD	S. Sacramento Valley	Stockton, CA	0	0	0	0	0	0	0	17	3	22
PRAR	Sacramento Valley	Redding, CA	3	0	3	0	3	0	3	0	3	0
SADA	Sacramento Valley	Redding, CA	4	0	3	0	3	0	3	0	3	0
OHM	Sacramento Valley	Gerber, CA	3	18	0	0	0	0	0	0	0	0
STCR	Sacramento Valley	Hamilton City, CA	3	17	3	0	3	0	3	0	3	3
SUNO	Sacramento Valley	Gerber, CA	3	0	3	0	3	0	3	0	0	0
LBWA	San Joaquin Valley	Los Banos, CA	7	3	6	0	2	0	5	0	1	0
OFWA	San Joaquin Valley	Los Banos, CA	6	8	6	0	3	0	4	5	2	0
LOLI	San Joaquin Valley	Friant, CA	0	0	0	0	0	0	0	19	3	23
WUNI	San Joaquin Valley	Friant, CA	0	0	0	0	0	0	0	19	4	24
SEFI	Southeast Farallon Islands	San Francisco, CA	62	93	75	93	74	93	70	92	73	93
LACR	West Marin County	Olema, CA	0	0	0	10	3	11	4	10	3	11
MUHO	West Marin County	Olema, CA	7	13	13	12	9	14	9	12	8	14
PGUP	West Marin County	Bolinas, CA	7	14	8	12	7	13	8	13	9	12
PIGU	West Marin County	Bolinas, CA	7	12	10	13	8	13	8	13	8	12
PN	West Marin County	Bolinas, CA	52	86	50	78	51	79	51	80	46	78
RECR	West Marin County	Muir Beach, CA	0	0	0	11	4	10	4	11	4	12

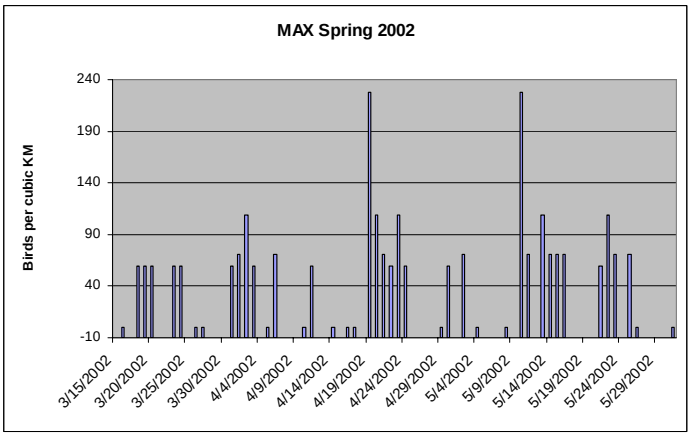
Appendix B. Name and locations of banding and other monitoring stations in relation to nearest WSR-88D Doppler weather radar station. Stations that were used in the analysis with WSR-88D data are in bold.

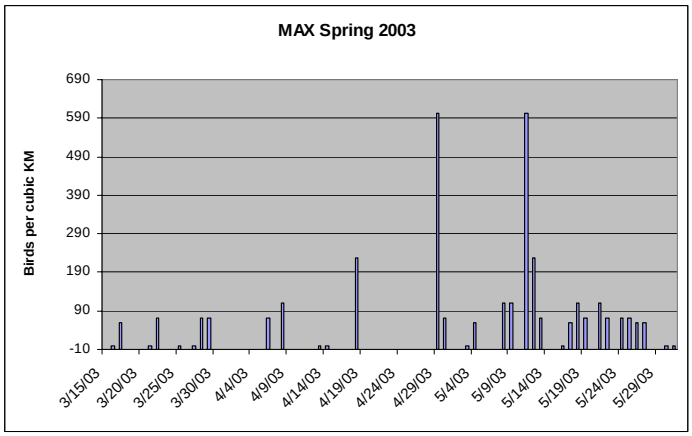
Station	Region	Nearest town	X_COORD	Y_COORD	Nearest WSR-88D	Distance to nearest WSR-88D (Km)
BAIR	Eastern Sierra	Independence, CA	-118.301	36.73357	KHNX	126
DEPO	Eastern Sierra	Mammoth Lakes, CA	-119.119	37.64658	KHNX	158
INDE	Eastern Sierra	Independence, CA	-118.358	36.83359	KHNX	129
LEEV	Eastern Sierra	Lee Vining, CA	-119.146	37.97342	KHNX	193
MILL	Eastern Sierra	Mono City, CA	-119.16	38.01665	KHNX	198
RUSH	Eastern Sierra	Lee Vining, CA	-119.1	37.94786	KHNX	192
TABO	Eastern Sierra	Independence, CA	-118.346	37.04487	KHNX	138
TUTT	Eastern Sierra	Lone Pine, CA	-118.24	36.61511	KHNX	126
WILS	Eastern Sierra	Mono City, CA	-119.178	38.05519	KHNX	201
GUCR	Lassen	Mineral, CA	-121.434	40.31012	KBBX	95
TAFO	S. Sacramento Valley	Galt, CA	-121.404	38.25519	KDAX	35
WELE	S. Sacramento Valley	Galt, CA	-121.394	38.26707	KDAX	35
NAKA	S. Sacramento Valley	Stockton, CA	-121.217	38.15528	KDAX	55
WOOD	S. Sacramento Valley	Stockton, CA	-121.315	38.16121	KDAX	48
PRAR	Sacramento Valley	Redding, CA	-122.403	40.50409	KBBX	135
SADA	Sacramento Valley	Redding, CA	-122.479	40.49365	KBBX	137
OHM	Sacramento Valley	Gerber, CA	-122.046	39.96285	KBBX	66
STCR	Sacramento Valley	Hamilton City, CA	-121.907	39.58984	KBBX	27
SUNO	Sacramento Valley	Gerber, CA	-121.922	39.38547	KBBX	29
LOLI	San Joaquin Valley	Friant, CA	-119.73	37.02967	KHNX	82
WUNI	San Joaquin Valley	Friant, CA	-119.753	36.93384	KHNX	72
LBWA	San Joaquin Valley	Los Banos, CA	-120.667	37	KMUX	105
OFWA	San Joaquin Valley	Los Banos, CA	-121	37	KMUX	77
LACR	West Marin County	Olema, CA	-122.771	38.06039	KMUX	129
MUHO	West Marin County	Olema, CA	-122.87	38.04853	KMUX	132
PGUP	West Marin County	Bolinas, CA	-122.742	37.9319	KMUX	114
PIGU	West Marin County	Bolinas, CA	-122.69	37.91917	KMUX	111
PN	West Marin County	Bolinas, CA	-122.74	37.93066	KMUX	114
RECR	West Marin County	Muir Beach, CA	-122.58	37.86721	KMUX	100
SEFI	Southeast Farallon Islands	San Francisco, CA	-123.002	37.69722	KMUX	114

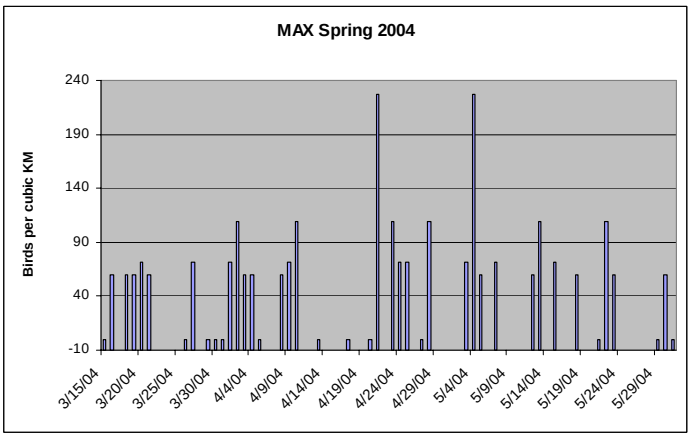
Appendix C-1. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Medford, Oregon (KMAX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





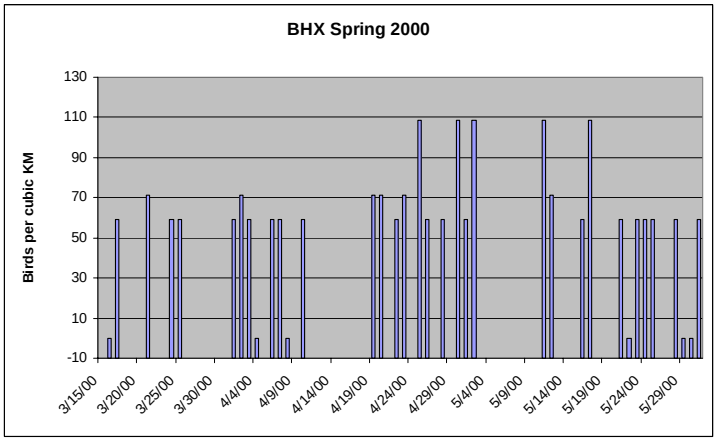


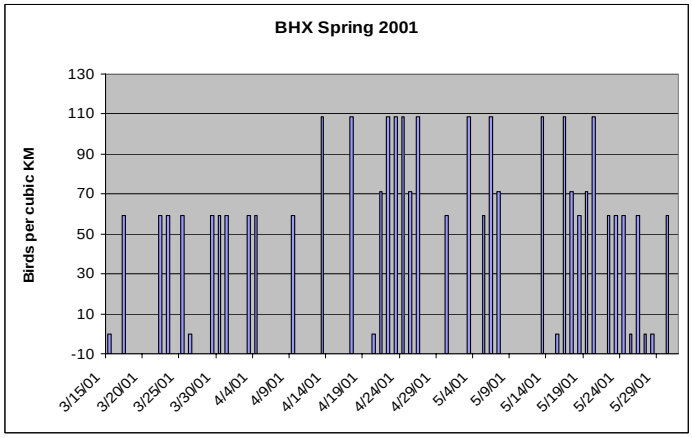


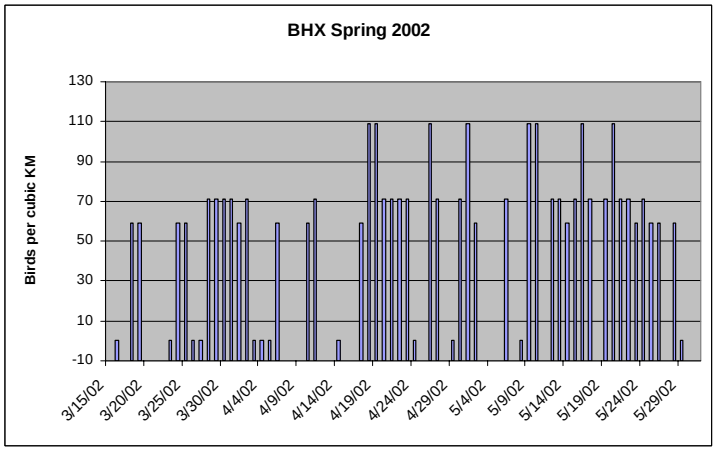


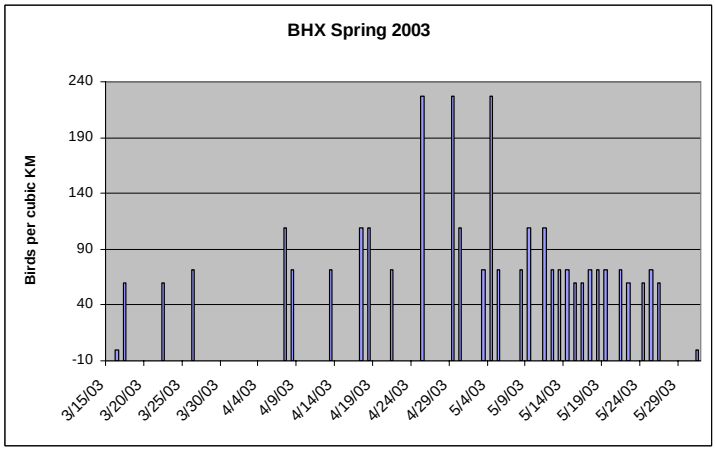
Medford, OR

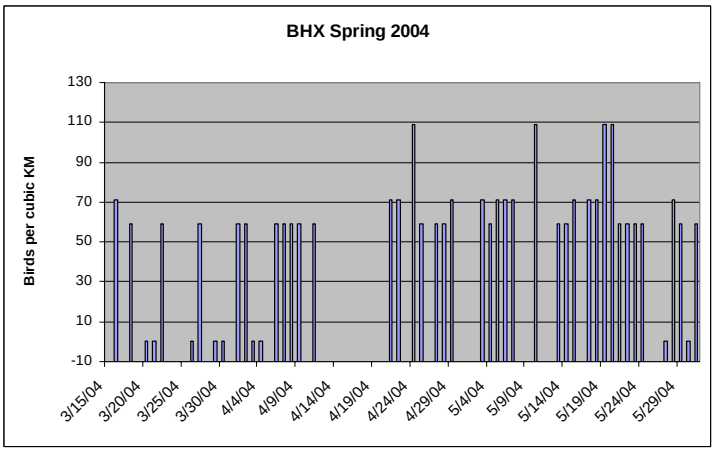
Appendix C-2. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Eureka, California (KBHX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





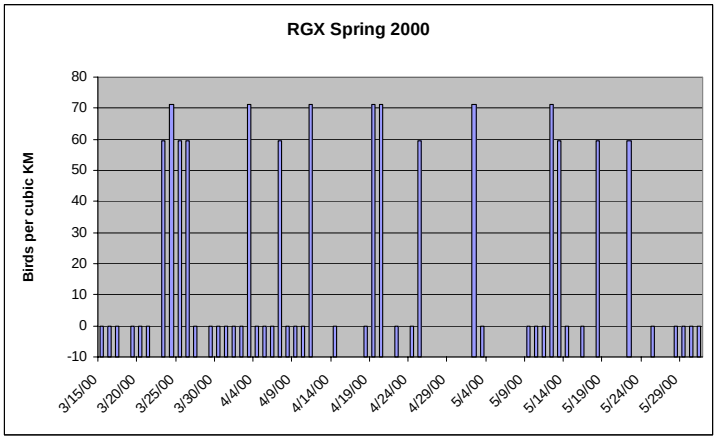


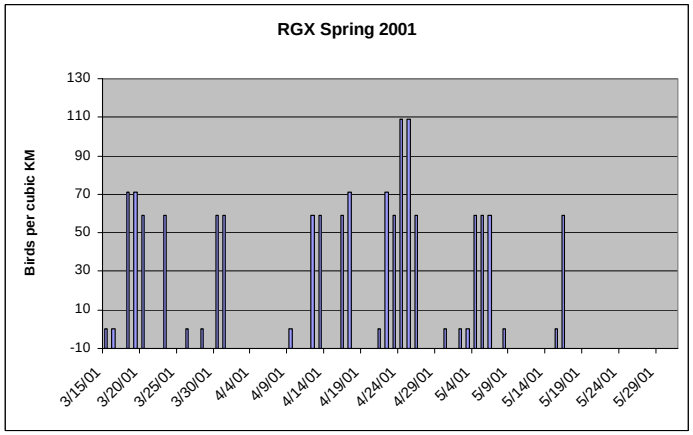


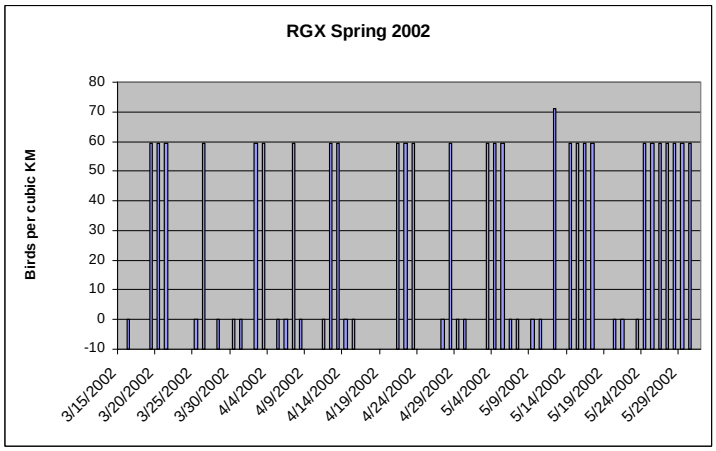


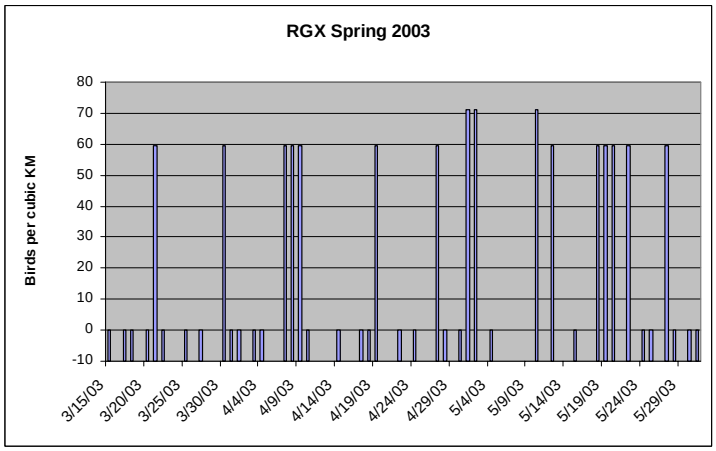
Eureka, CA (North Coast)

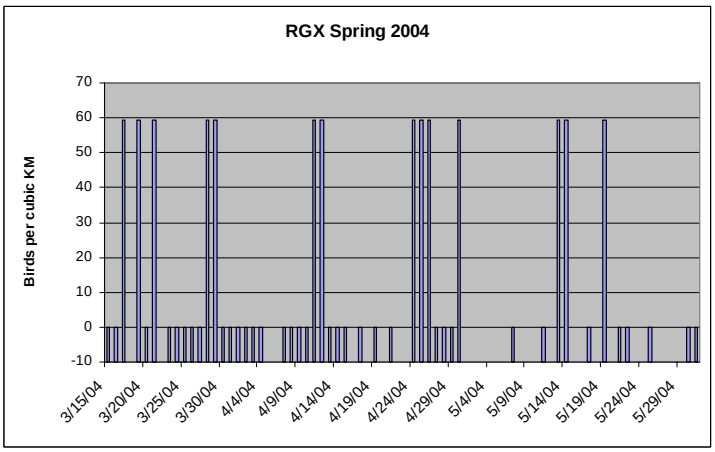
Appendix C-3 Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Nixon, Nevada (KRGX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





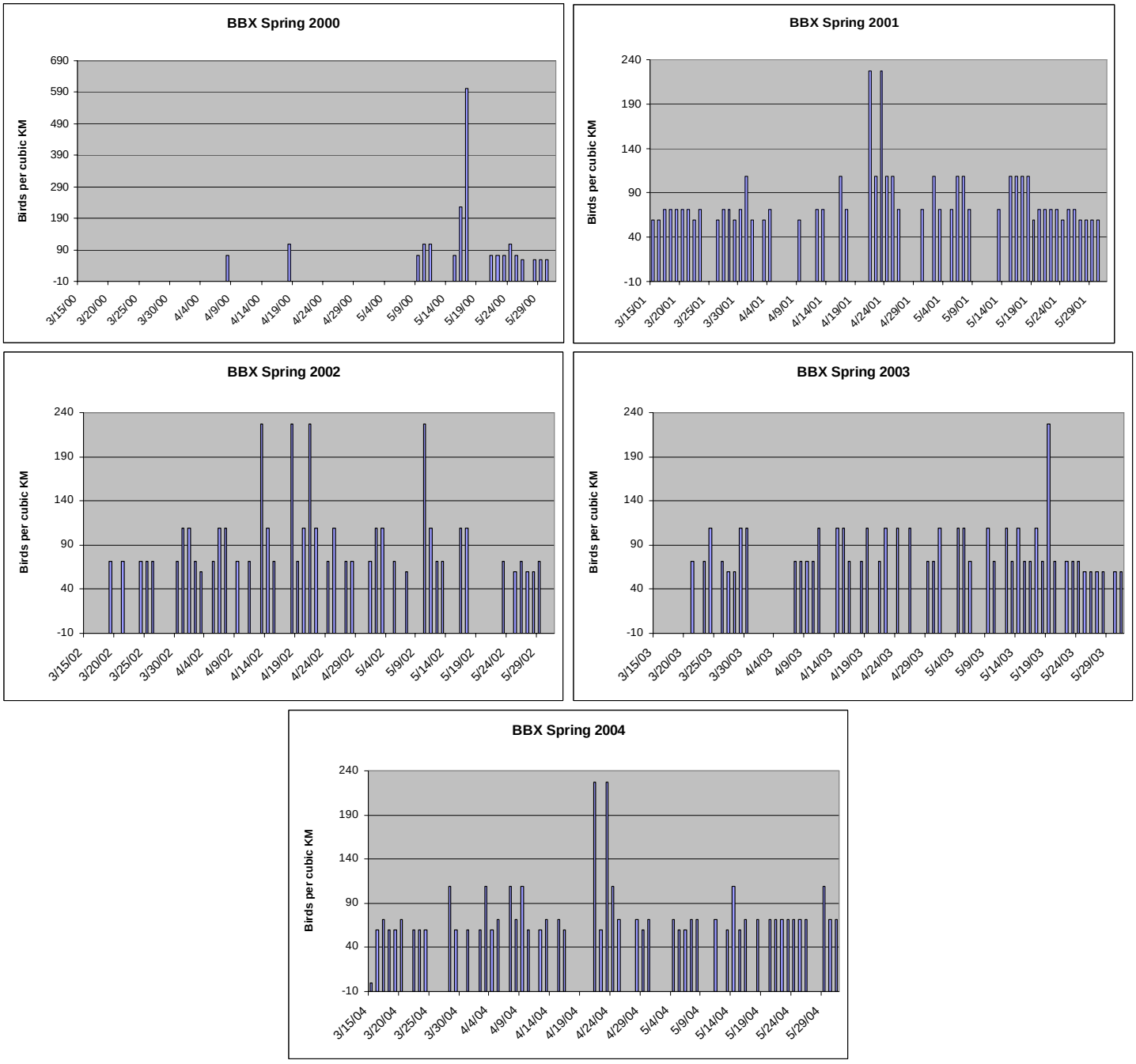






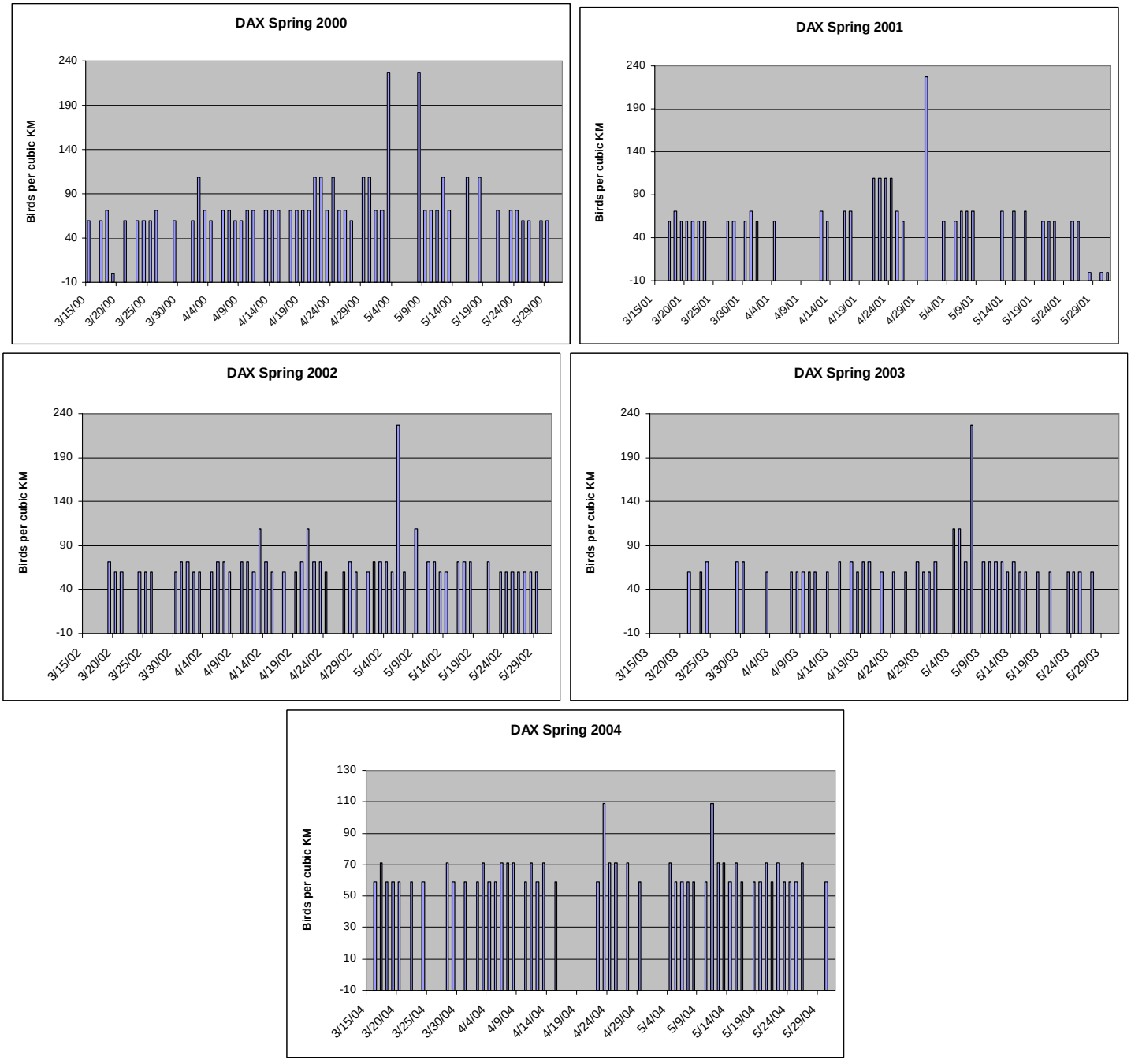
Nixon, Nevada (NE Nevada)

Appendix C-4. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Sacramento, California (KBBX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



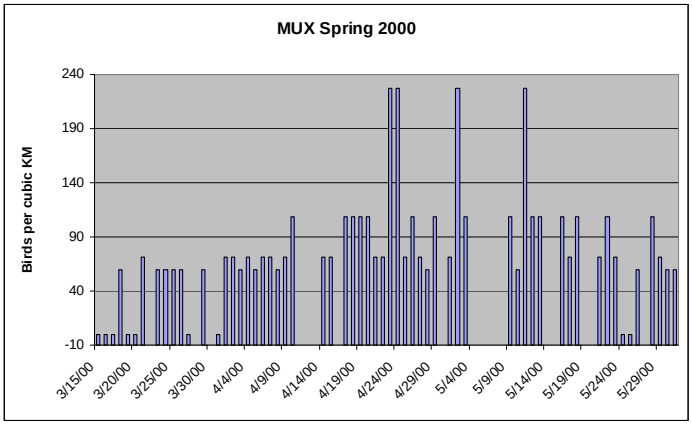
Sacramento, CA (Sacramento Valley)

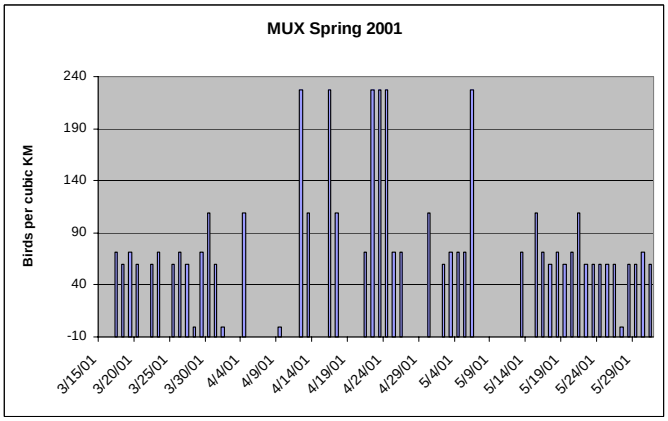
Appendix C-5. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Davis, California (KDAX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).

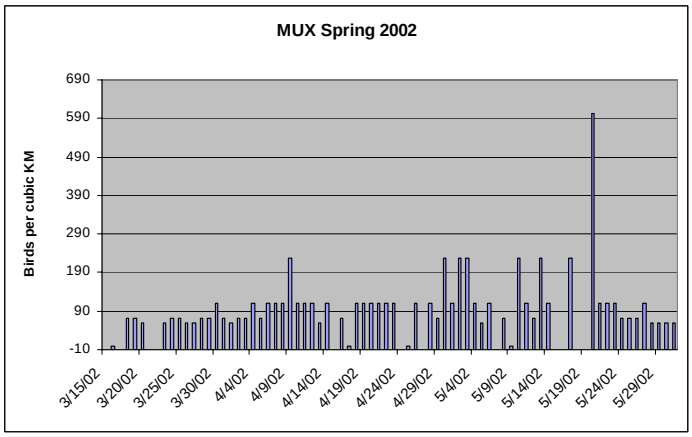


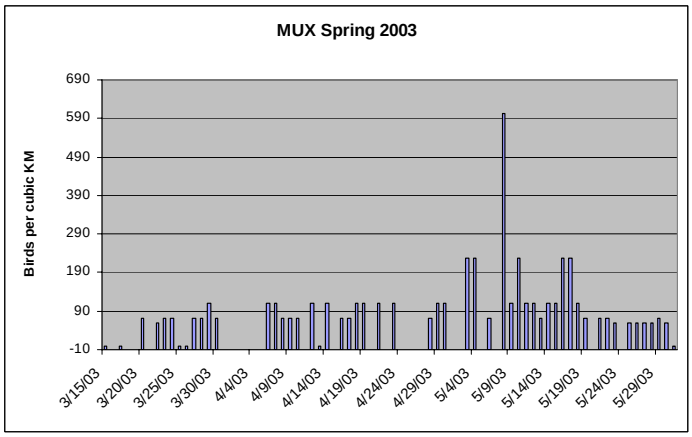
Davis, CA (S. Sacramento Valley)

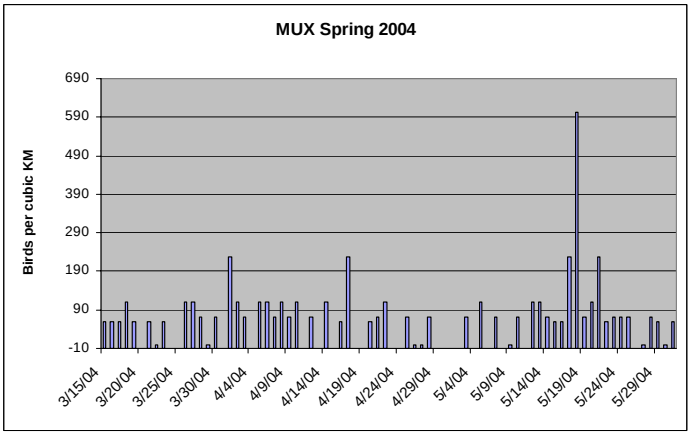
Appendix C-6. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Los Gatos, California (KMUX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





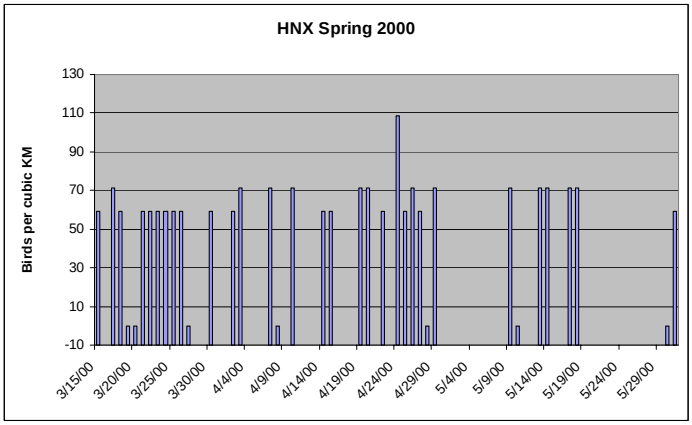


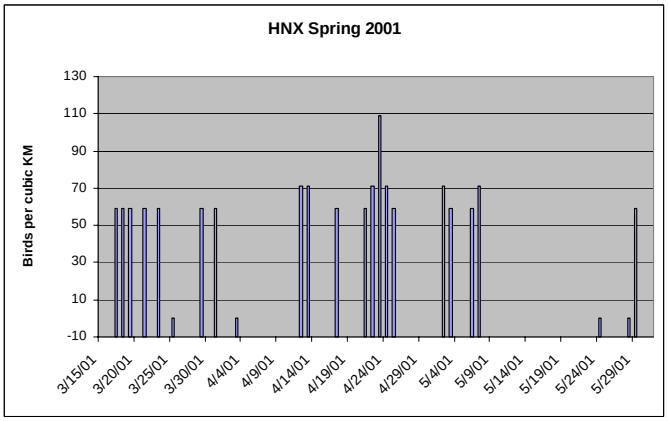


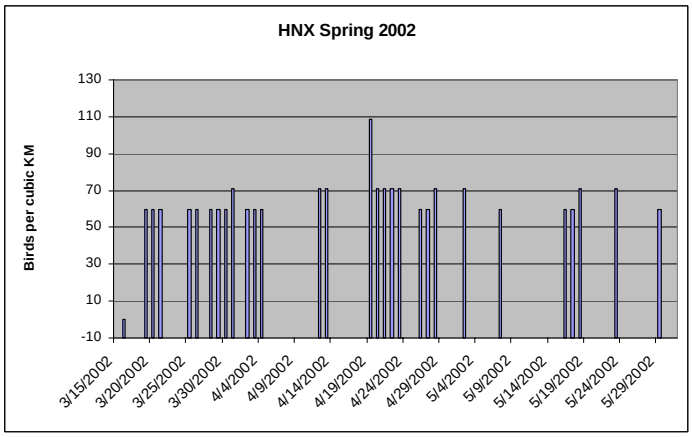


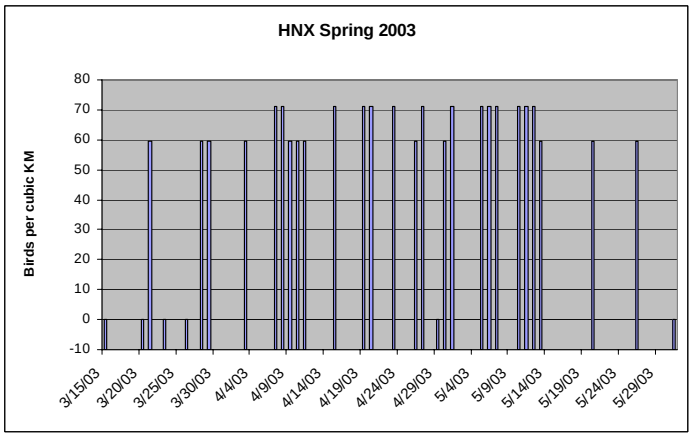
Los Gatos, CA (Central Coast)

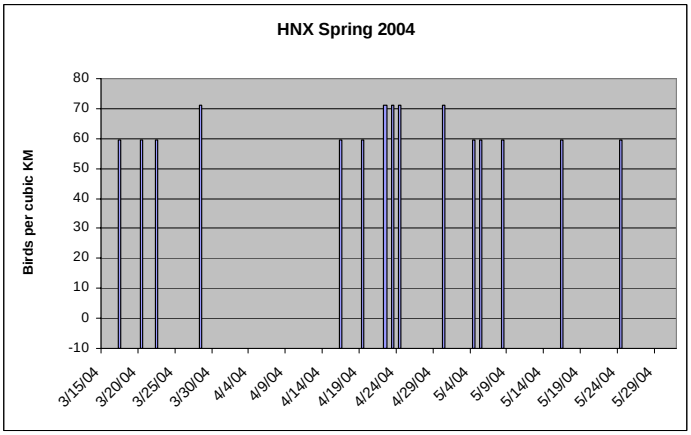
Appendix C-7. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Hanford, California (KHNX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





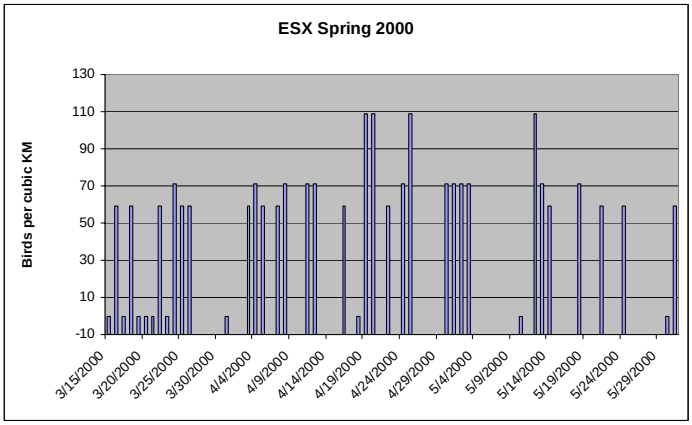


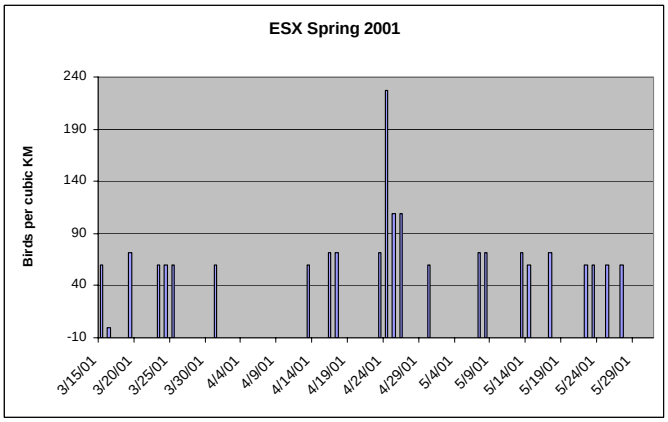


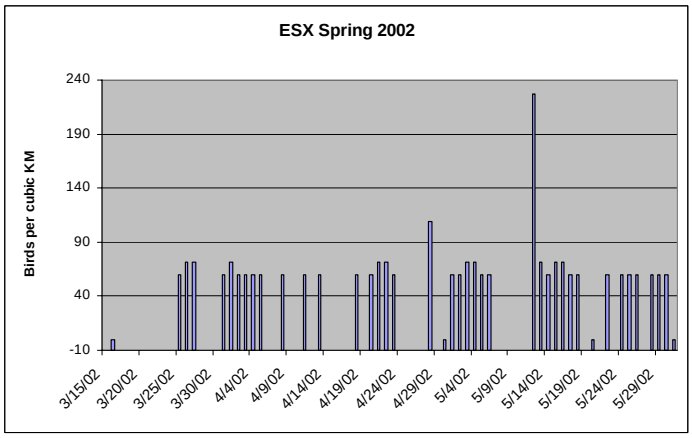


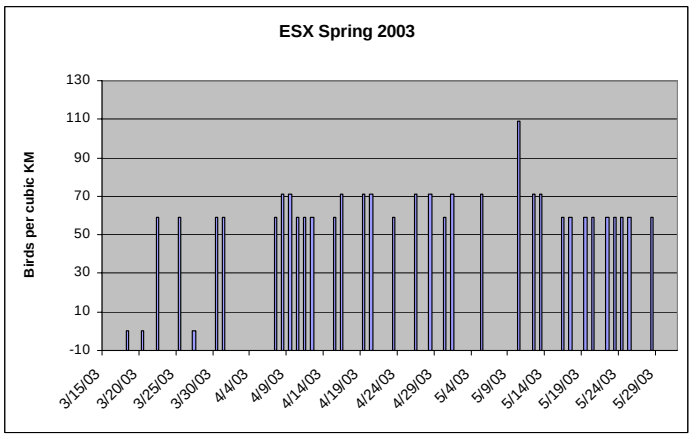
Hanford, CA (Southern San Joaquin Valley)

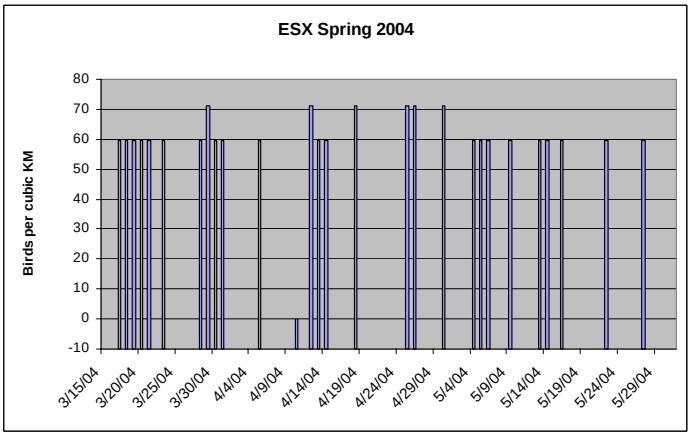
Appendix C-8. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Las Vegas, Nevada (KESX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





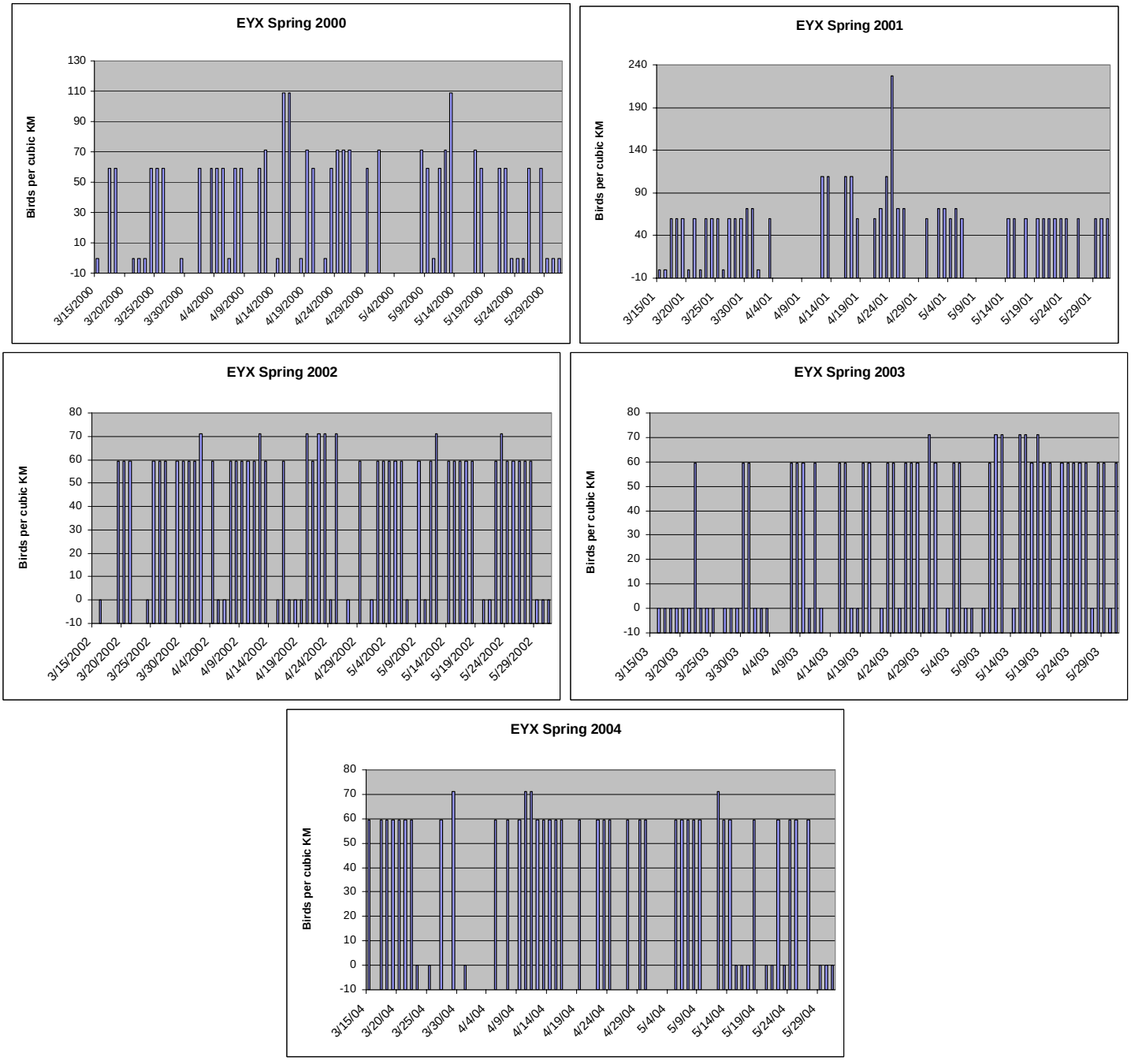






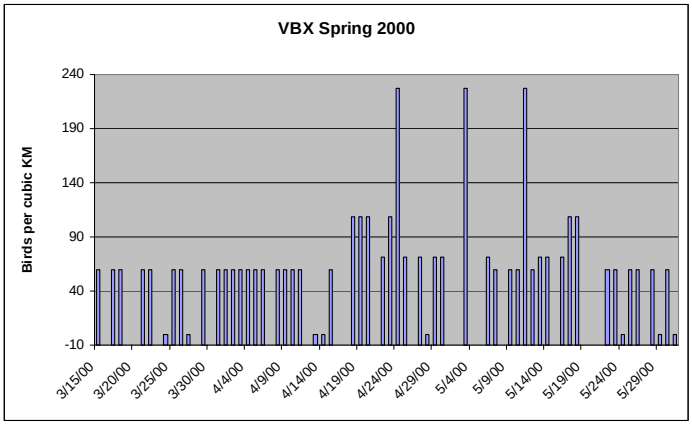
Las Vegas, NV (SE Nevada)

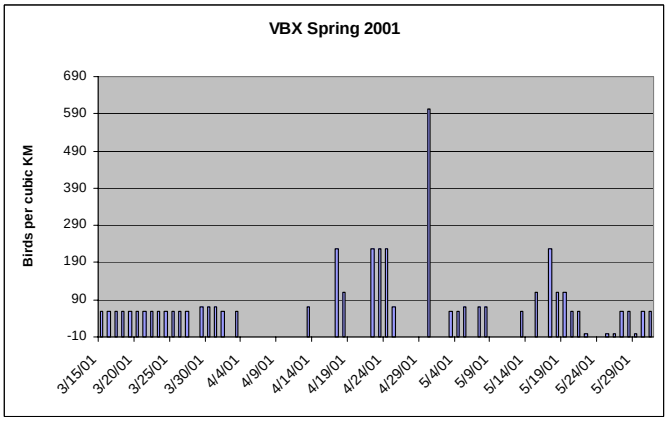
Appendix C-9. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Edwards AFB, California (KEYX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).

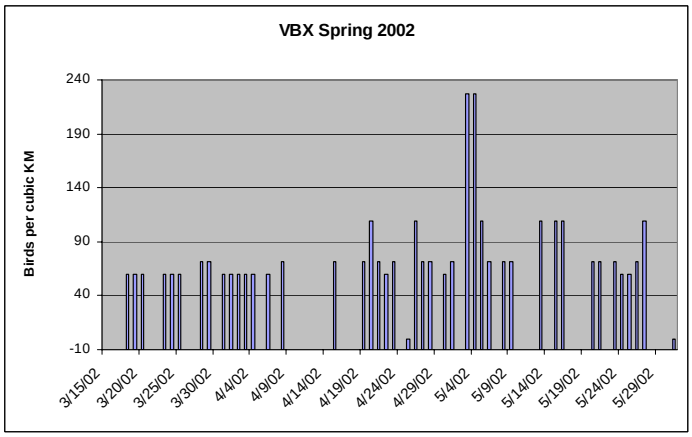


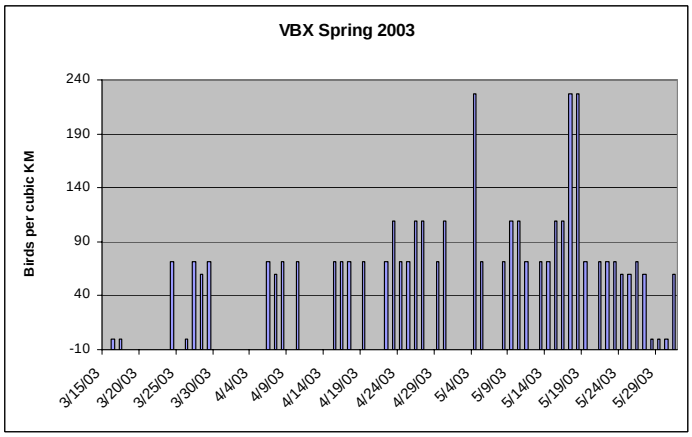
Edwards AFB (Southern CA interior)

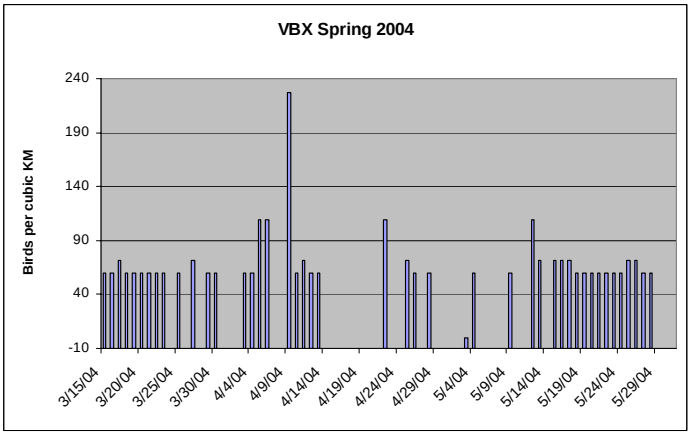
Appendix C-10. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Orcutt, California (KVBX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





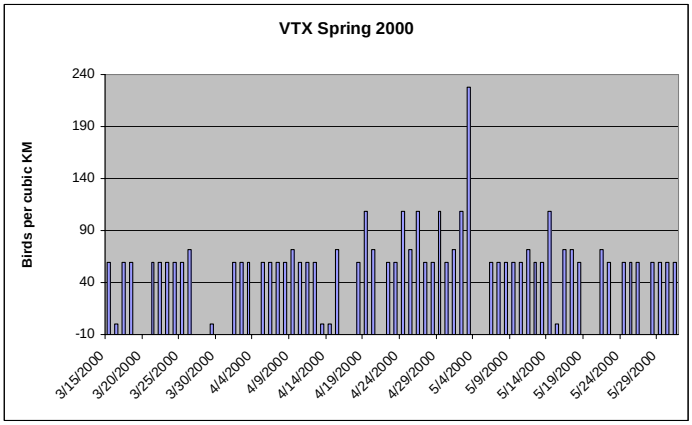


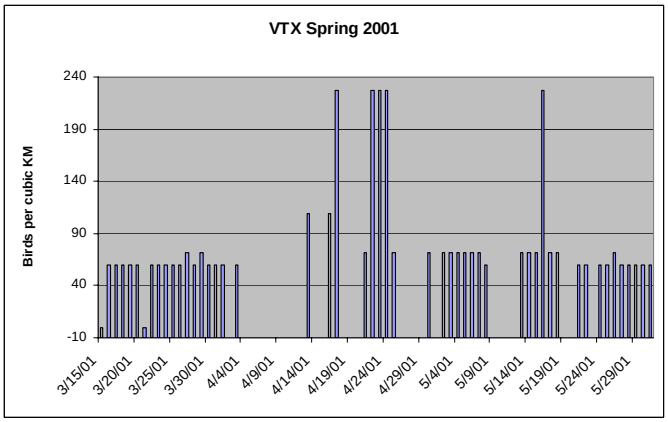


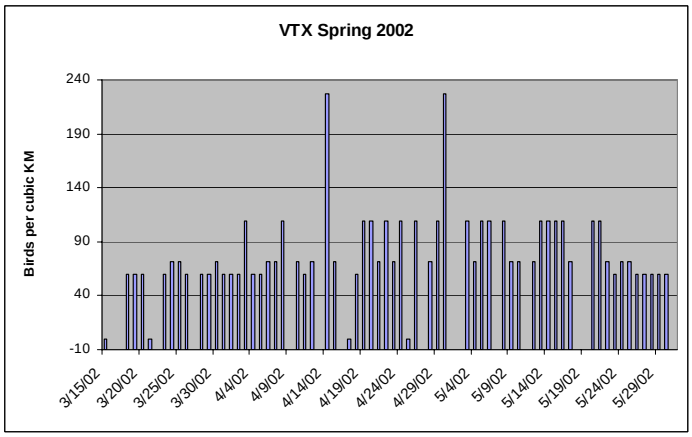


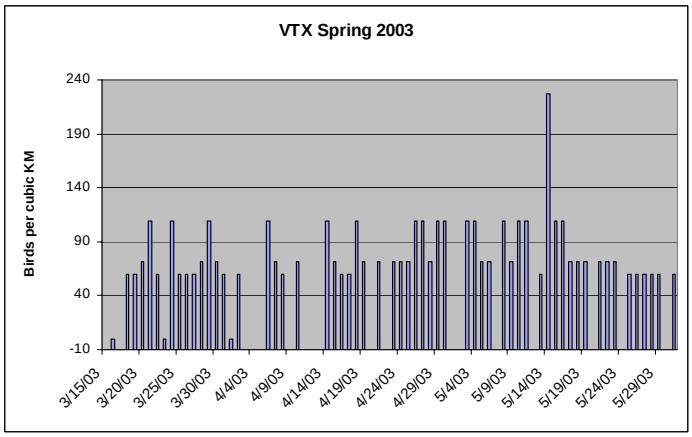
Orcutt, CA (Vandenberg AFB, South-Central Coast)

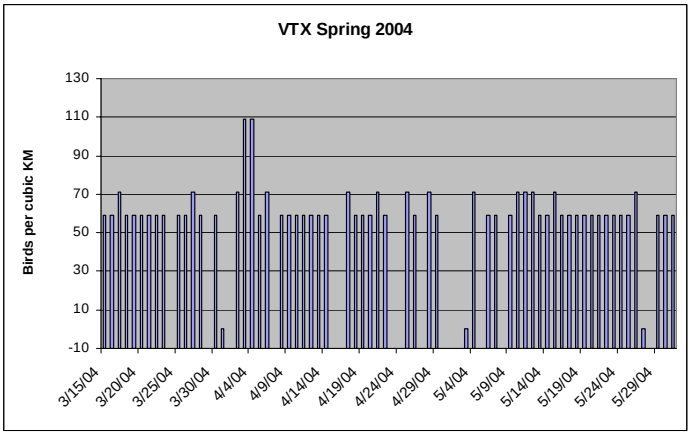
Appendix C-11. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Los Angeles, California (KHNX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





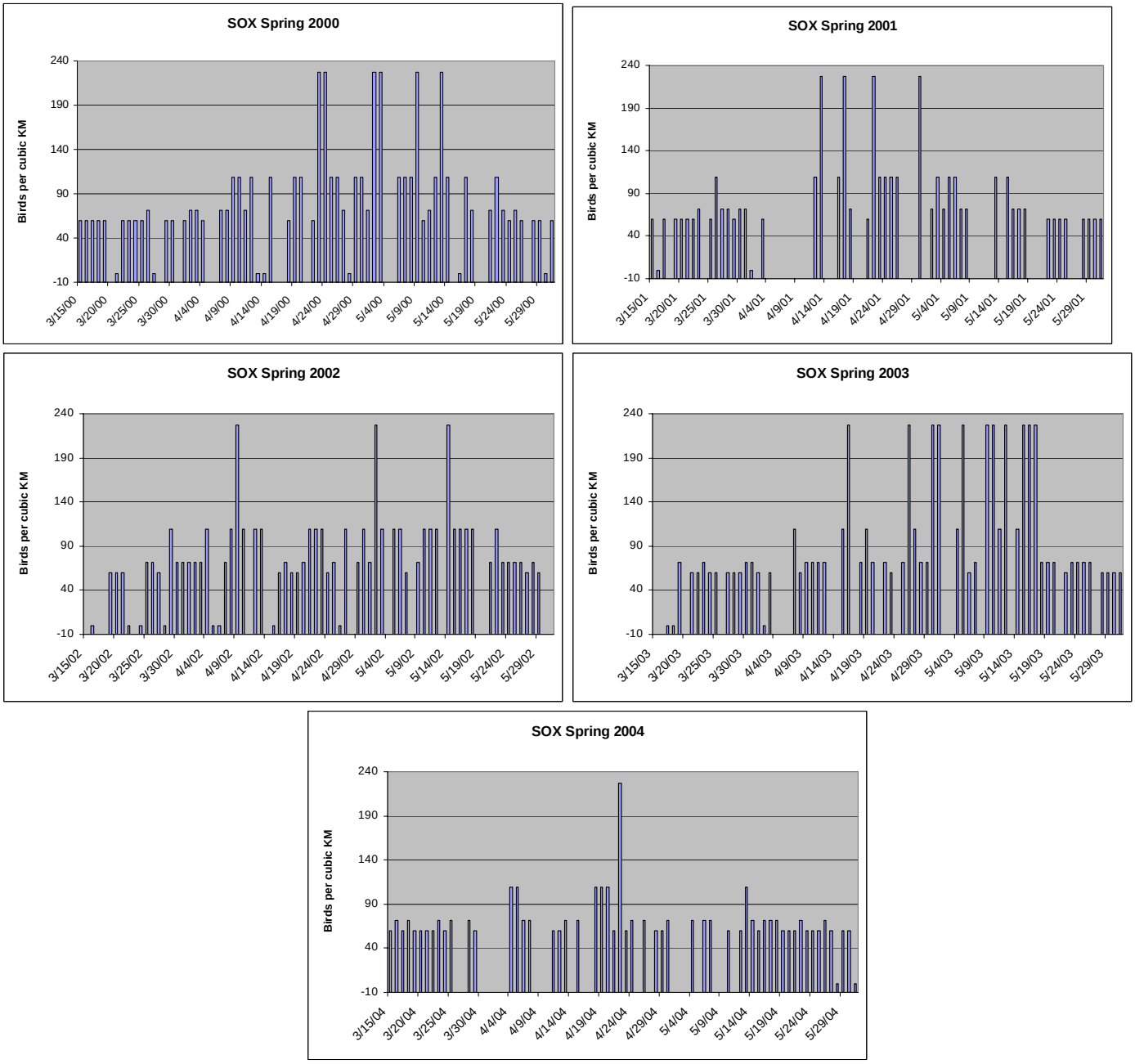






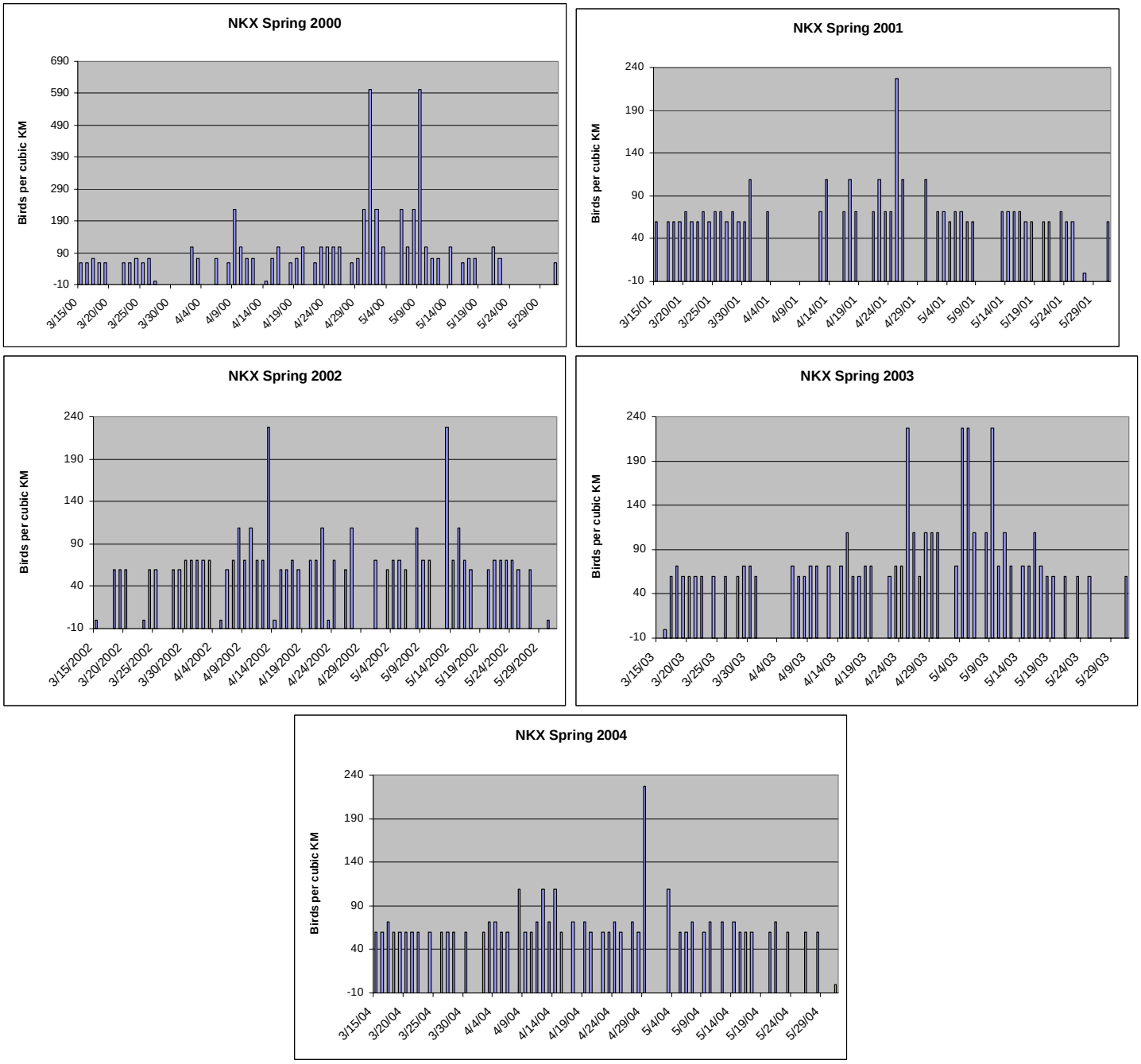
Los Angeles, CA (Southern California coast)

Appendix C-12. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in the Santa Ana Mts, California (KSOX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



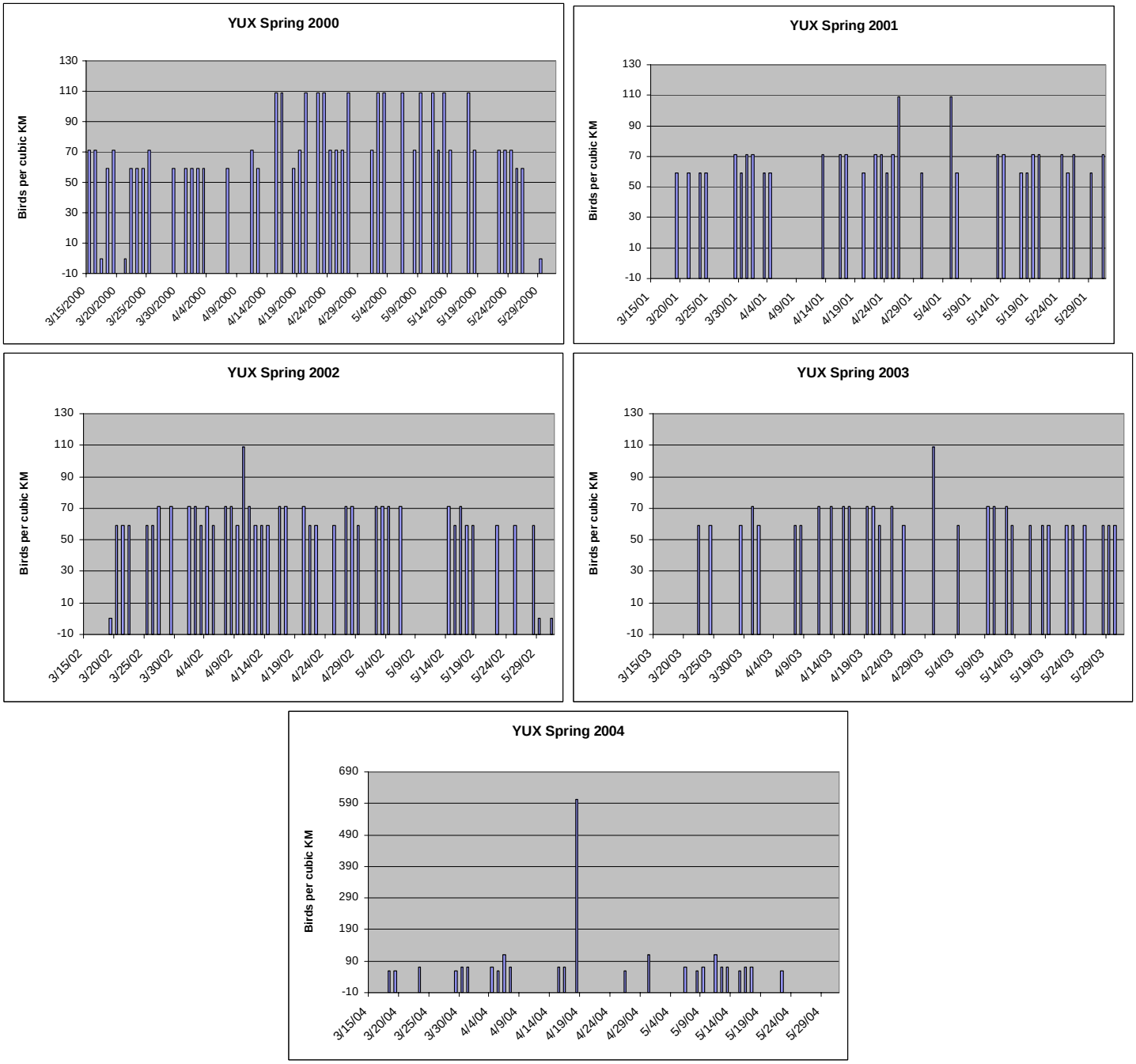
Santa Ana Mts., CA (southern California coast)

Appendix C-13. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in San Diego, California (KNKX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



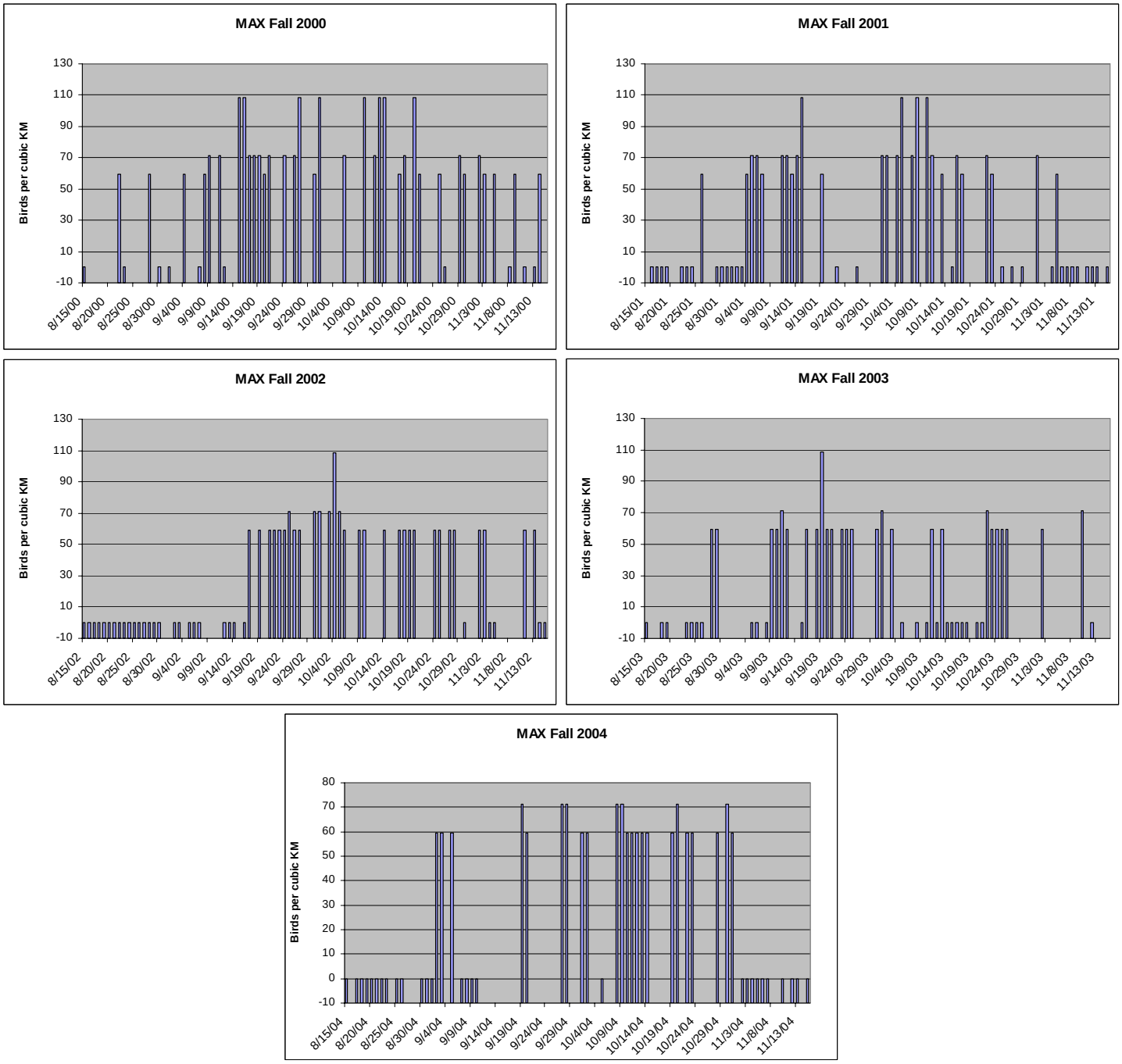
San Diego, California (southernmost California coast)

Appendix C-14. Spring migration temporal patterns (15 March-31 May) detected from the WSR-88D station in Yuma, Arizona (KYUX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



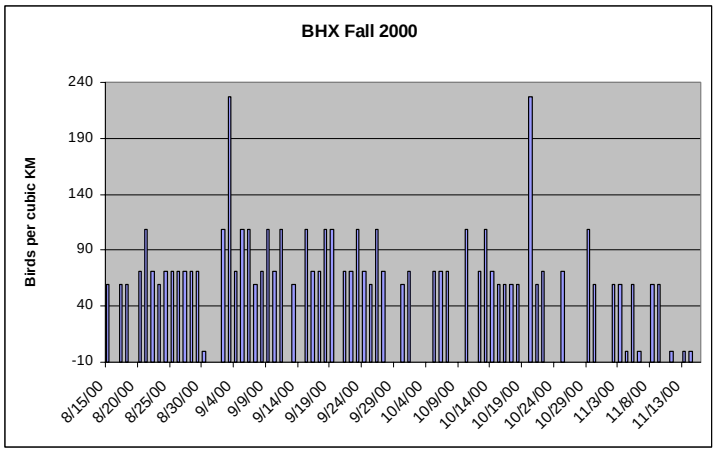
Yuma, Arizona (SE corner of California, SW corner of Arizona)

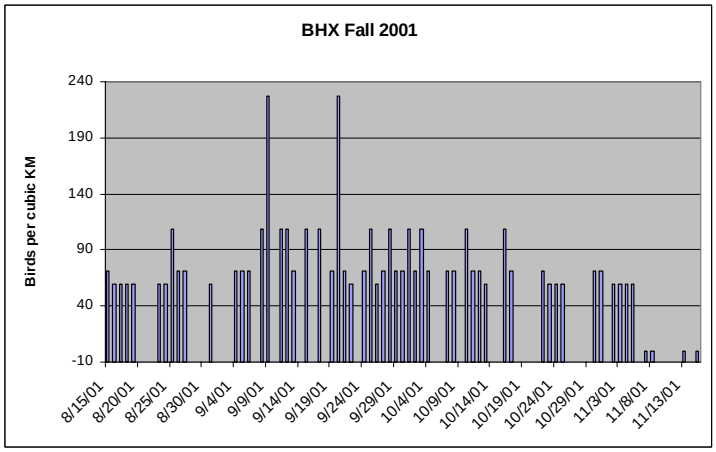
Appendix D-1. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Medford, Oregon (KMAX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).

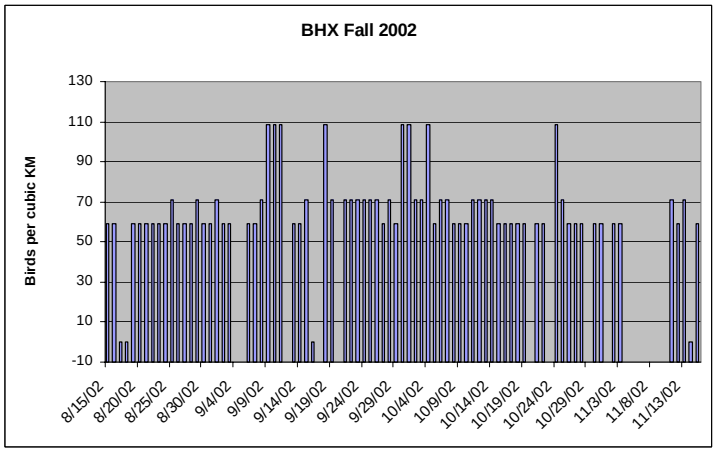


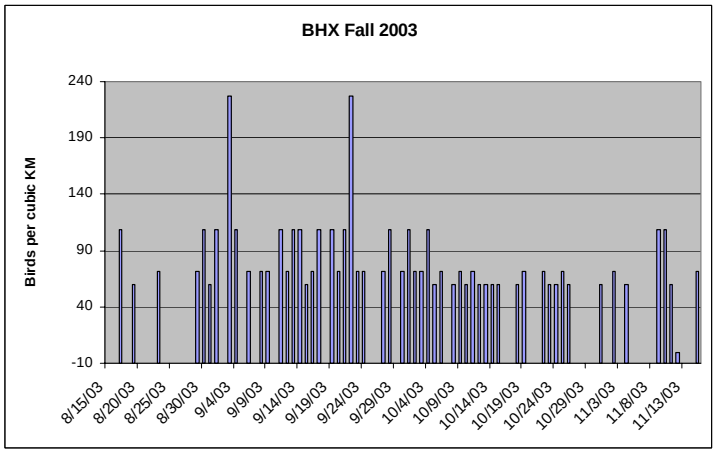
Medford, OR

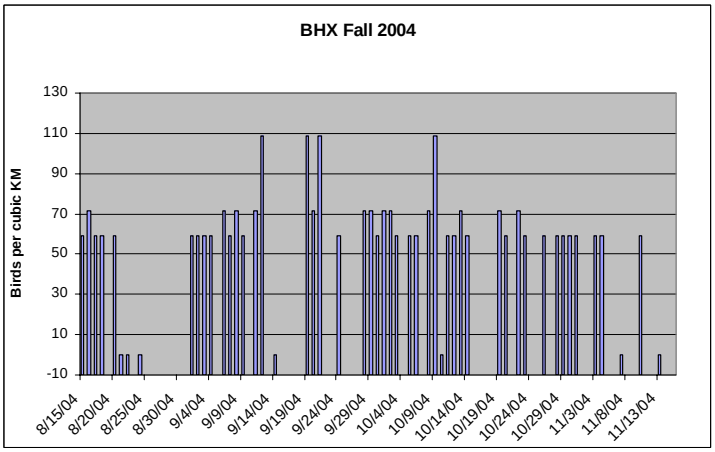
Appendix D-2. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Eureka, California (KBHX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).





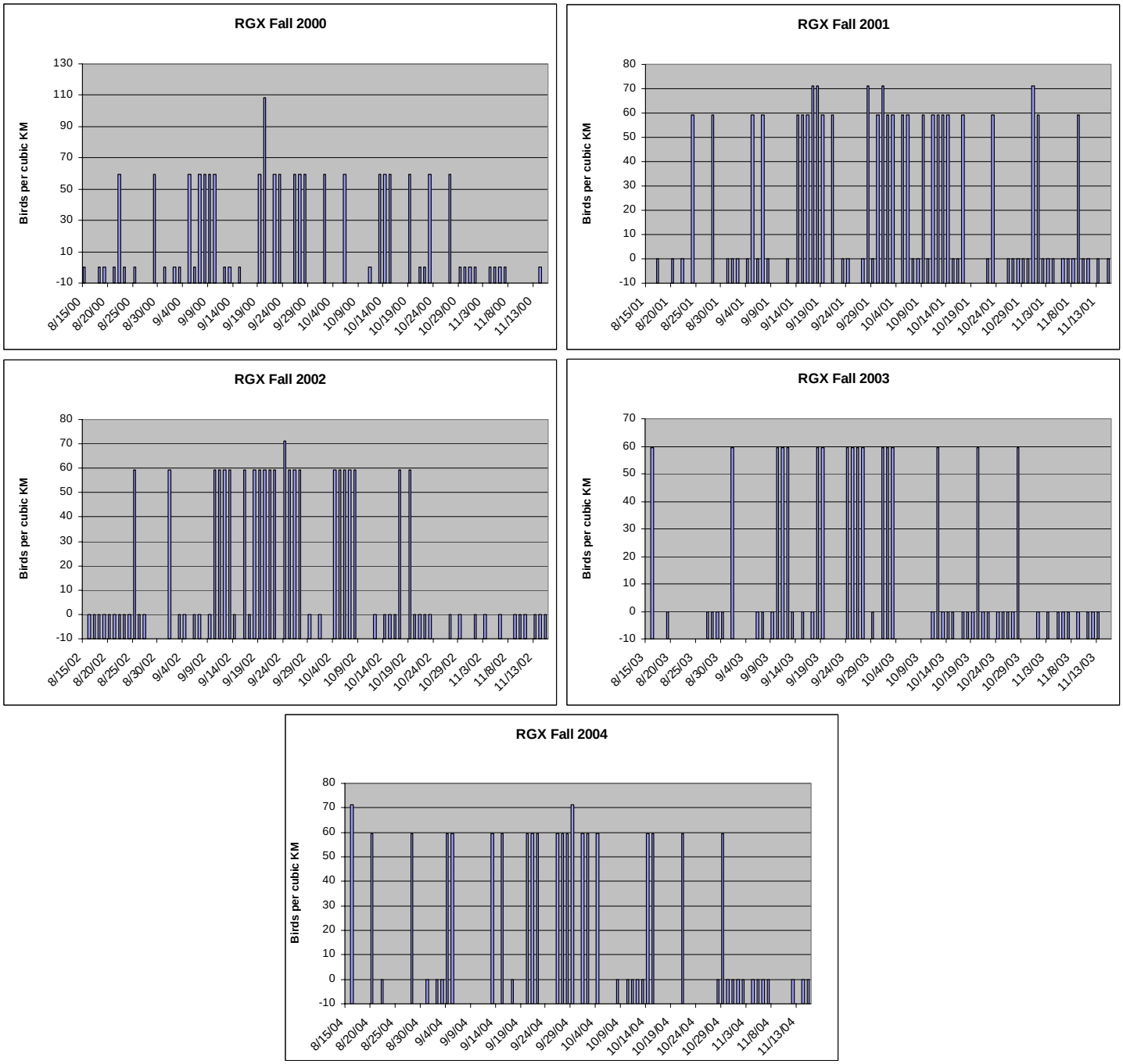






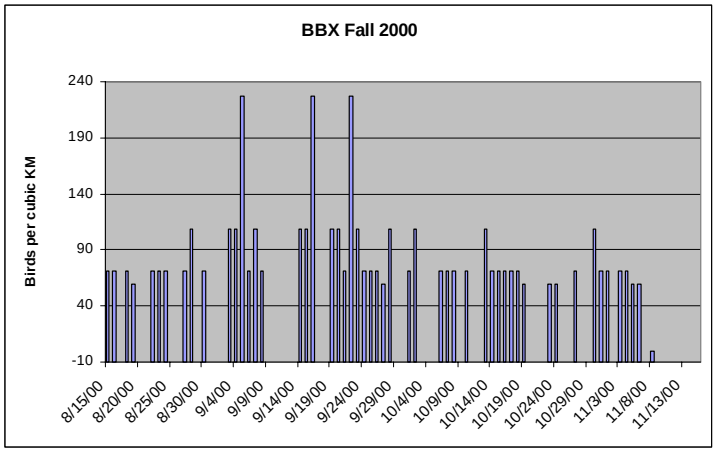
Eureka, CA (North Coast)

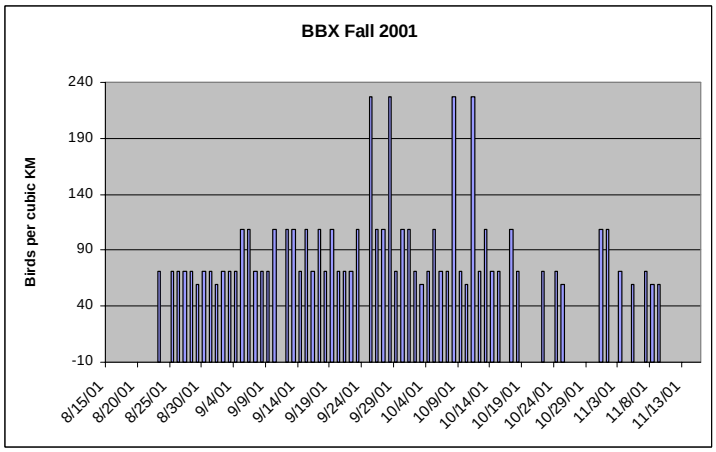
Appendix D-3. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Nixon, Nevada (KRGX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).

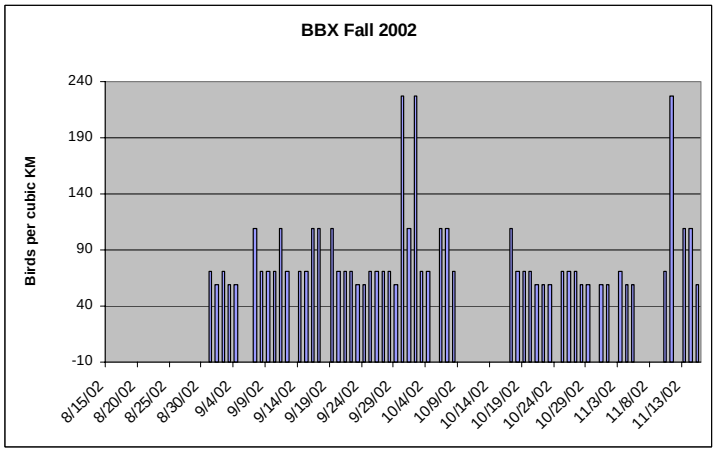


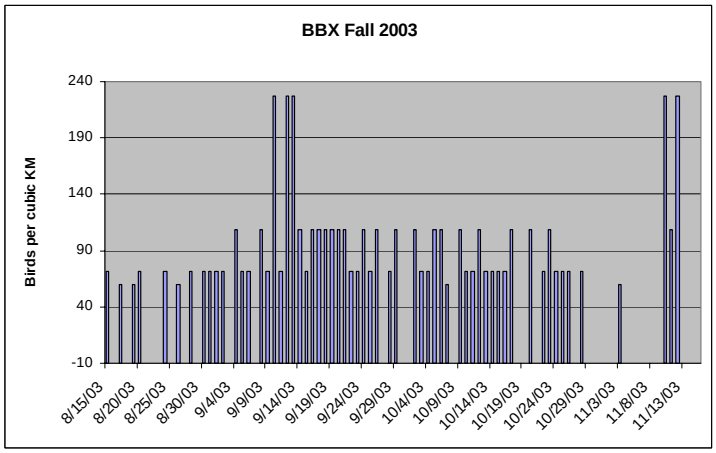
Nixon, Nevada (NE Nevada)

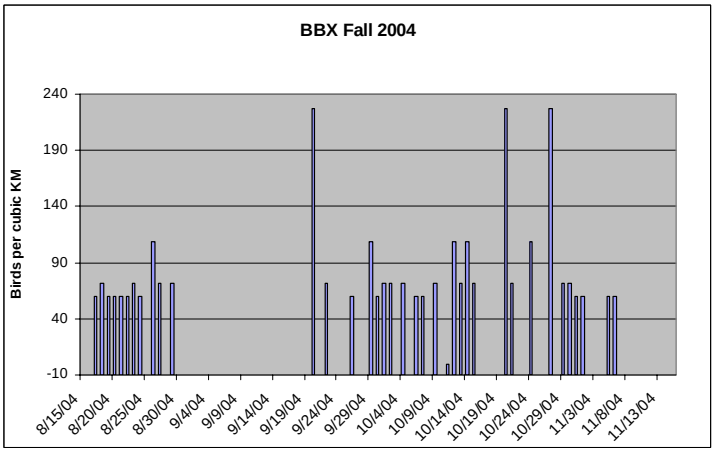
Appendix D-4. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Sacramento, California (KBBX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



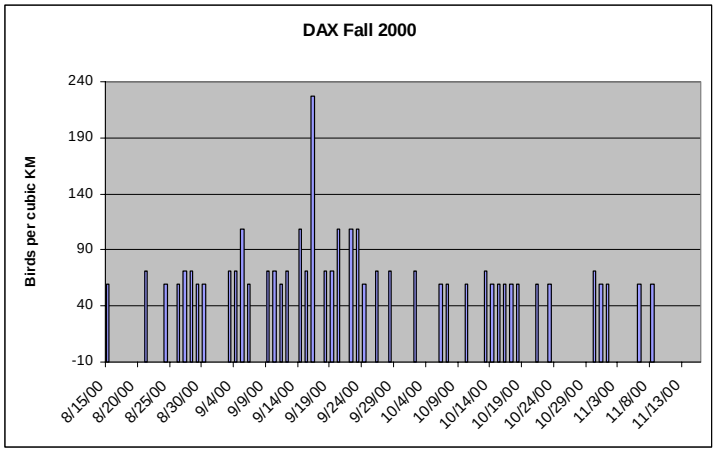


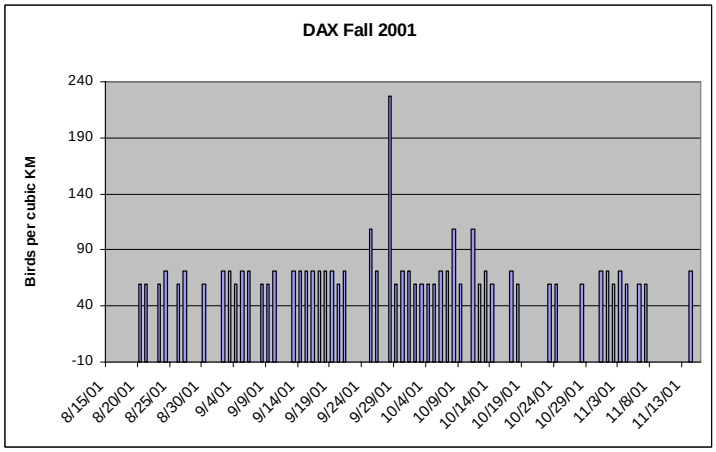


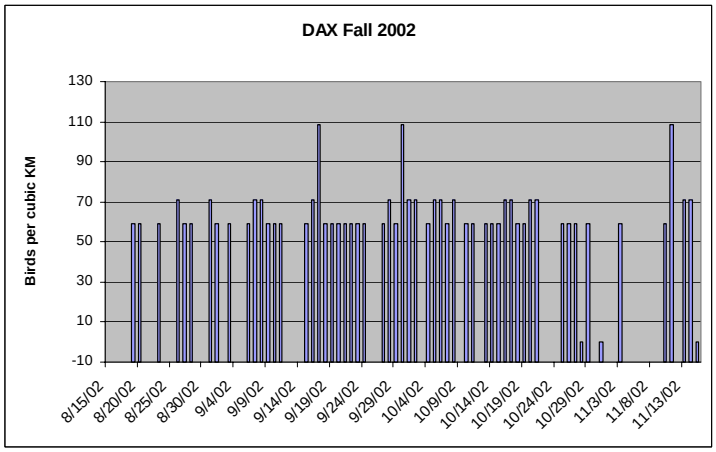


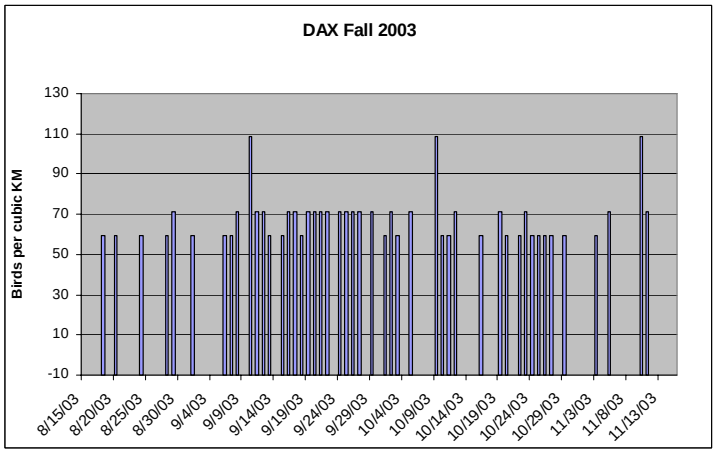


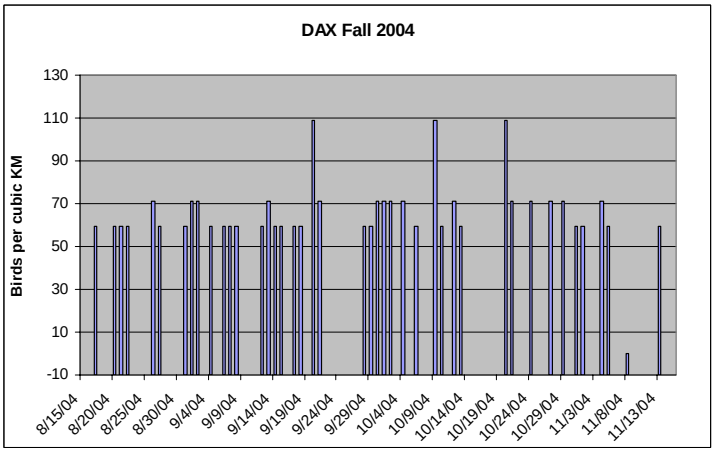
Appendix D-5. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Davis, California (KDAX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



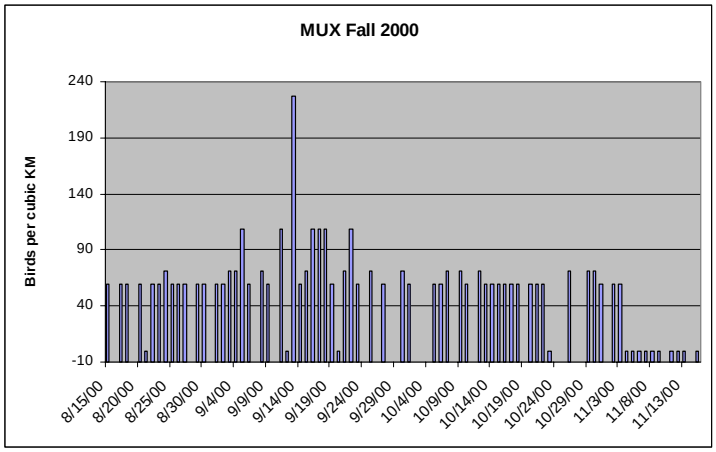


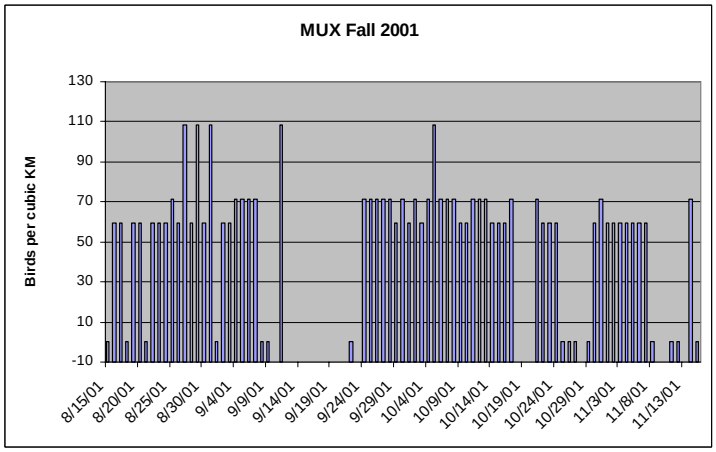


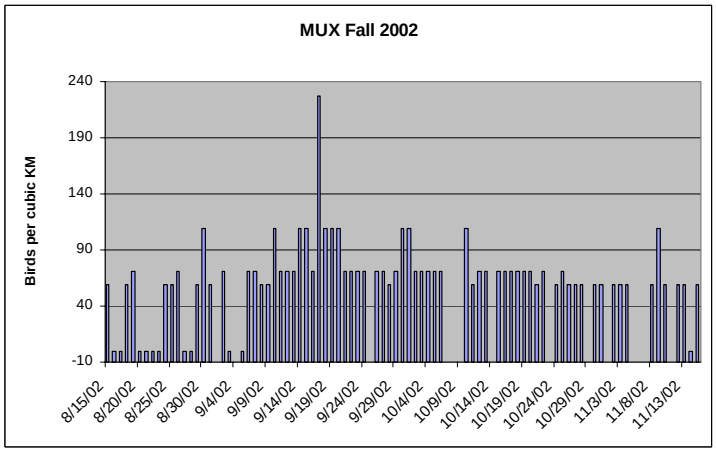


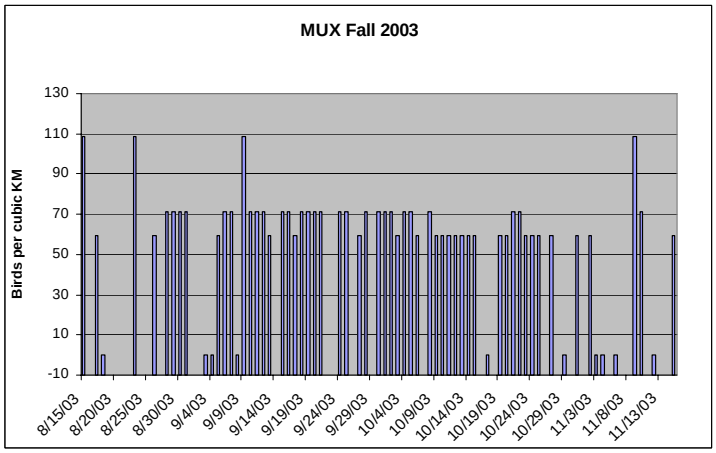


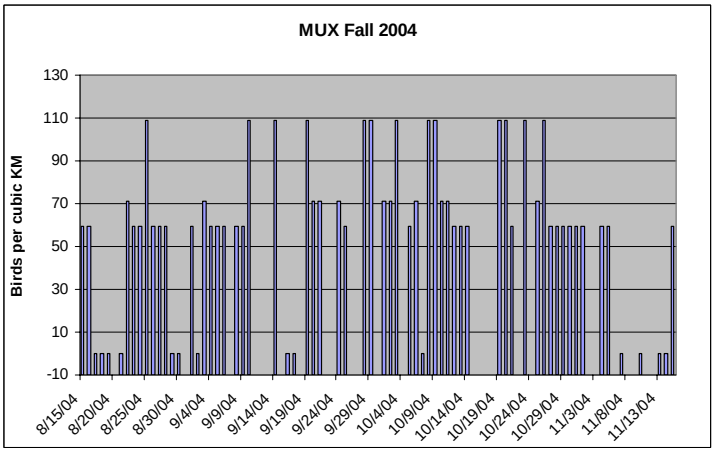
Appendix D-6. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Los Gatos, California (KMUX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



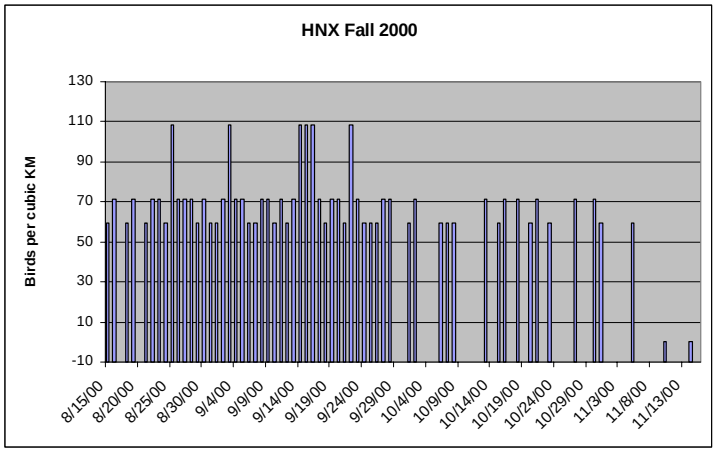


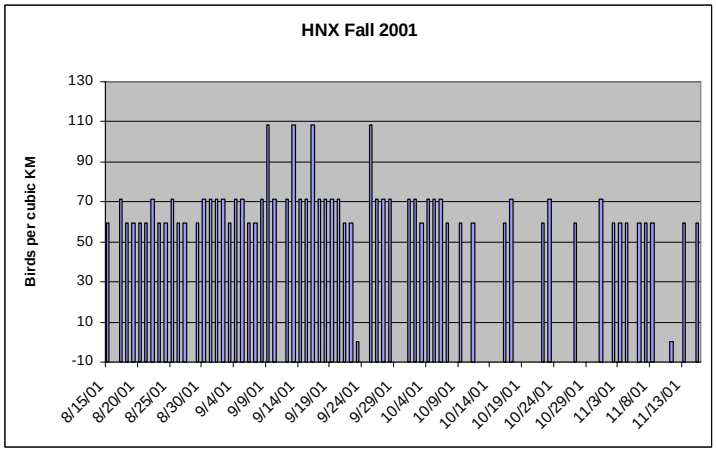


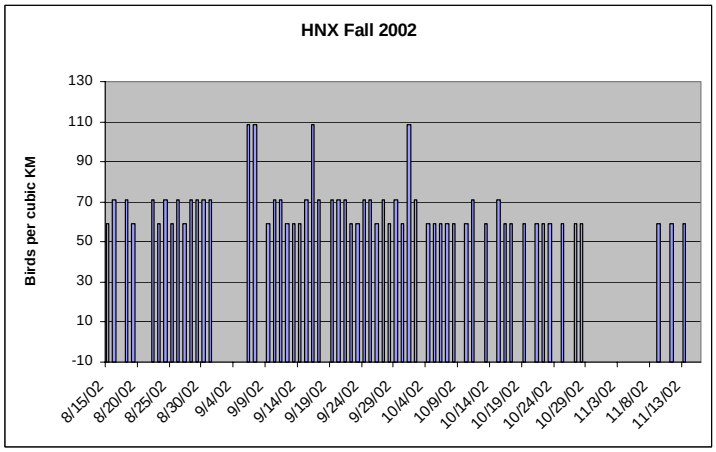


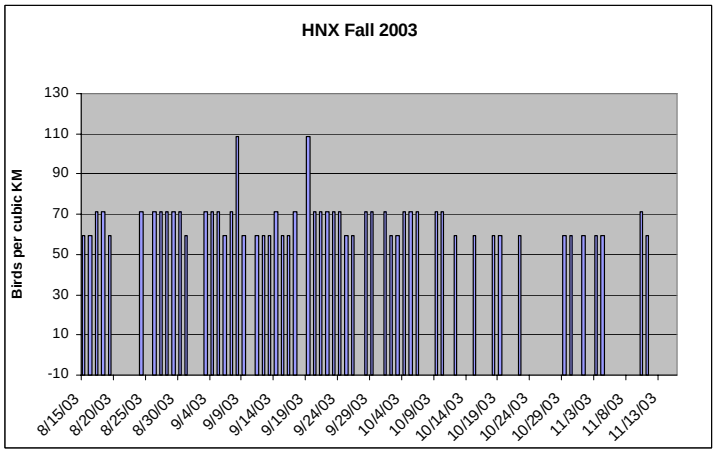


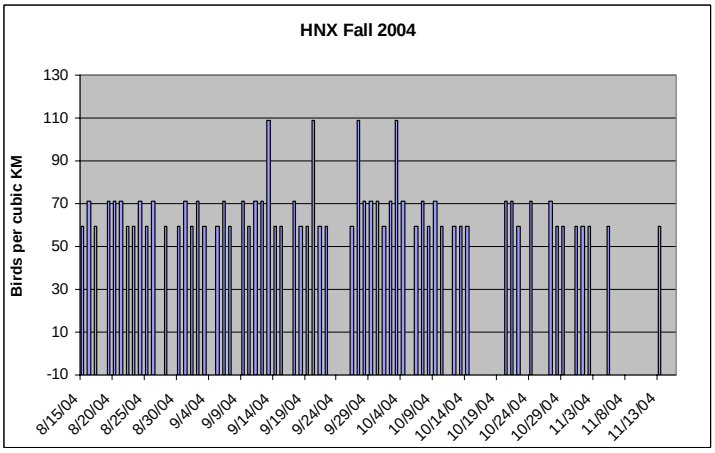
Appendix D-7. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Hanford, California (KHNX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



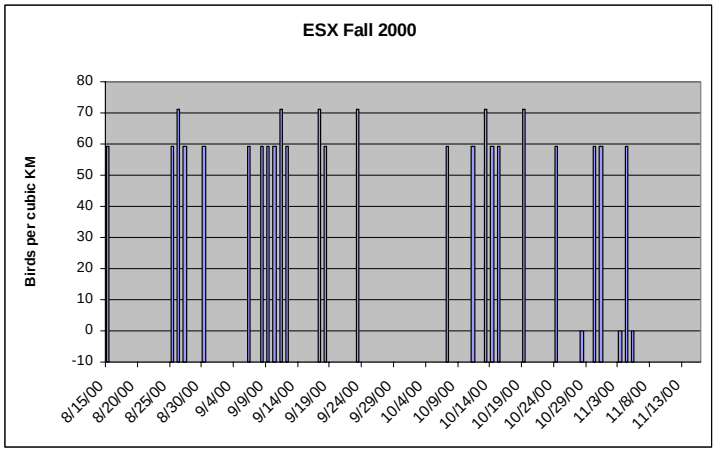


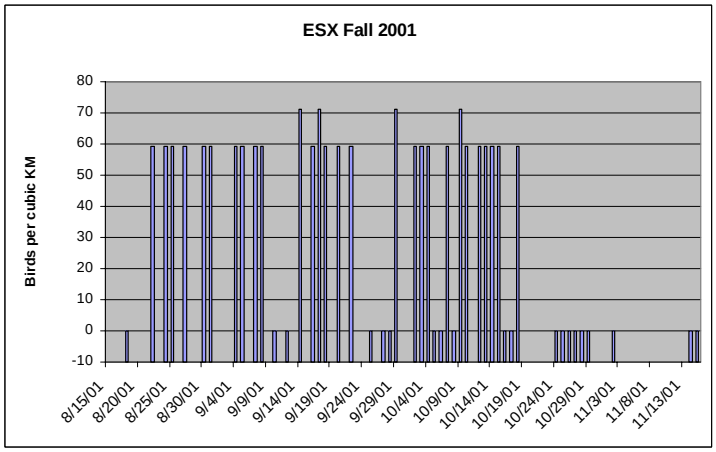


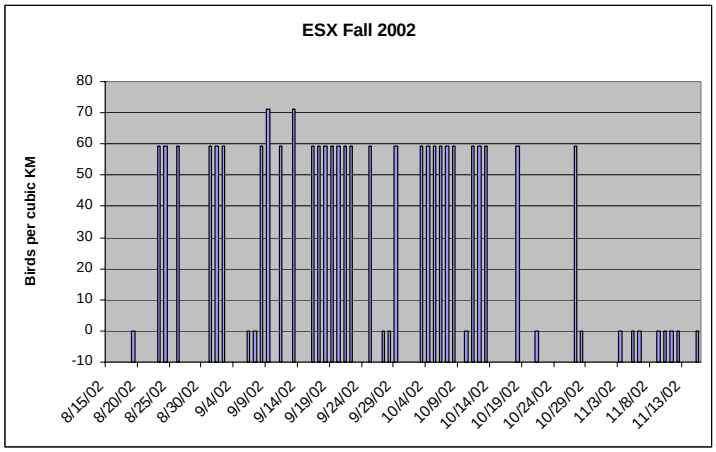


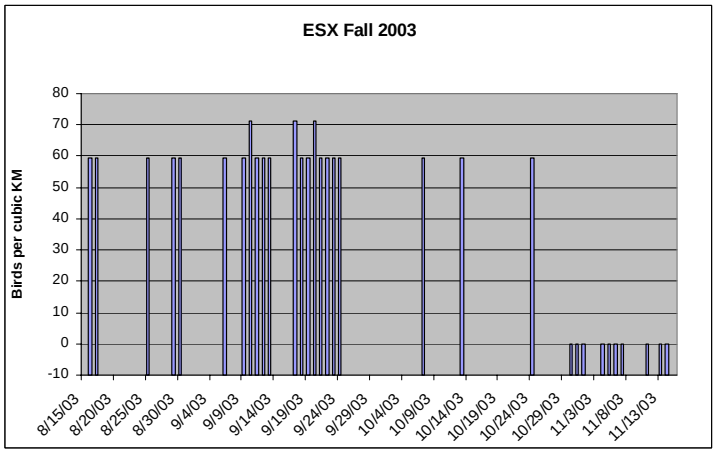


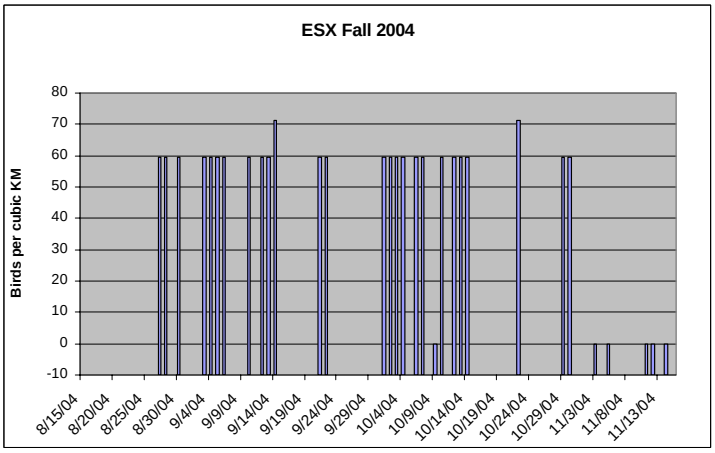
Appendix D-8. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Las Vegas, Nevada (KESX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



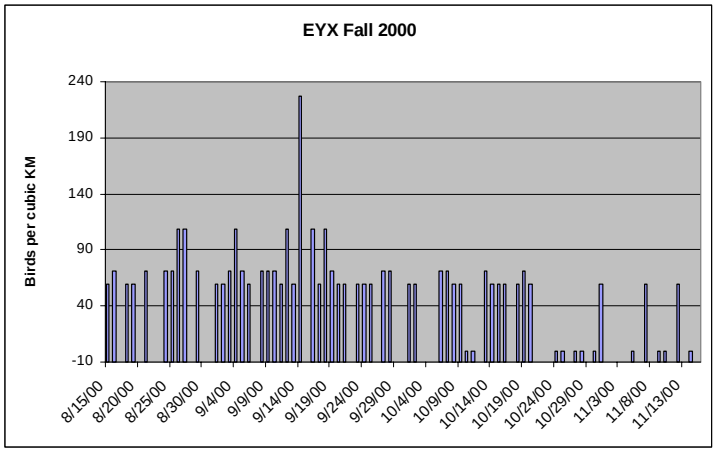


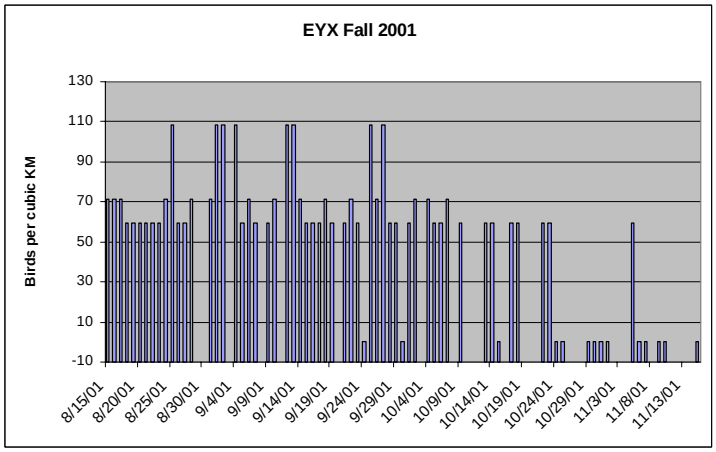


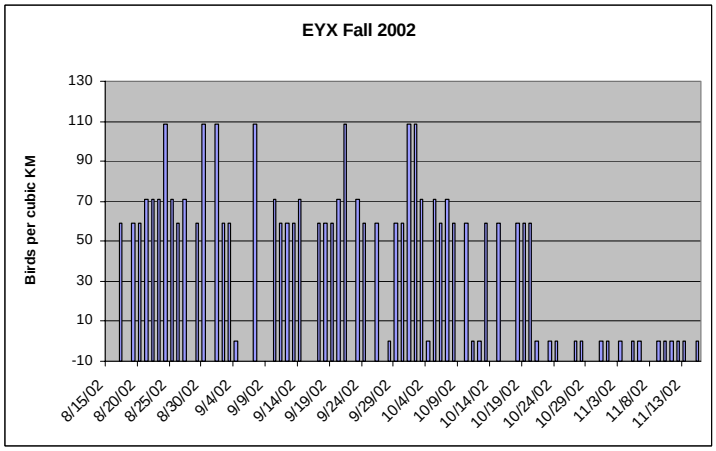


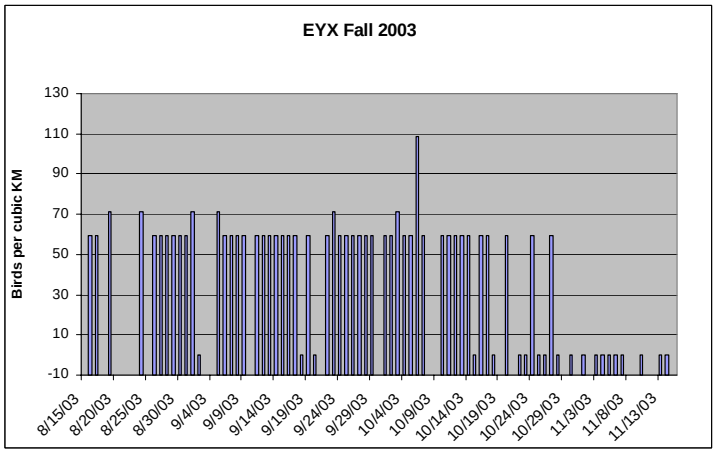


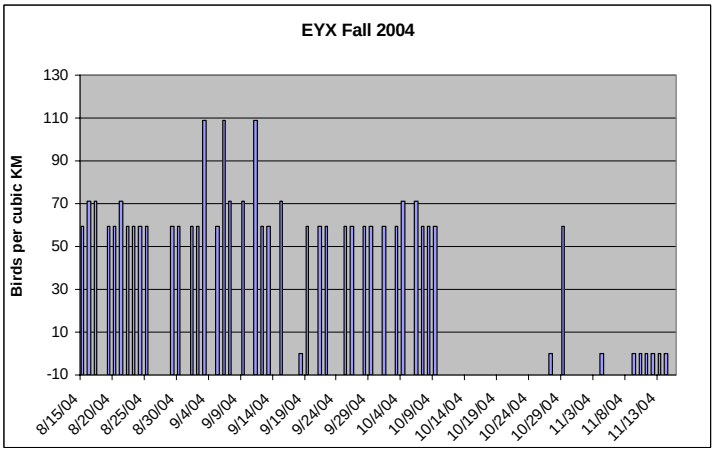
Appendix D-9. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station at Edwards AFB, California (KEYX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



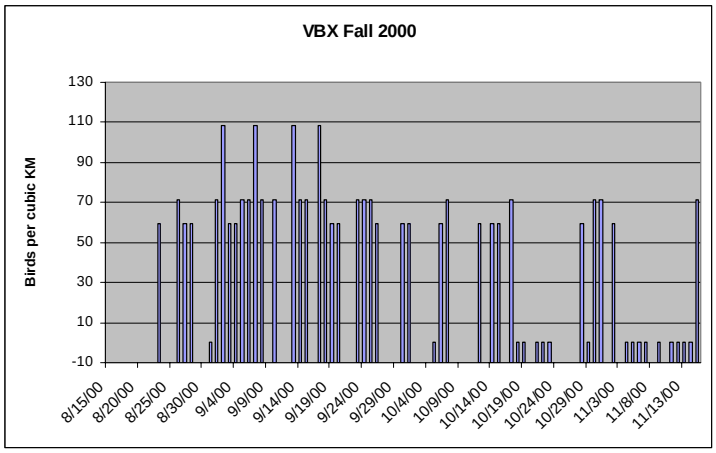


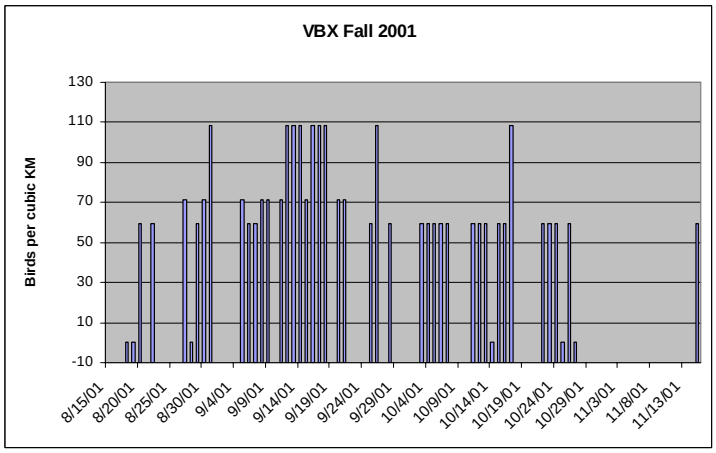


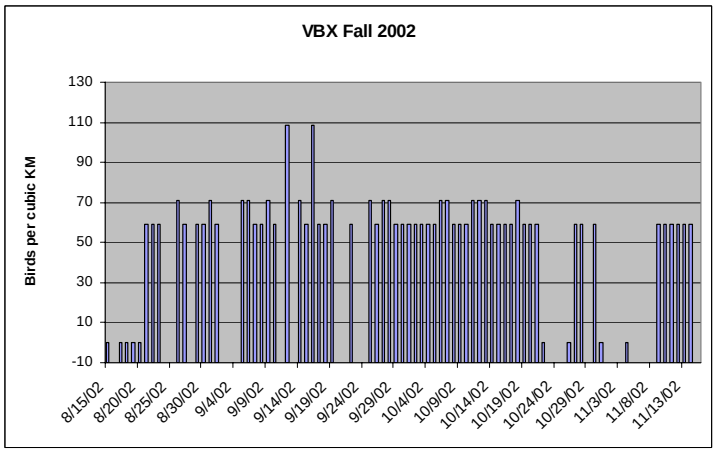


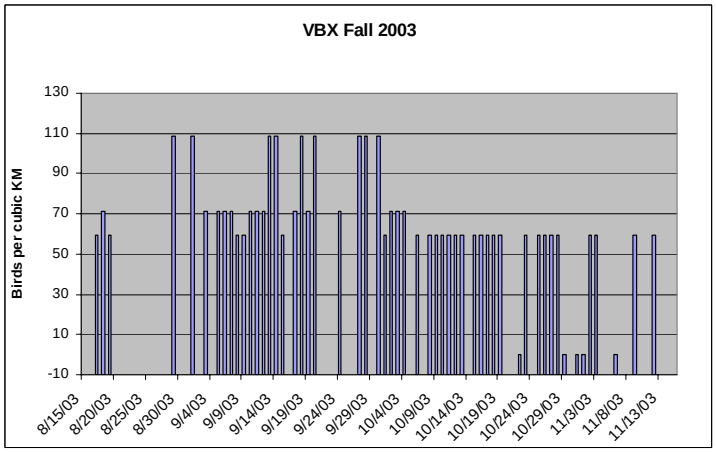


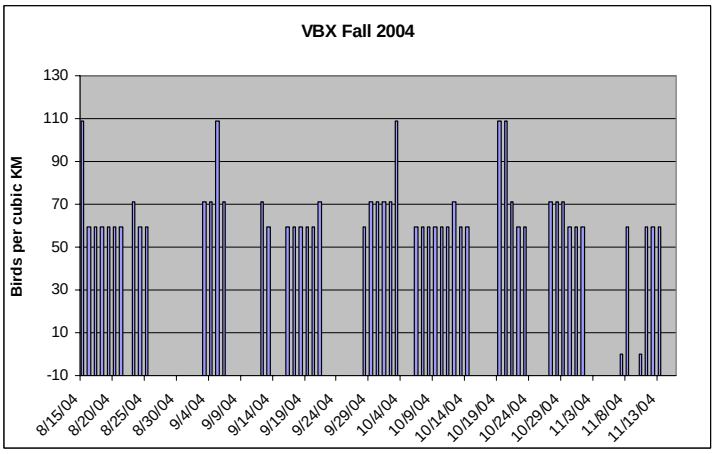
Appendix D-10. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station at Vandenberg AFB (Orcutt), California (KVBX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



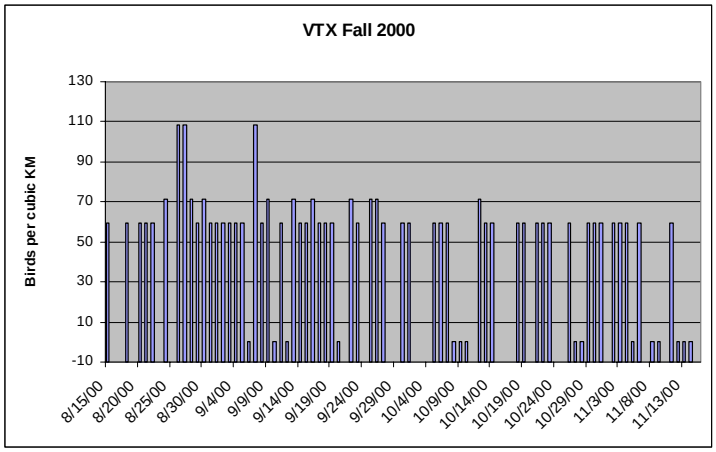


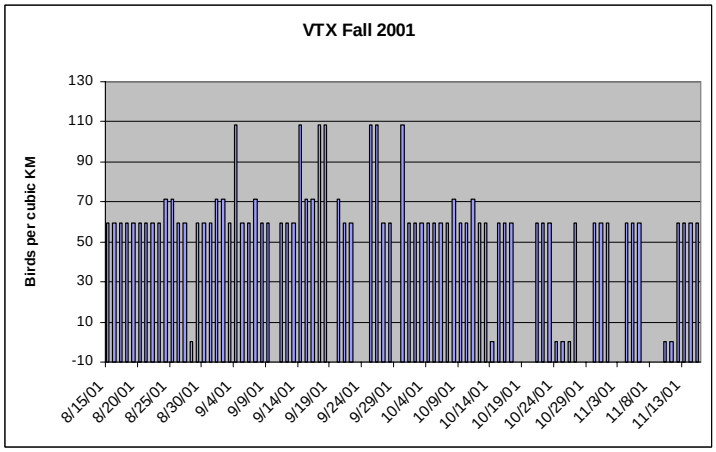


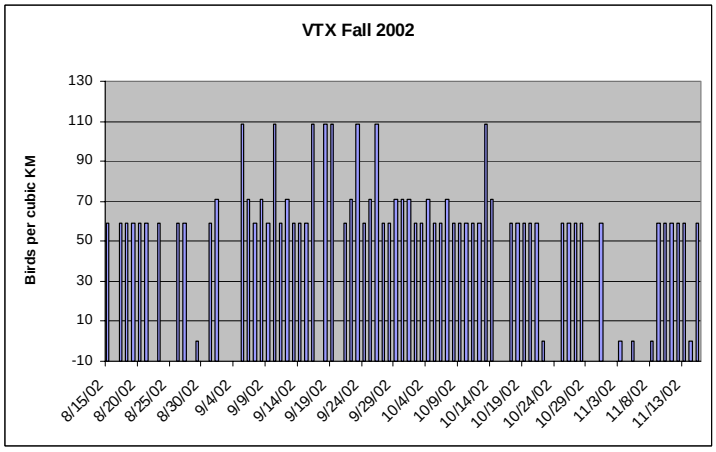


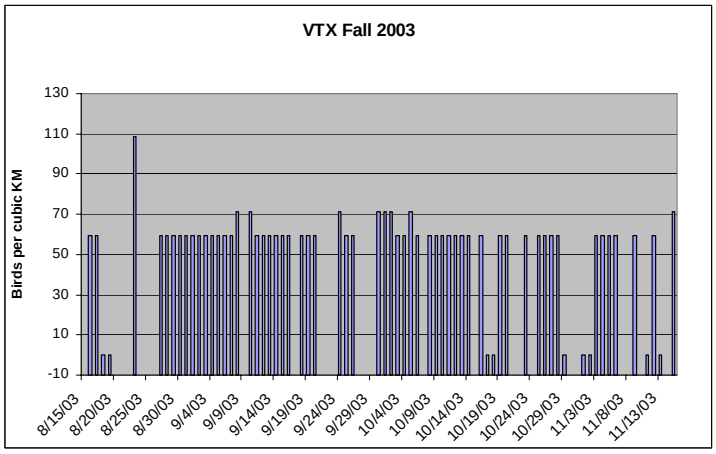


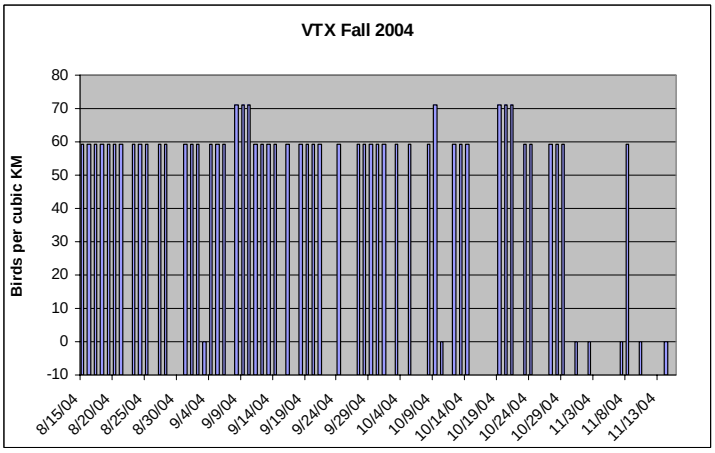
Appendix D-11. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Los Angeles, CA (KVTX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



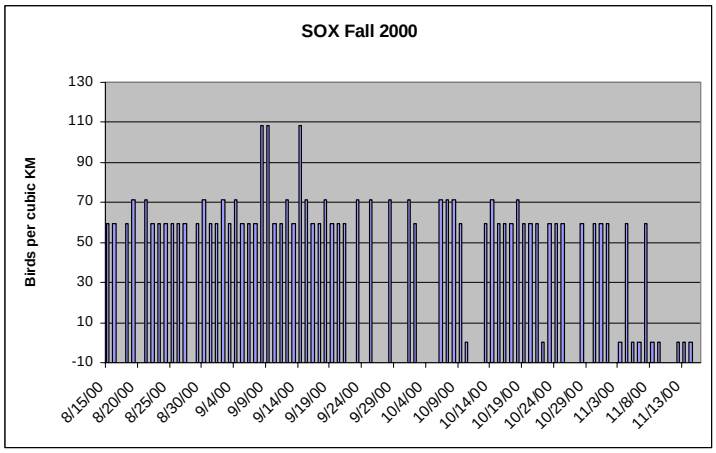


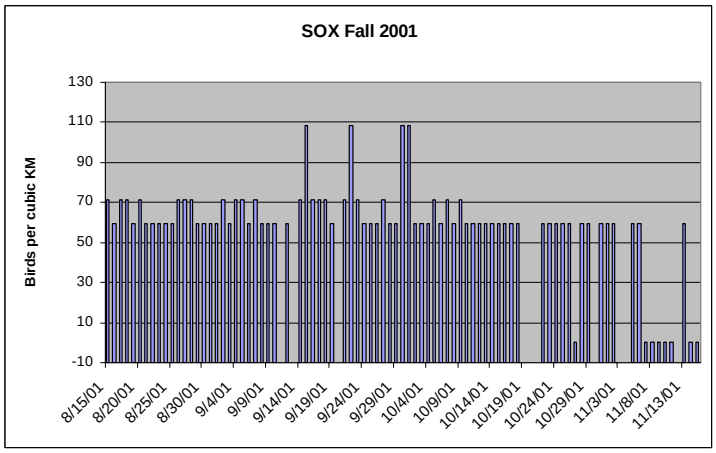


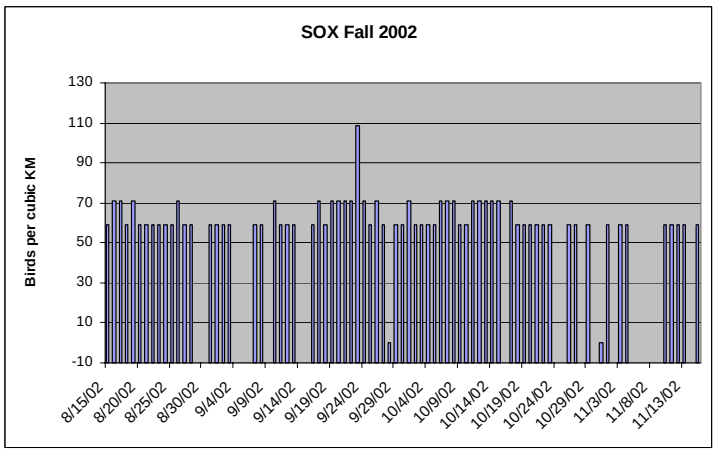


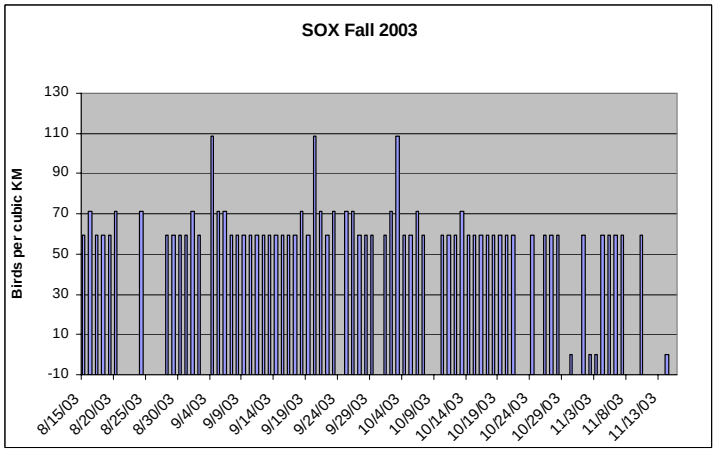


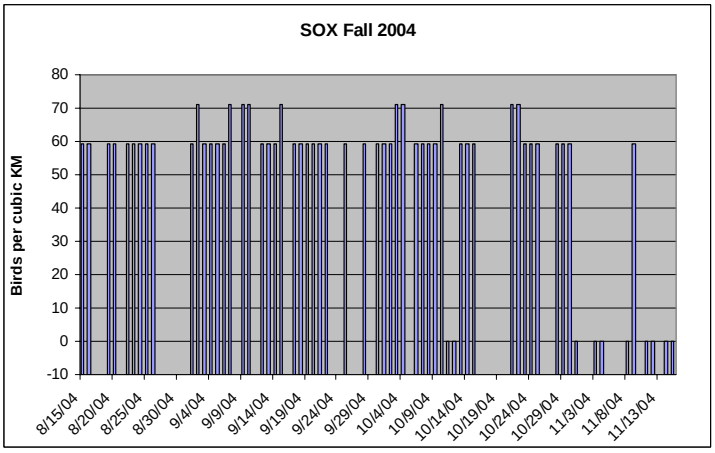
Appendix D-12. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in the Santa Ana Mts, California (KSOX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



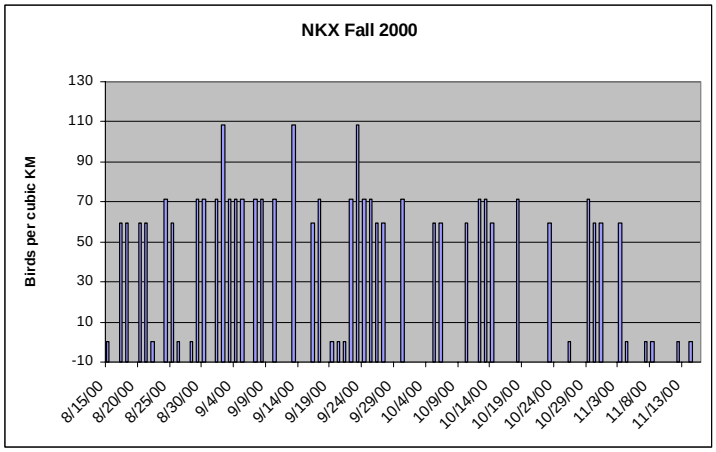


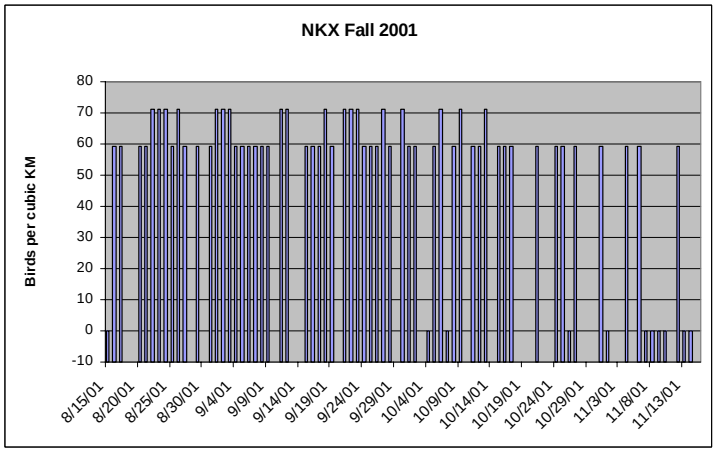


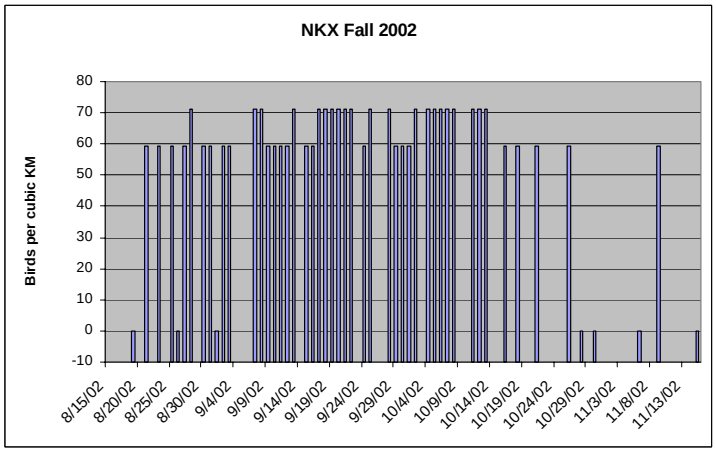


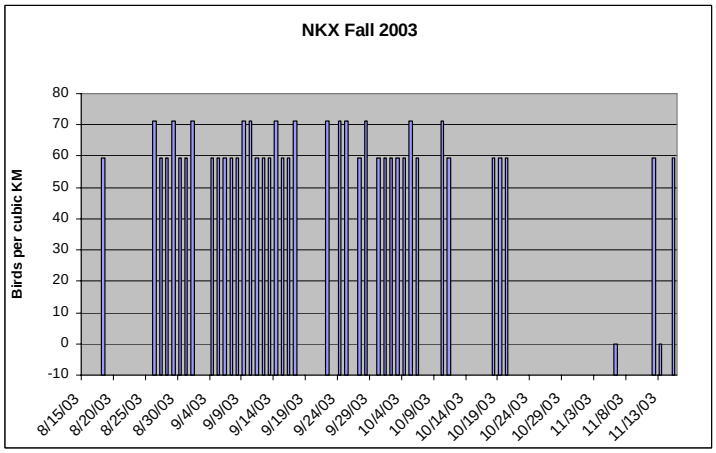


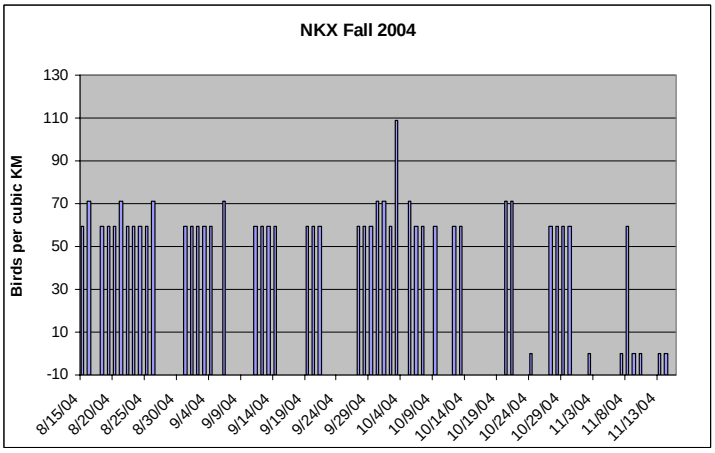
Appendix D-13. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in San Diego, CA (KNKX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



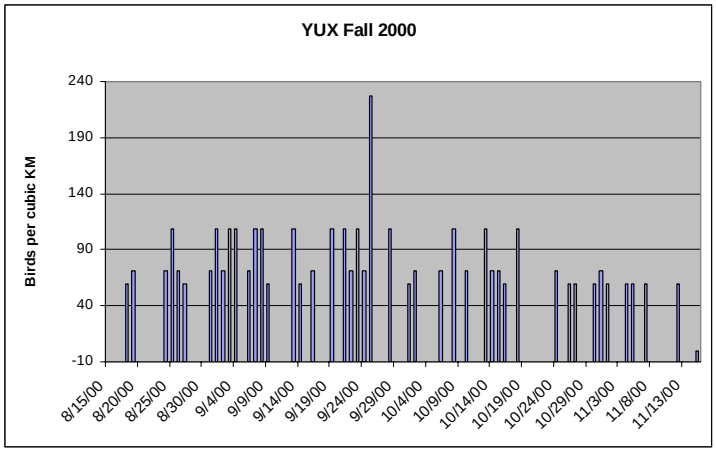


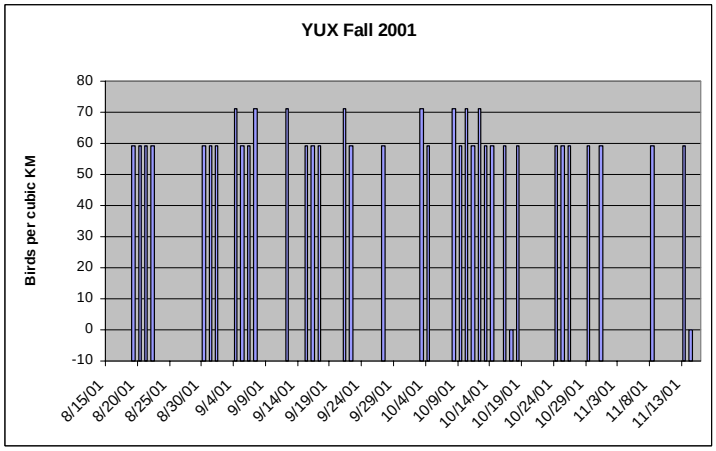


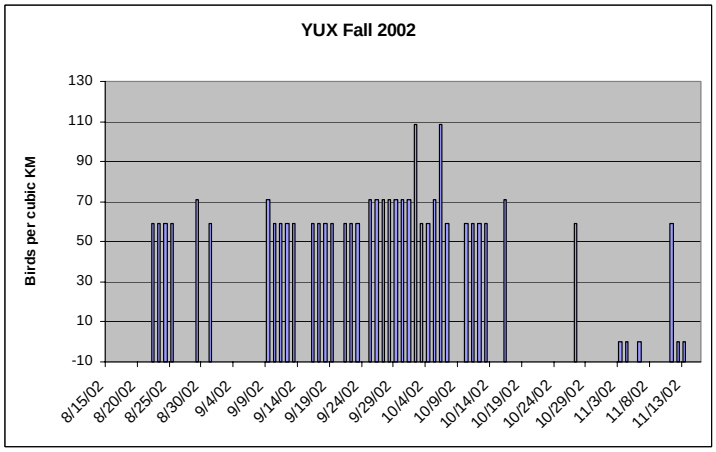


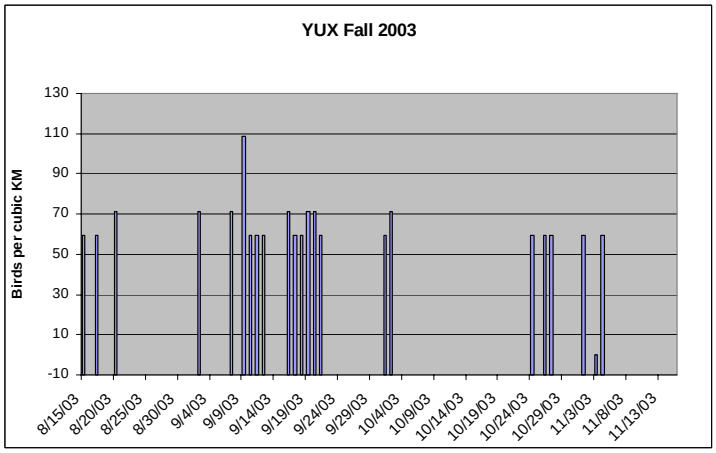


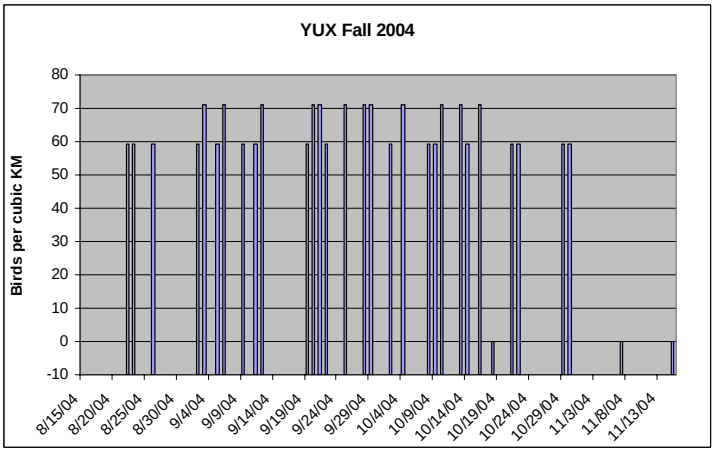
Appendix D-14. Fall migration temporal patterns (15 August-15 November) detected from the WSR-88D station in Yuma, Arizona (KYUX), 2000-2004. Note: dates on which no migration was detected are shown as "0" (bar showing), whereas dates on which data were unavailable are shown as "-10" (no bar showing).



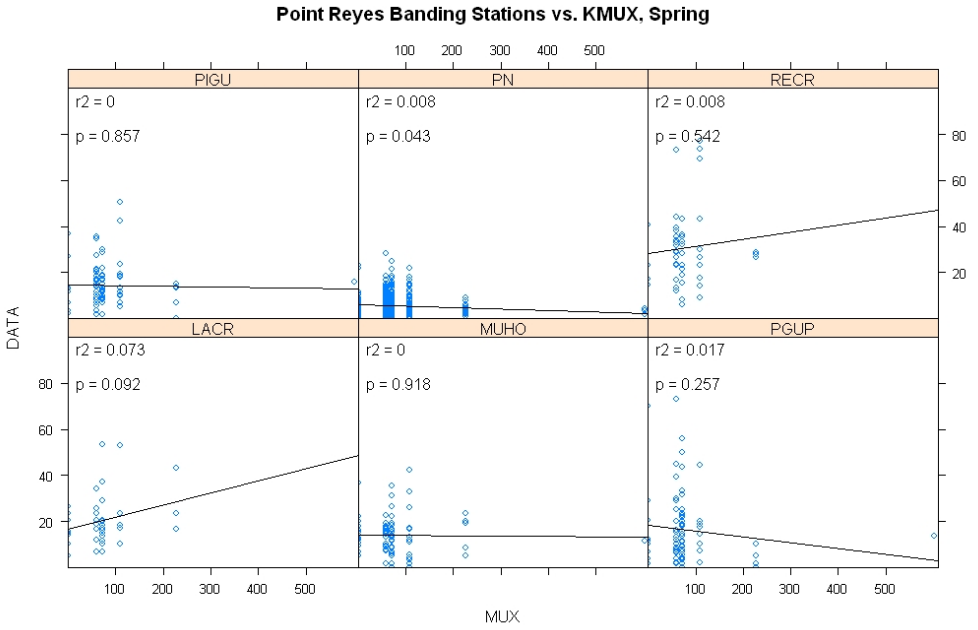


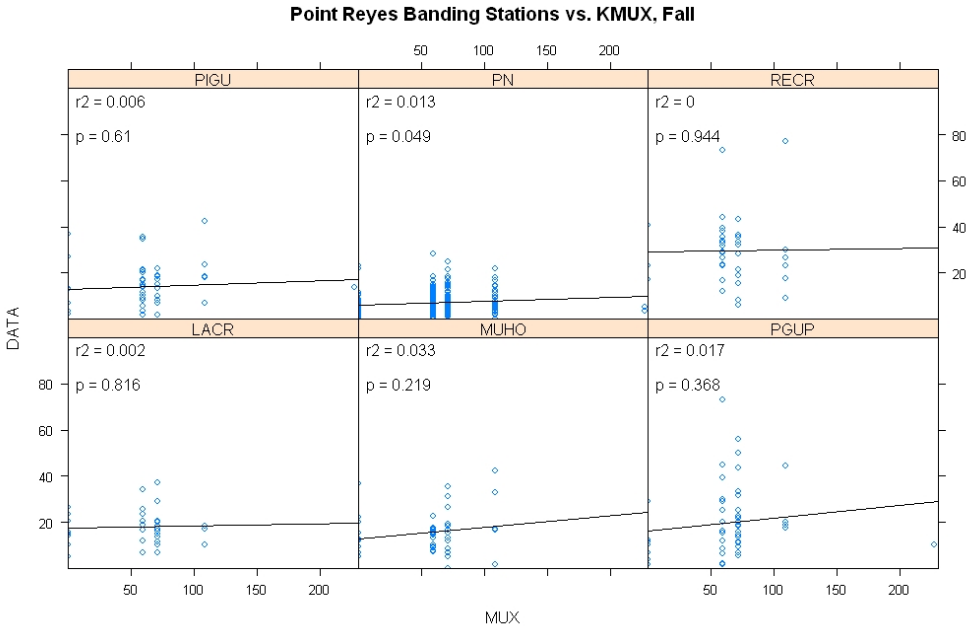




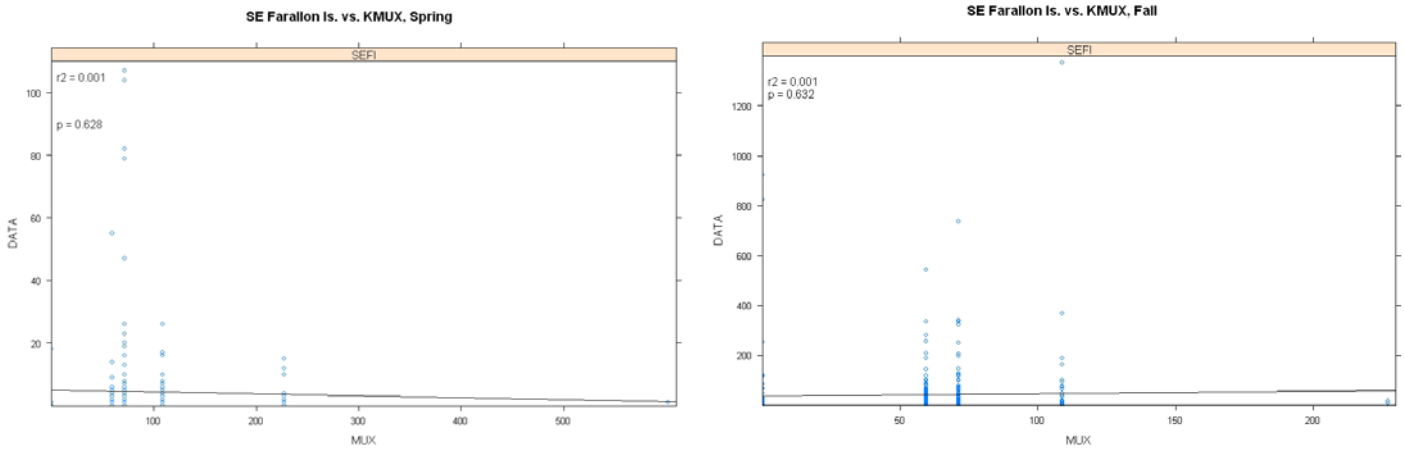


Appendix E. Linear regression plots between daily capture rates in the Point Reyes area (6 stations) for spring (top) and fall (bottom) and WSR88D radar station KMUX daily birds/km^3.

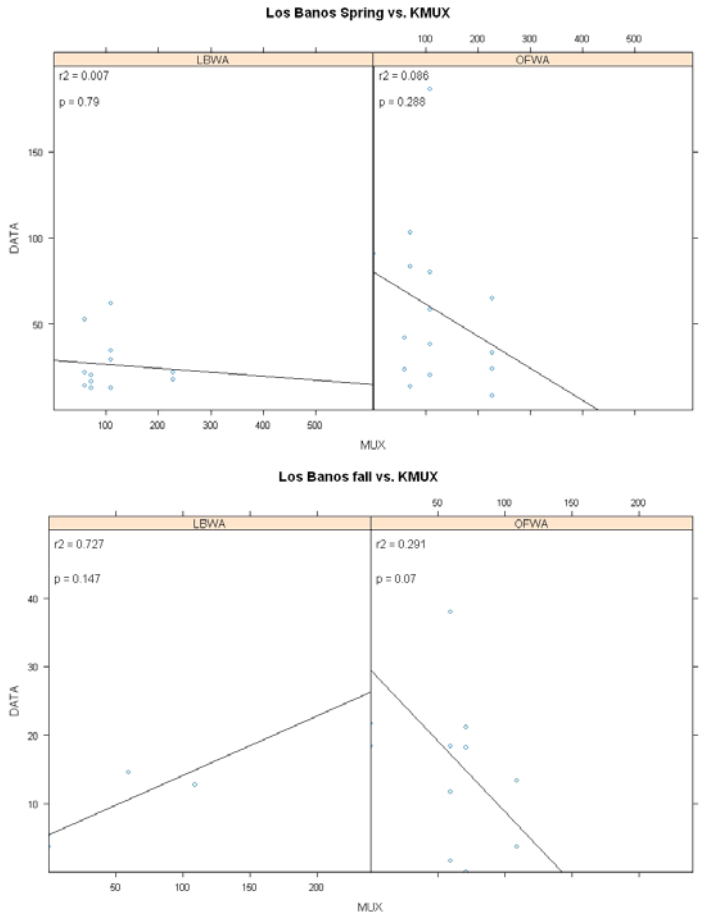




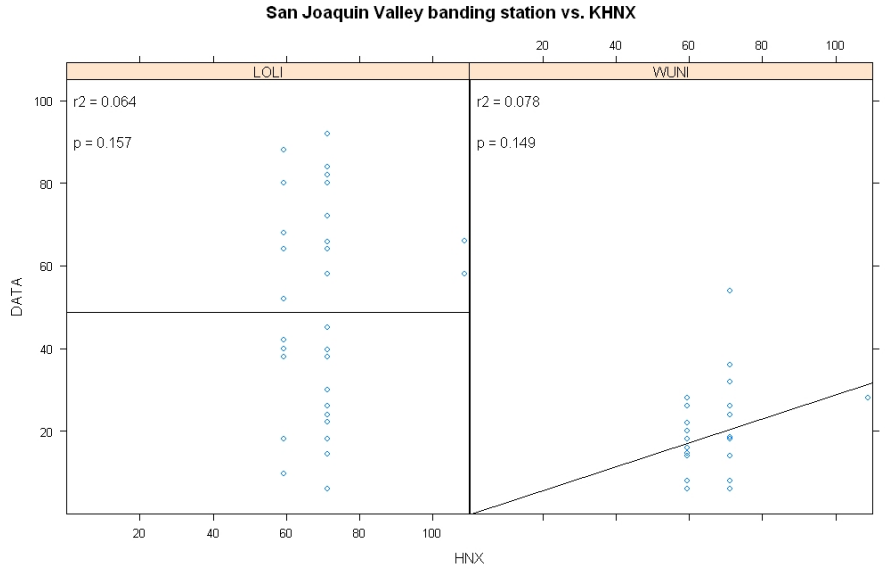
Appendix F. Linear regression plots between SE Farallon Island daily migrant arrivals for spring (left) and fall (right) and WSR-88D radar station KMUX daily birds/km^3.



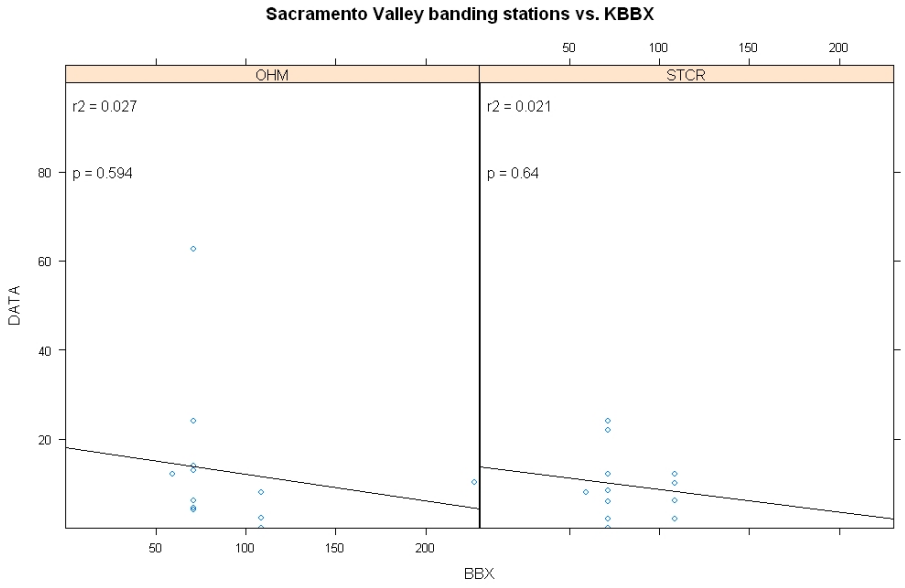
Appendix G. Linear regression plots between Los Banos daily capture rates (2 sites) for spring (top) and fall (bottom) and WSR-88D radar station KMUX daily birds/km^3.



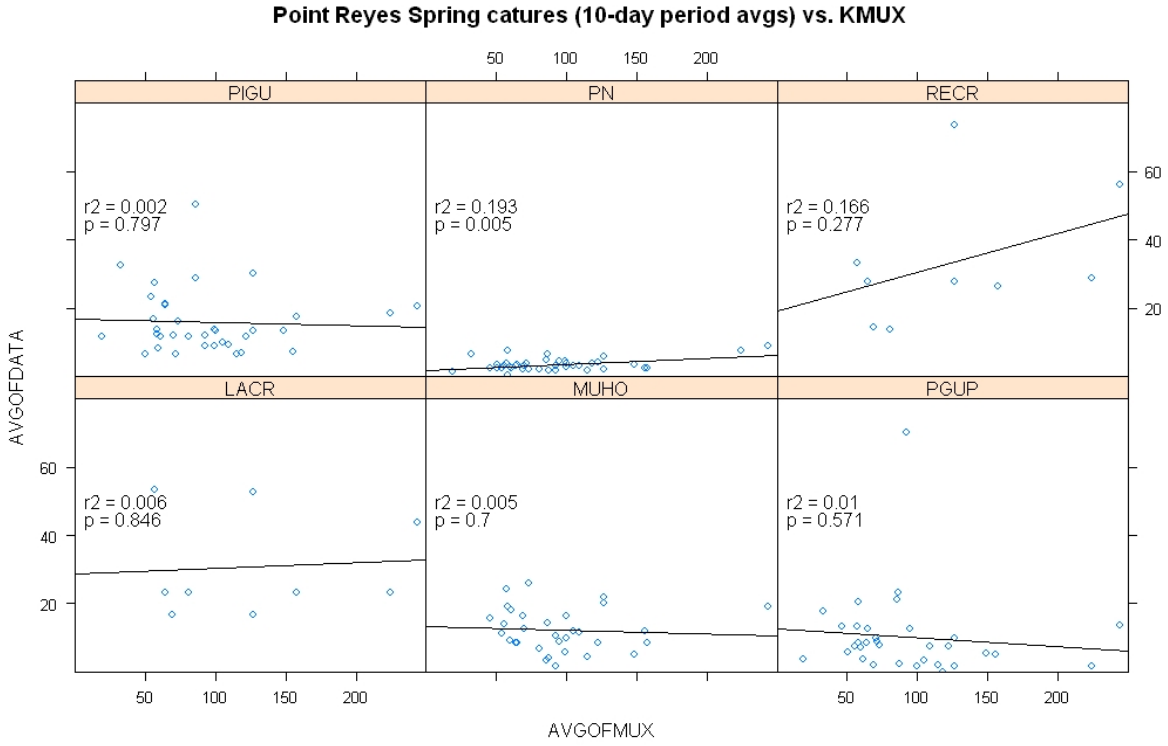
Appendix H. Linear regression plots between San Joaquin Valley daily capture rates (2 sites) for fall (bottom) and WSR-88D radar station KHNX daily birds/km^3.

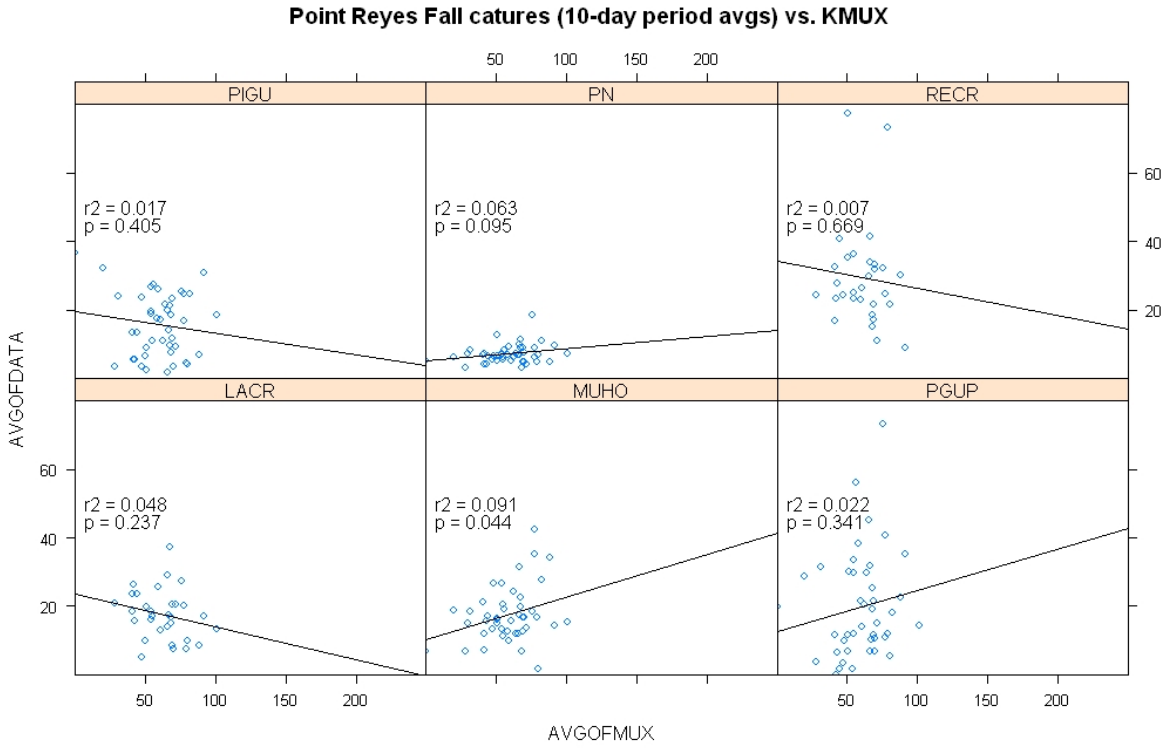


Appendix I. Linear regression plots between Sacramento Valley daily capture rates (2 sites) for fall (bottom) and WSR-88D radar station KHNX daily birds/km^3.

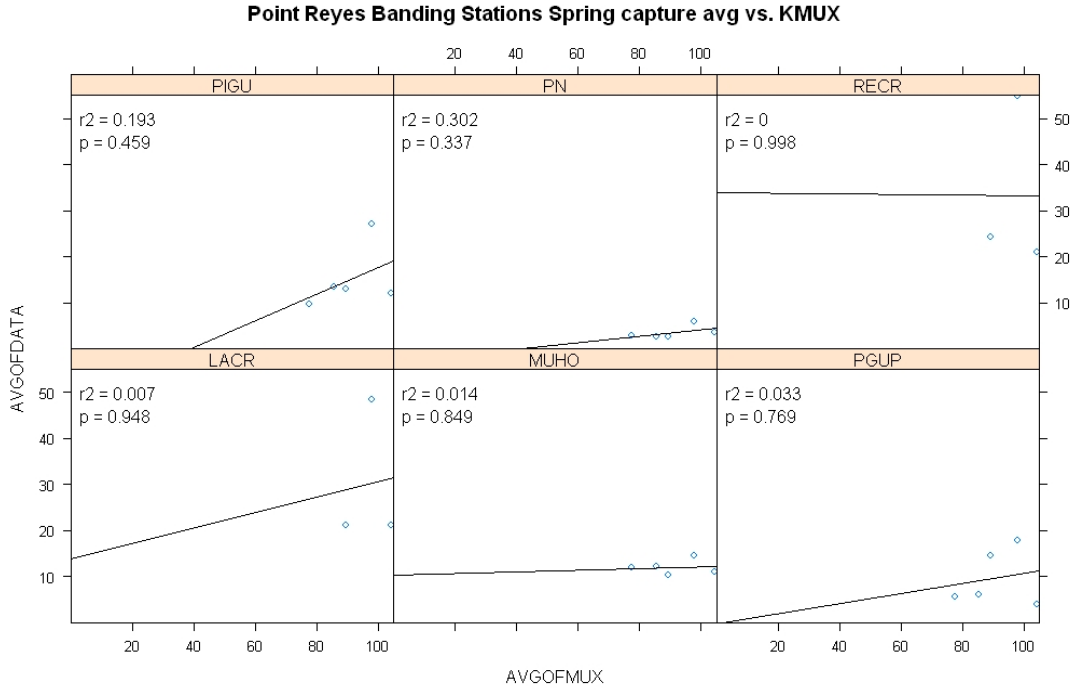


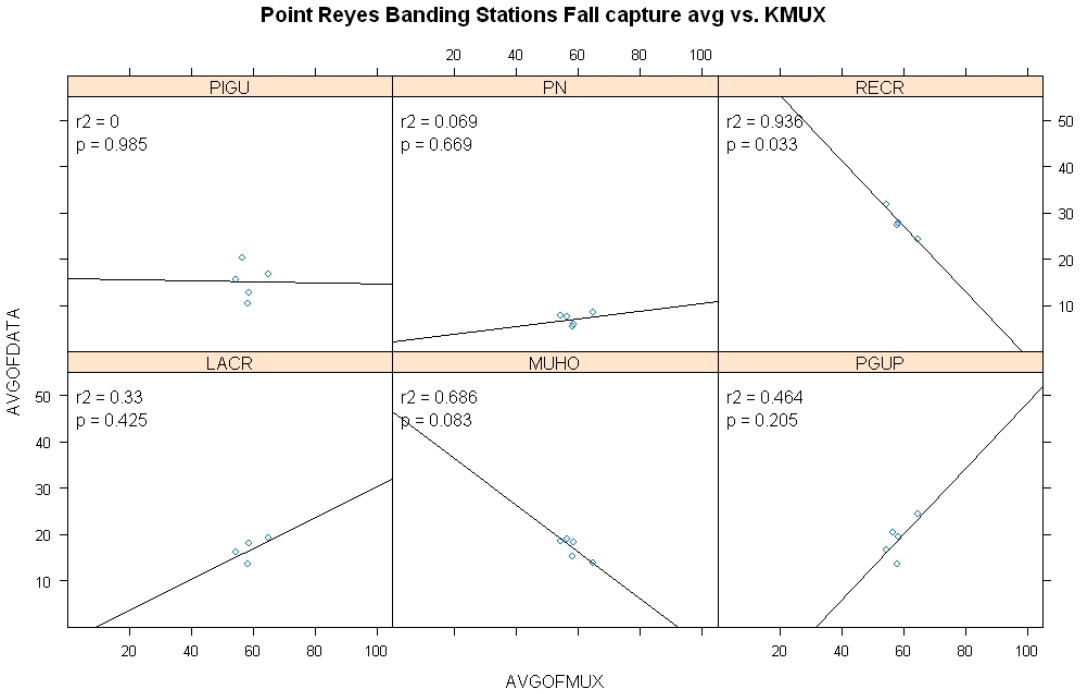
Appendix J. Linear regression plots between radar station KMUX average birds/km^3 and the 10-day average capture rates in the Point Reyes area from 6 stations for spring (top) and fall (bottom).





Appendix K. Linear regression plots between radar station KMUX seasonal average birds/km^3 and the seasonal average capture rates in the Point Reyes area from 6 stations for spring (top) and fall (bottom).





Department of Defense
Legacy Resource Management Program

PROJECT 06-329

Analysis of California Migration Patterns Using NEXRAD and On-the-ground Data

SUPPLEMENT A

Sidney A. Gauthreaux, Jr. and John W. Livingston
Clemson University Radar Ornithology Lab

February 2008

Technical Report

DOPPLER WEATHER SURVEILLANCE RADAR MEASUREMENTS OF BIRD MIGRATION PATTERNS IN THE STATE OF CALIFORNIA

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11 June 2007

INTRODUCTION

This project, "Doppler Weather Surveillance Radar Measurements of Bird Migration Patterns in the State of California," involves the analysis of bird migration patterns using 14 of the WSR-88D Doppler weather surveillance radars (NEXRAD) that cover the state of California (Table 1). The characteristics of the WSR-88D can be found in **Appendix A**. Although the surveillance coverage of some of these radars is blocked by mountains and hills, samples of migration in areas without blockage are possible. The radar analysis covers the spring and fall migration for five years (2000-2004). The extracted data includes the peak density of migration and the direction of movement for nights with migration. The data from this radar analysis will be related to on-the-ground data collected by Point Reyes Bird Observatory over the last several years.

This technical report contains details of the methodology that has been used to analyze the WSR-88D data in the archives at the Clemson University Radar Ornithology Laboratory (CUROL) and presents the findings of the analysis. This report contains the data extracted from the WSR-88D imagery in tables in the Appendices. The Excel data files are also provided. The project start date was delayed until June 2006 and the completion date of the project is June 30, 2007.

Table 1. WSR-88D radars that cover the state of California.

NEXRAD	ICAO RDA	LOCATION	RESPONSIBLE WFO
MEDFORD	KMAX	MEDFORD, OR	MEDFORD, OR
EUREKA (BUNKER HILL)	KBHX	EUREKA, CA	EUREKA, CA
SACRAMENTO	KDAX	DAVIS, CA	SACRAMENTO, CA
LOS ANGELES	KVTX	LOS ANGELES, CA	LOS ANGELES, CA
RENO	KRGX	NIXON, NV	RENO, NV
SACRAMENTO	KDAX	DAVIS, CA	SACRAMENTO, CA
SAN DIEGO	KNKX	SAN DIEGO, CA	SAN DIEGO, CA
SAN FRANCISCO	KMUX	LOS GATOS, CA	MONTEREY/SAN FRANCISCO, CA
SAN JOAQUIN VALY	KHNX	HANFORD, CA	SAN JOAQUIN/ HANFORD, CA
SANTA ANA MTS	KSOX	SANTA ANA MTS, CA	SAN DIEGO, CA
YUMA	KYUX	YUMA, AZ	PHOENIX, AZ
BEALE AFB	KBBX	SACRAMENTO, CA	SACRAMENTO, CA
EDWARDS AFB	KEYX	LAS VEGAS, NV	LAS VEGAS, NV
VANDENBERG AFB	KVBX	ORCUTT, CA	AFWA

METHODS OF ANALYSIS

For the California radar analysis we used the archive of data for all WSR-88D stations in the United States, Alaska, Hawaii, and Puerto Rico at the Clemson University Radar Ornithology Laboratory (CUROL). These data are archived on CD-R and DVD disks. We used computer programs that facilitate the viewing of radar data, the detection of bird targets in the atmosphere, and the quantification of bird migration aloft within 240 km of the radar. We also used archives of surface and aloft weather conditions. Winds aloft are particularly important because flight speed of targets is the best way currently of distinguishing migrating birds from insects and foraging birds and bats in the atmosphere (Gauthreaux and Belser 1998, 1999, 2003).

WSR-88D Data

To determine the amount of migration occurring over each of the 14 WSR-88D radar sites (Table 1), we used a special product developed for CUROL by the Unisys Corporation (Malvern, PA). This product is an unfiltered national mosaic of base reflectivity from each of the approximately 150 WSR-88D stations in the United States. The resolution of the product is 2 km by 2 km with 16 levels of reflectivity values and encoded with a .137 file extension. From 2000 through early May 2002 these products were generated by the Unisys Corporation every 30 minutes and we downloaded them by FTP twice a day. From early May 2002 through 2005 the frequency of product generation was increased to every 15 minutes, and since 2006 the national mosaic maps are generated every 5 minutes--the time it takes the WSR-88D to scan at multiple levels when the radar is operating in the precipitation mode. Because of the volume of data and the fact that the FTP server purges files as new ones are added, we download these files from Unisys several times a day.

To view the national mosaic base reflectivity images we had to rename the .137 file extension to a .637 file extension and place the files in a special product folder (WIS) within the program folder of the SkyView 50® Sofware from the Unisys Corporation. Once the images were placed in the product folder, they could be viewed by opening the SkyView 50 ® Software. A maximum of 99 images could be loaded into the product folder for a viewing session. Initially we opened the first mosaic file that displayed the entire United States. We then placed the cursor over the state of California and magnified the image 4x (Figure 1) to display the WSR-88D coverage over California in more detail.

In order to determine the time of peak nocturnal migration over the coverage area we examined all images between 23:00 UTC and 11:00 UTC the following day. Once we determined the time of peak nightly movement, we entered the maximum relative reflectivity values in decibels of reflectivity (dBZ) for each of the 14 stations into an Excel database along with date and time (UTC). An Excel database was created for each season of the study (Appendices B & C), and data for the 14 stations were arranged in columns within each worksheet in the following sequence: date, time of peak reflectivity, reflectivity value in dBZ levels, direction, comment code, and whether the image was used.

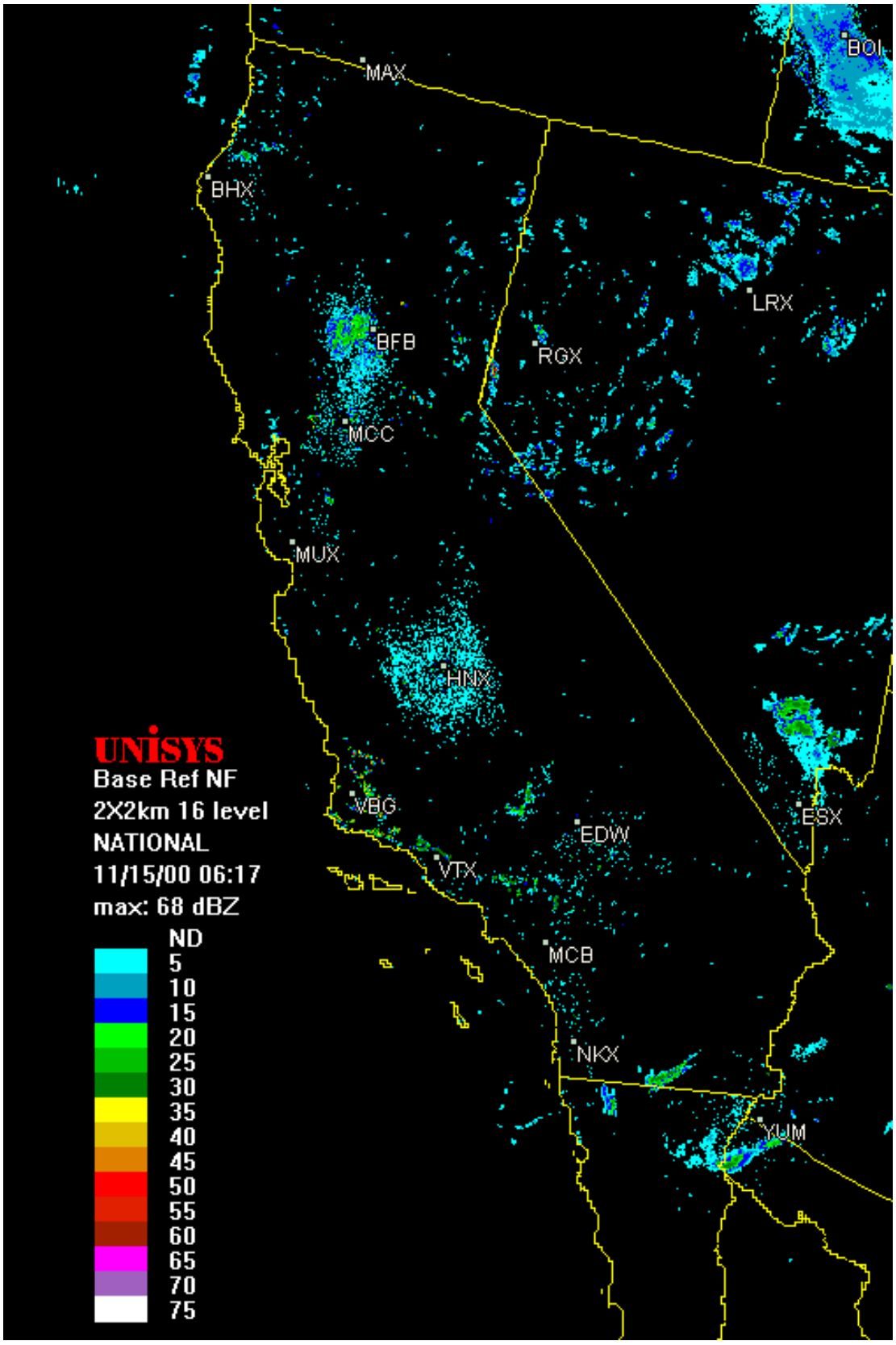


Figure 1. Magnified portion of national mosaic base reflectivity product showing the locations of WSR-88D radars in California and the dBZ bins for reflectivity values.

Because of the value bins in reflectivity data from the WSR-88D (e.g., 5 dBZ, 10 dBZ, 15 dBZ, 20 dBZ, 25 dBZ, see Figure 1), the peak of nightly migration for a radar station falls into discrete density categories (e.g., 59, 71, 109, 227, 602 birds per cubic km, respectively). When no reflectivity (0 dBZ) from biological targets was recorded for a station, no migration was entered into the data base, and when only insect reflectivity was recorded for a station, no migration was recorded in the data base. We have classified movements with densities of 59-109 birds per cubic km as light migratory movements, movements with densities of 227 as medium density movements, and flights with densities of 600 or greater as high density movements. When extensive precipitation was present in a radar coverage area, we noted the event in the database, and coded “no migration” for that night. We confirmed precipitation events over California by examining surface weather maps and satellite maps at the appropriate time. On nights when a radar was not functional (indicated by red station code letters), a "ND" (for no data) was coded into the dBZ column for that station. On a few dates when a national mosaic was not available from Unisys, a code of “ND” was placed in the time column for that date. We processed national mosaics from 15 March to 31 May and from 15 August to 15 November for the years 2000 through 2004.

Because reflectivity alone can not provide information on the direction of flight, we used a subsample of base velocity products (Figure 2) from seven of the 14 stations (KDAX, KESX, KHNX, KMAX, KNKX, KRGX, KYUX, see Table 1 and Figure 1) to determine direction of movement over the State of California. Base velocity images were examined only when base reflectivity data indicated biological targets in the atmosphere. Not all reflectors displayed in base reflectivity products are migrating birds. Occasionally most of the reflectors are insects. In order to discriminate migrating birds from insects, we used radial velocity products (Figure 2) from the CUROL and winds aloft maps (Figure 3) from the Weather Center of Plymouth State University (http://vortex.plymouth.edu/u-make.html). The vector closest to the radar location in the Plymouth winds aloft maps was chosen and compared to the maximum radial velocity value of the reflectors aloft. If the radial velocity of the reflectors was within 3 m/s of the wind speed and moving in the same direction, the reflectors were classified as insects. If the maximum radial velocity was greater than 3 m/s or the reflectors were moving against the wind or at large angles from downwind, the reflectors were classified as migrating birds. When winds were calm and reflectors showed no radial velocity the reflectors were classified as insects. Once the identity of the reflectors was determined to be birds, we recorded the direction of movement in the worksheet. The direction of movement was determined from the base velocity product by measuring the azimuth of maximum inbound/outbound velocity. This can not be done for stations with severe beam blockage, because the maximum inbound and outbound velocities are obscured. For this report three of the 14 stations (from N to S, KMAX, KHNX, and KYUX) were selected for graphical illustration of year-to-year seasonal temporal patterns and the year-to-year seasonal directional tendencies of migration. The direction of migratory movements extracted from the base velocity files was analyzed with the software program Oriana 2.01 (Kovach Computing Services, Anglesey, Wales).

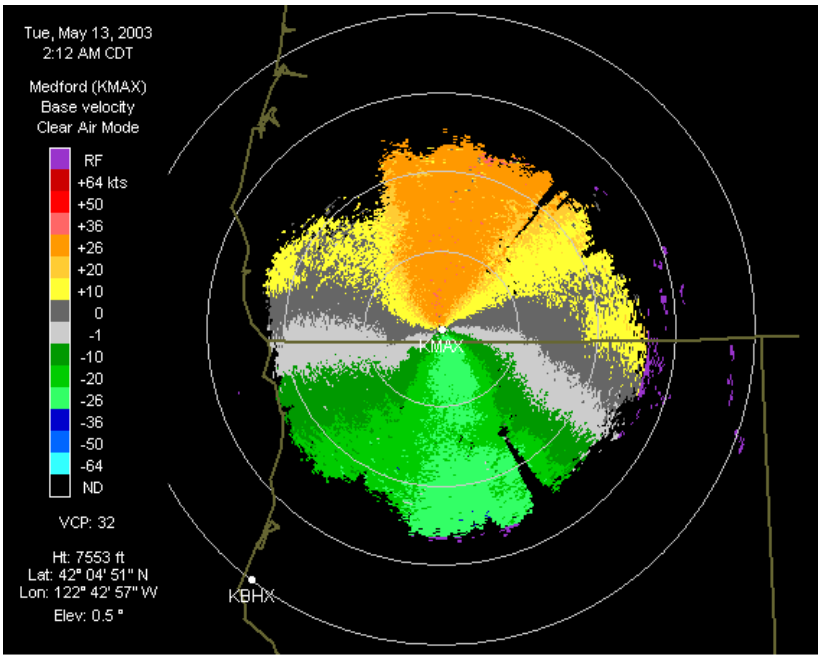


Figure 2. Base velocity product for Medford, OR (MAX) on 13 May 2003 at 07:12 UTC. Targets in green are moving toward the radar and target in shades of yellow and orange are moving away from the radar.

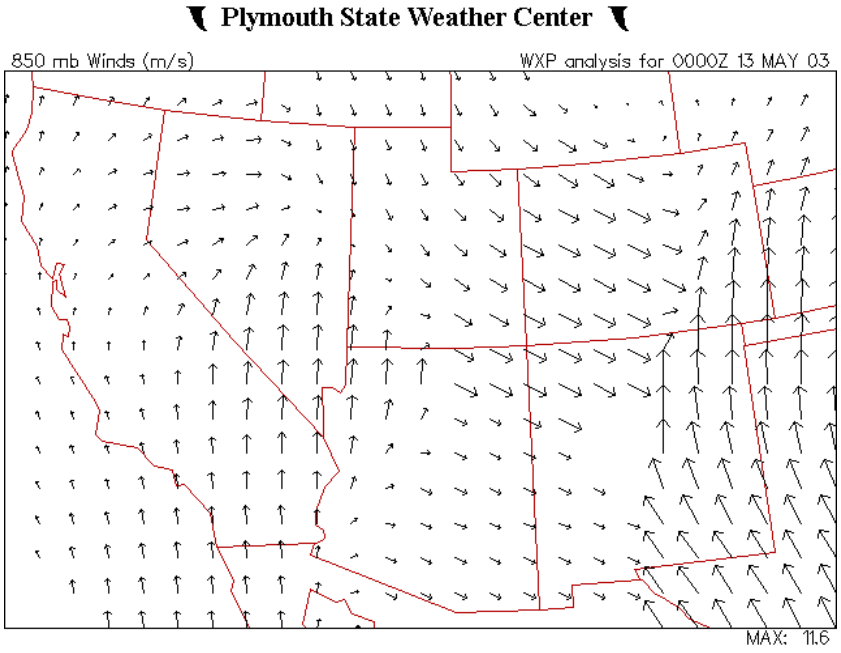


Figure 3. Map of winds aloft for the 850 mb atmospheric pressure level (approximately 1200 m above ground level) on 13 May 2003 at 00:00 UTC. The maximum vector length in this image is 11.6 m/s and the vectors of interest must be compared with it to measure wind velocity. The vector points in the direction of wind flow.

RESULTS AND DISCUSSION

Temporal Patterns--Spring

The seasonal temporal patterns of spring migration in California are shown in Figures 4-6 and the data for all 14 stations can be found in Appendix B. With respect to northern California the temporal pattern of spring migration based on radar data from the WSR-88D at Medford, OR (KMAX) can be found in Figure 4. For the years 2000-2004, the beginning of spring migration appears to be in late March, increases, peaks between about the third week in April and the second week of May, and then declines until the end of May. Occasionally peak nights reached 25 dBZ (602 birds km^{-3}).

The spring temporal pattern for Hanford (KHNX), in the middle of California (Figure 5), for the years 2000-2004 is less clearly defined than in northern California, because the density of peak movement was less in the middle of the State (compare Figures 4 & 5) and the coverage pattern for the Hanford radar was less extensive. Based on the data from the Hanford WSR-88D, migration begins in late March, peaks in the last week of April and the first week in May, and then declines toward the end of May. Most of the peak movements showed 10 dBZ of reflectivity or 71 birds km^{-3}, and on a few occasions reached 15 dBZ (109 birds km^{-3}).

Spring migration in southern California starts a little earlier than in the middle and northern portions of the State. Based on the radar data gathered from the Yuma, Az WSR-88D station (KYUX), migration starts in mid-March, peaks between mid-April and the first week in May, and declines toward the end of May (Figure 6). Several nights from 2000-2004 have peak spring migration reaching 15 dBZ levels (109 birds km^{-3})—more than in the middle of the State but less than in the northern parts of California.

The amount of migration recorded by WSR-88D radars in California during the spring appears to be considerably less than that recorded in the central and eastern United States (Gauthreaux et al. 2003). Along the northern Gulf coast from Brownsville, TX through Mobile, AL, peak migration levels occasionally reach 25-30 dBZ (602-1788 birds km^{-3}) in late April and early May because of trans-Gulf and circum-Gulf migration (Gauthreaux personal observations). For the spring seasons 2000-2004, the highest density of migration recorded passing over northern California was 25 dBZ (602 birds km^{-3}), and this occurred on only three nights over the five spring seasons.

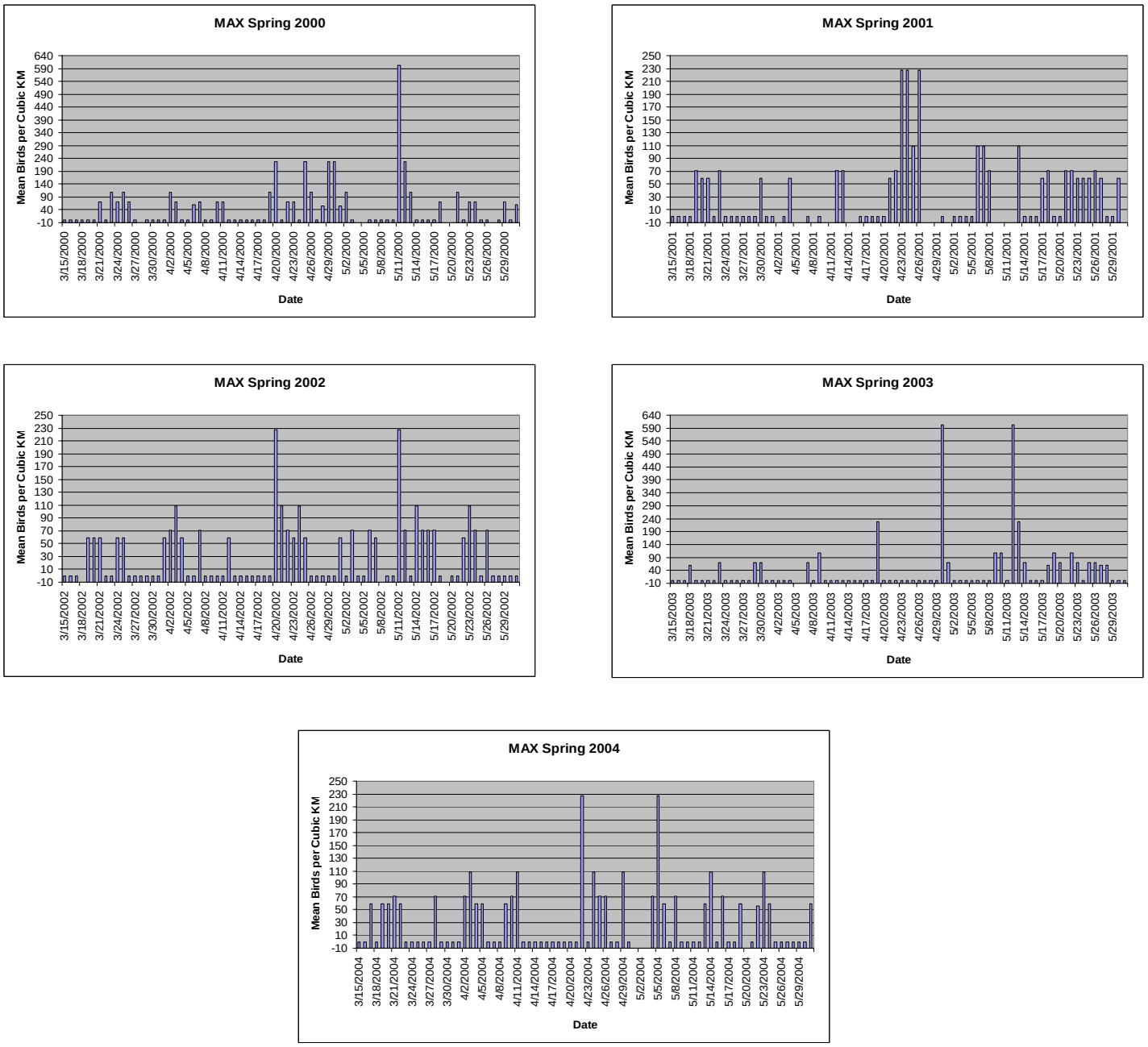
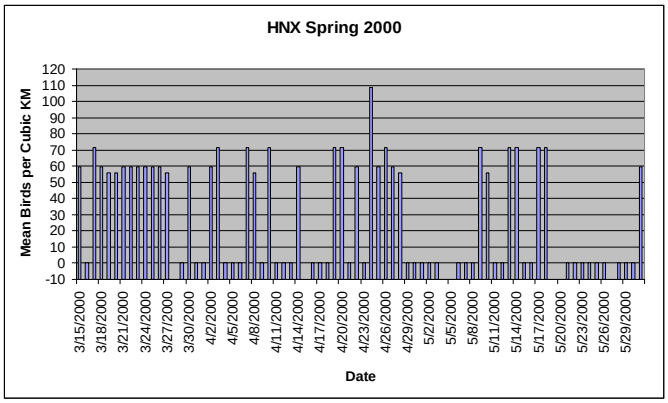
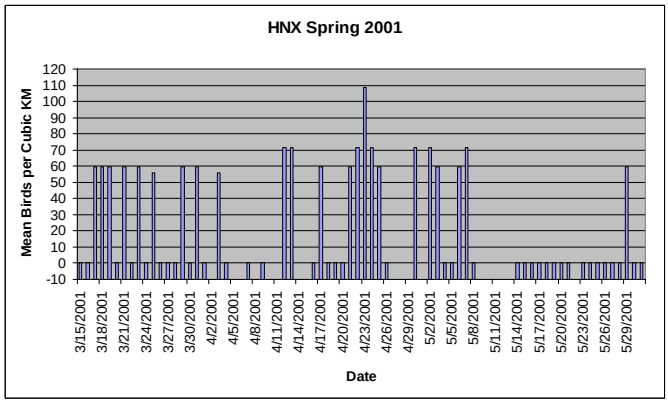
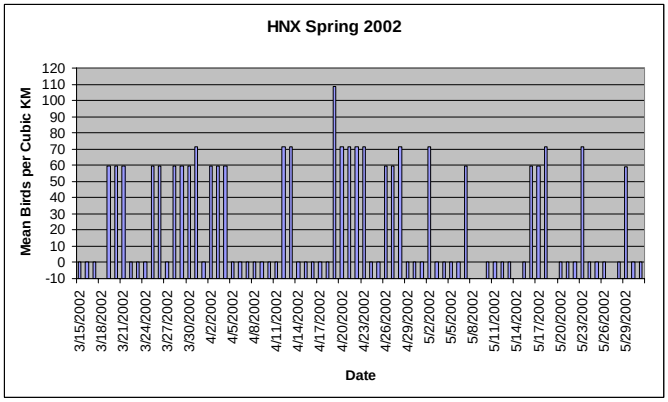
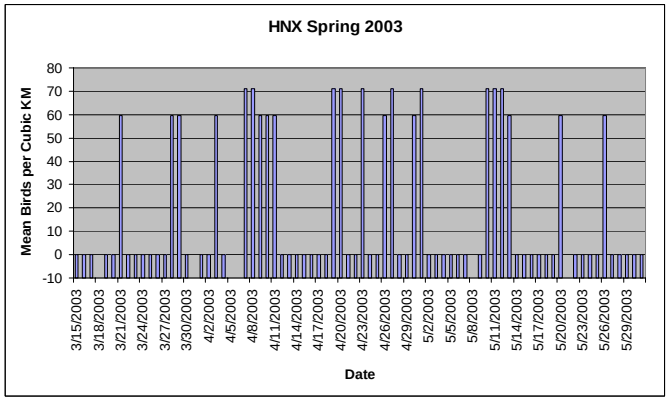


Figure 4. Spring temporal patterns (15 March-31 May) for the Medford, Oregon (KMAX) WSR-88D for the years 2000-2004.









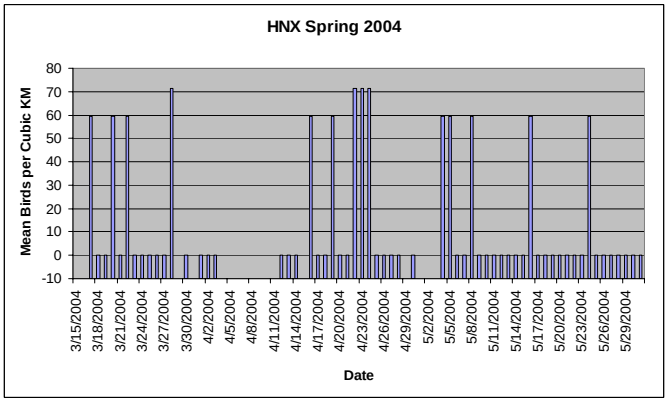
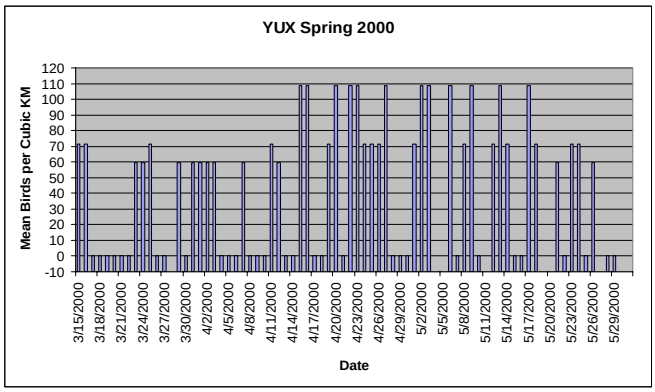
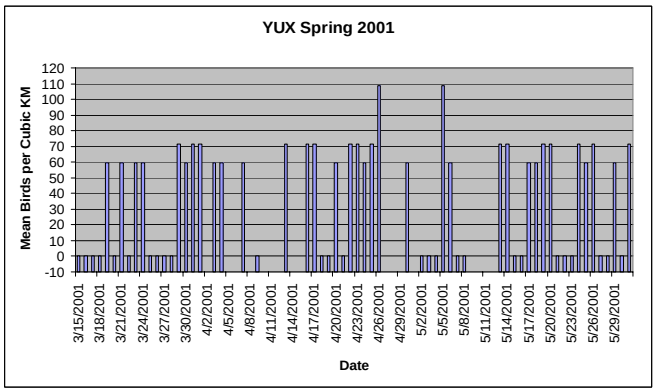
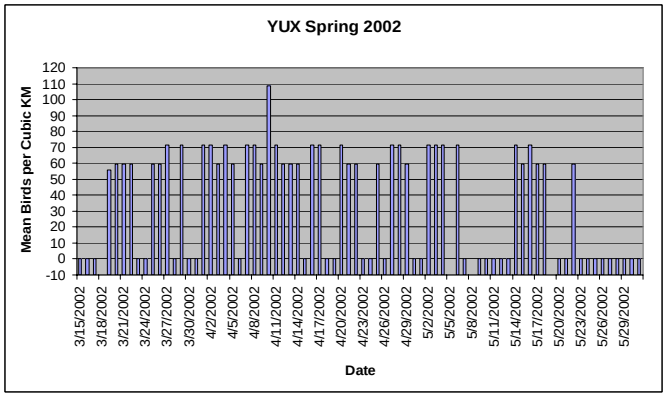
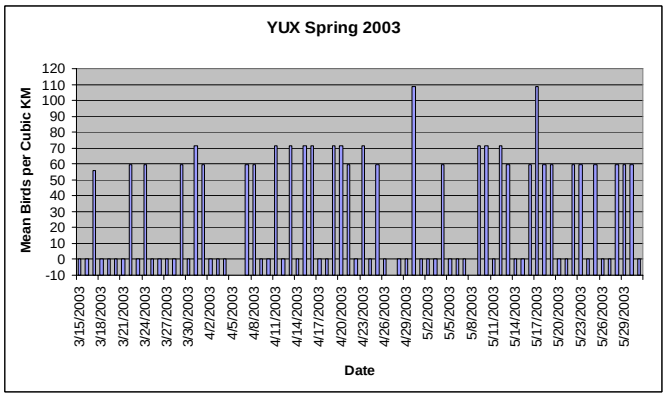


Figure 5. Spring temporal patterns (15 March-31 May) for the Hanford, California (KHNX) WSR-88D for the years 2000-2004.









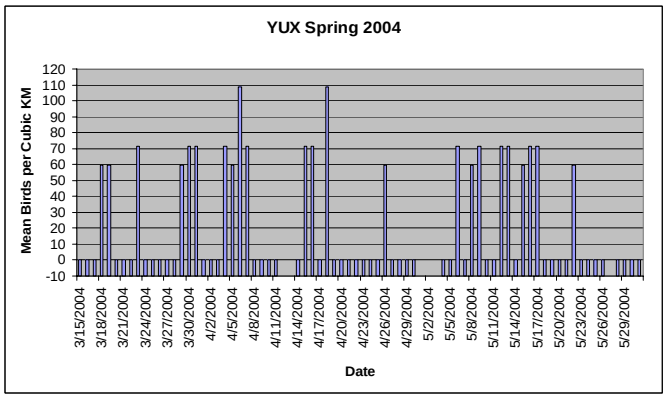


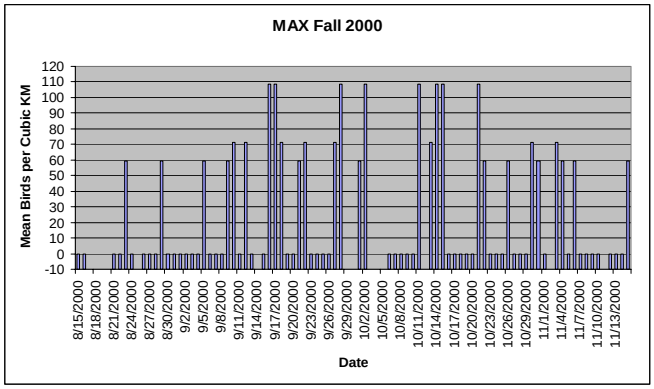
Figure 6. Spring temporal patterns (15 March-31 May) for the Yuma, Arizona (KYUX) WSR-88D for the years 2000-2004.

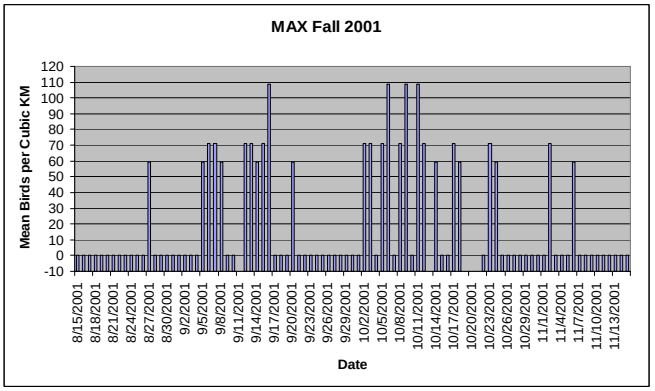
Temporal Patterns--Fall

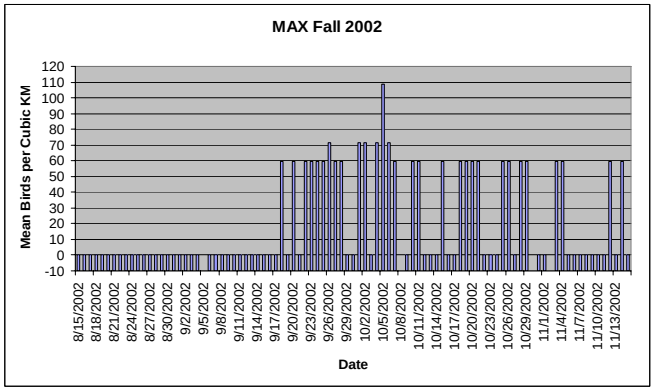
The seasonal temporal patterns of fall migration in California are shown in Figures 7-9 and the data for all 14 stations can be found in Appendix C. The fall temporal patterns of bird migration for northern California for the years 2000-2004 can be found in Figure 7. Based on radar data from the WSR-88D at Medford, OR (KMAX), fall migration begins in the last week of August, increases in mid-September, peaks between the first and the second week of October and then declines through the middle of November. In general the highest dBZ values recorded in the fall are 15 dBZ (109 birds km^{-3}), but this is not the case for every year. During 2000-2004, 15 dBZ levels were reached only during the years 2000-2002. For the years 2003-2004 the highest dBZ values in fall were 10 dBZ (71 birds km^{-3}). A surprising finding is that the magnitude of migration over northern California in fall is less than the magnitude of spring migration. Many of the fall movements had densities of approximately 71 birds km^{-3}, while in spring many of the movements were double that density.

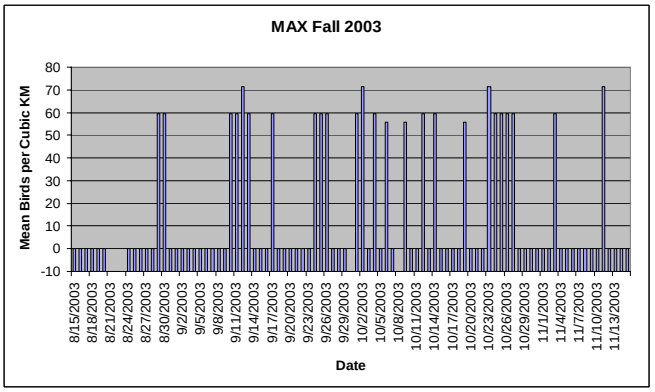
The seasonal temporal pattern of fall bird migration for middle California for the years 2000-2004 can be found in Figures 8. Based on radar data from the WSR-88D at Hanford, CA (KHNX), low density movements (10 dBZ or 71 birds km^{-3}) begin in mid-August, and the first migrations at the 15 dBZ level occur in late August. The peak of fall migration generally occurs around mid-September, and the last movements at the 15 dBZ level are completed by early October. Based on the number of nights when peak reflectivity reached 15 dBZ (109 birds km^{-3}), the amount of migration in the fall in the middle of the State is greater than that recorded in the northern portion of the State (19 nights vs. 13 nights, respectively). Unlike northern California for middle California there is a tendency for fall migration to have higher mean densities than in the spring (spring, 3 nights of 15 dBZ; fall 19 nights of 15 dBZ).

The seasonal temporal pattern of fall bird migration for southern California for the years 2000-2004 can be found in Figures 9. Based on radar data from the WSR-88D at Yuma, AZ (KYUX), low density movements (10 dBZ or 71 birds km^{-3}) begin near the end of August, and peak migration (15-20 dBZ or 109-227 birds km^{-3}) occurs from mid- to late-September. During the five years of study the highest dBZ value reached during fall migration at Yuma was 20 dBZ and this occurred on 25 September 2000. A total of 14 nights had 15 dBZ values, and all occurred within the period 25 August and 13 October. Like northern California, there appeared to be more bird migration during the spring than during the fall (spring 19 nights of 15 dBZ; fall 14 nights of 15 dBZ), but the highest dBZ value (20) for southern California occurred in the fall.









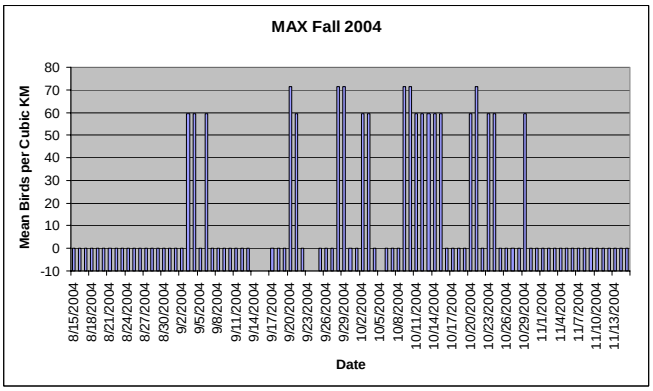


Figure 7. Fall temporal patterns (15 August-15 November) for the Medford, Oregon (KMAX) WSR-88D for the years 2000-2004.

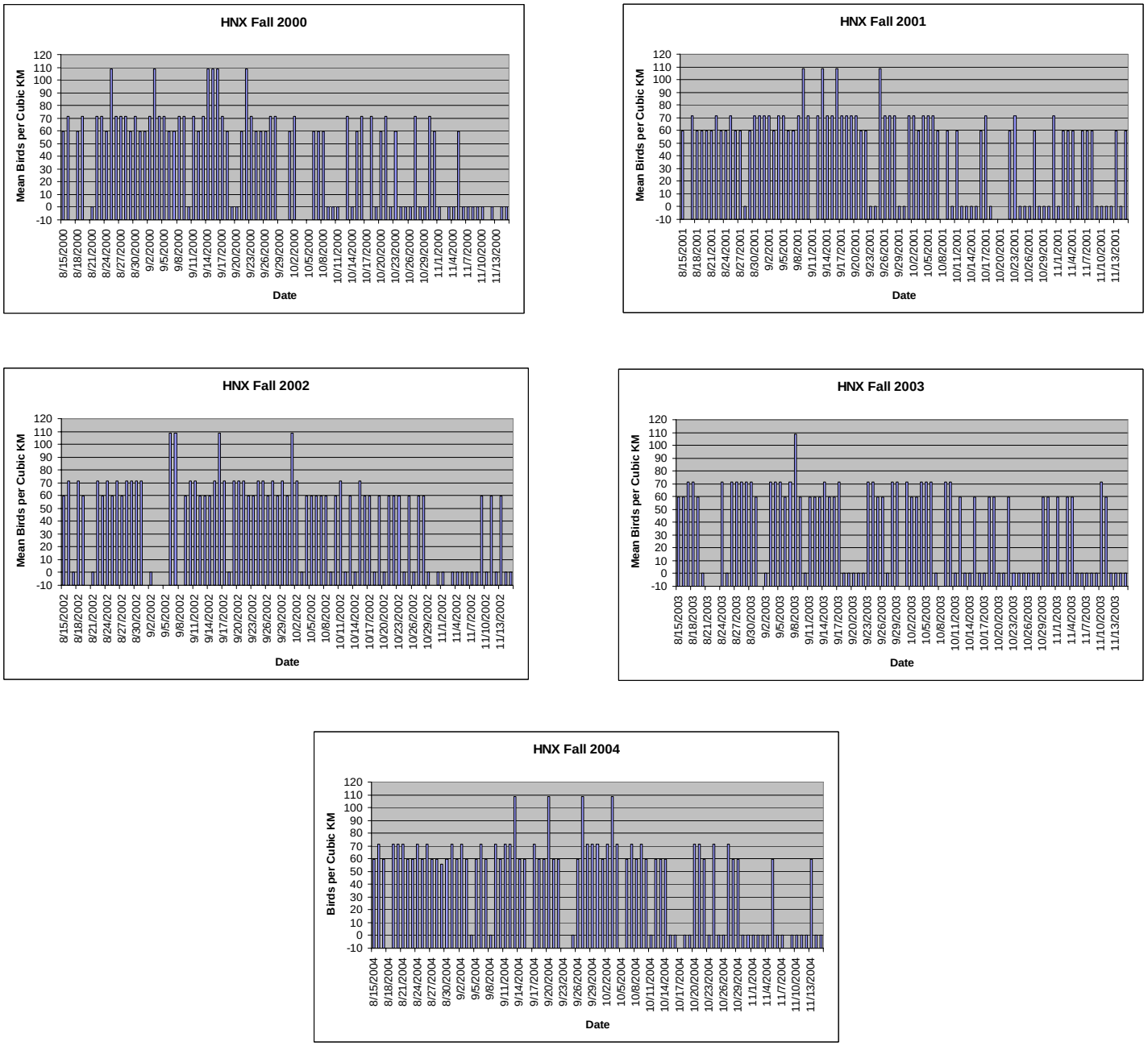
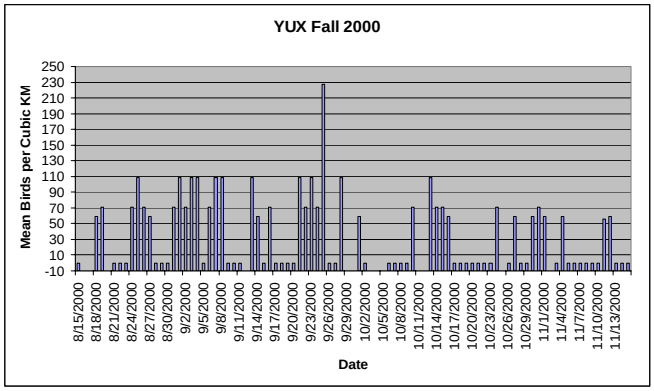
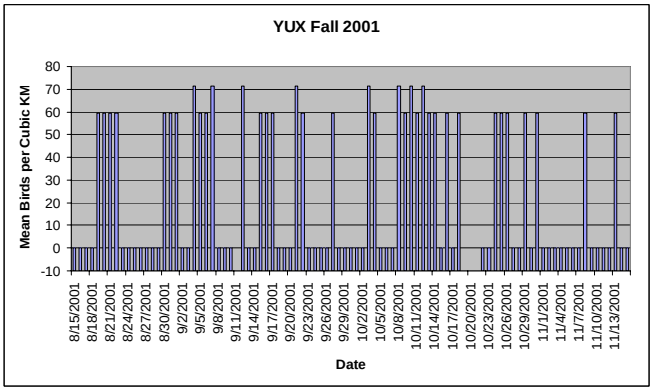
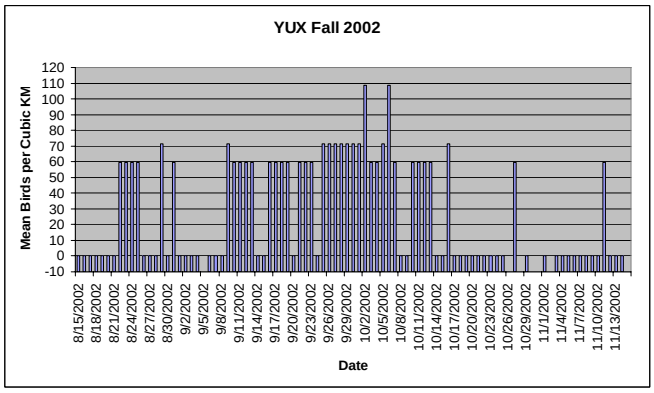
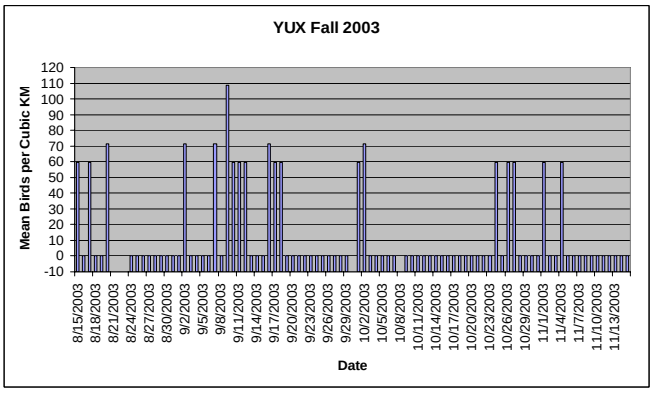


Figure 8. Fall temporal patterns (15 August-15 November) for the Hanford, California (KHNX) WSR-88D for the years 2000-2004.









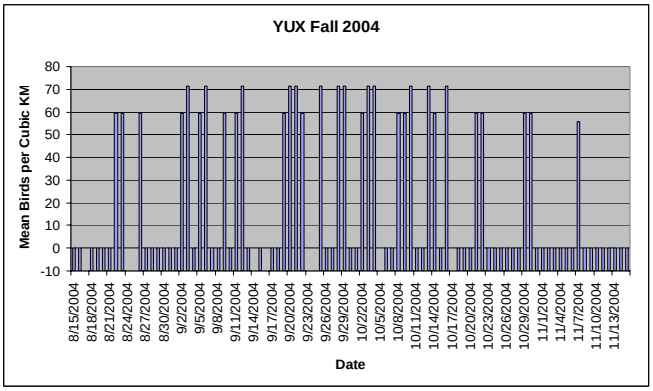


Figure 9. Fall temporal patterns (15 August-15 November) for the Yuma, Arizona (KYUX) WSR-88D for the years 2000-2004.

Directional Patterns--Spring

The results of the analysis of spring migration (15 March-31 May) directional data from the Medford, Oregon (KMAX), Hanford, CA (KHNX), and Yuma, Arizona (KYUX) WSR-88D stations for the years 2000-2004 can be found in Figures 10-12 and the circular statistical analyses can be found in Table 2. The mean direction of spring migration over the five years of study for northern California based on the radar data from Medford, OR is close to north (Figure 10) and the standard error of the mean direction is 3.3° or less (Table 2). There is little variation in the mean direction from year-to-year. The mean direction of migration over the middle part of California based on radar data from Hanford, CA is towards the NNW in spring (Figure 11) and the standard error of the mean direction is equal to 2.07° or less (Table 2). The year-to-year mean direction is also very constant varying from 333° to 339°. In southern California the mean direction of migration based on radar data from Yuma, AZ is towards the NW (314° to 331°) (Figure 12) and the standard error of the mean is 3.78° or less (Table 2). As the standard error suggest there is a little more variability to the directions of nocturnal migration over southern California, but the year-to-year circular distributions are much the same.

Overall the tendency in direction of spring migration changes from south to north in the State. In the south the direction is towards the NW and as one moves northward in the State the direction shifts to the north.

Directional Patterns—Fall

The results of the analysis of fall migration (15 August – 15 November) directional data from the Medford, Oregon (KMAX), Hanford, CA (KHNX), and Yuma, Arizona (KYUX) WSR-88D stations for the years 2000-2004 can be found in Figures 13-15 and the circular statistical analyses can be found in Table 3. The mean direction of fall migration over the five years of study for northern California based on the radar data from Medford, OR is slightly west of south (Figure 13) and the standard error of the mean direction ranges between 3.8° and 5.2° (Table 3). There is little variation in the mean direction from year-to-year (184° to 192°). The mean direction of migration over the middle part of California based on radar data from Hanford, CA is towards the SE in fall (Figure 14) and the standard error of the mean direction ranges from 0.7° to 1.4° (Table 3). The year-to-year mean direction is very constant varying from 146° to 147°. In southern California the mean direction of migration based on radar data from Yuma, AZ is towards the SE (130.2° to 136.8°) (Figure 15) and the standard error of the mean ranges from 3.1° to 3.7° (Table 3).

Overall the tendency in direction of fall migration changes from north to south in California. In the north the direction of movements is toward the SSW. In the middle of the State the direction of fall flights is toward the SSE, and in the southern part of the state fall movements are toward the SE. Thus the pattern of fall migration is reversed (back azimuth) from that recorded in the spring.

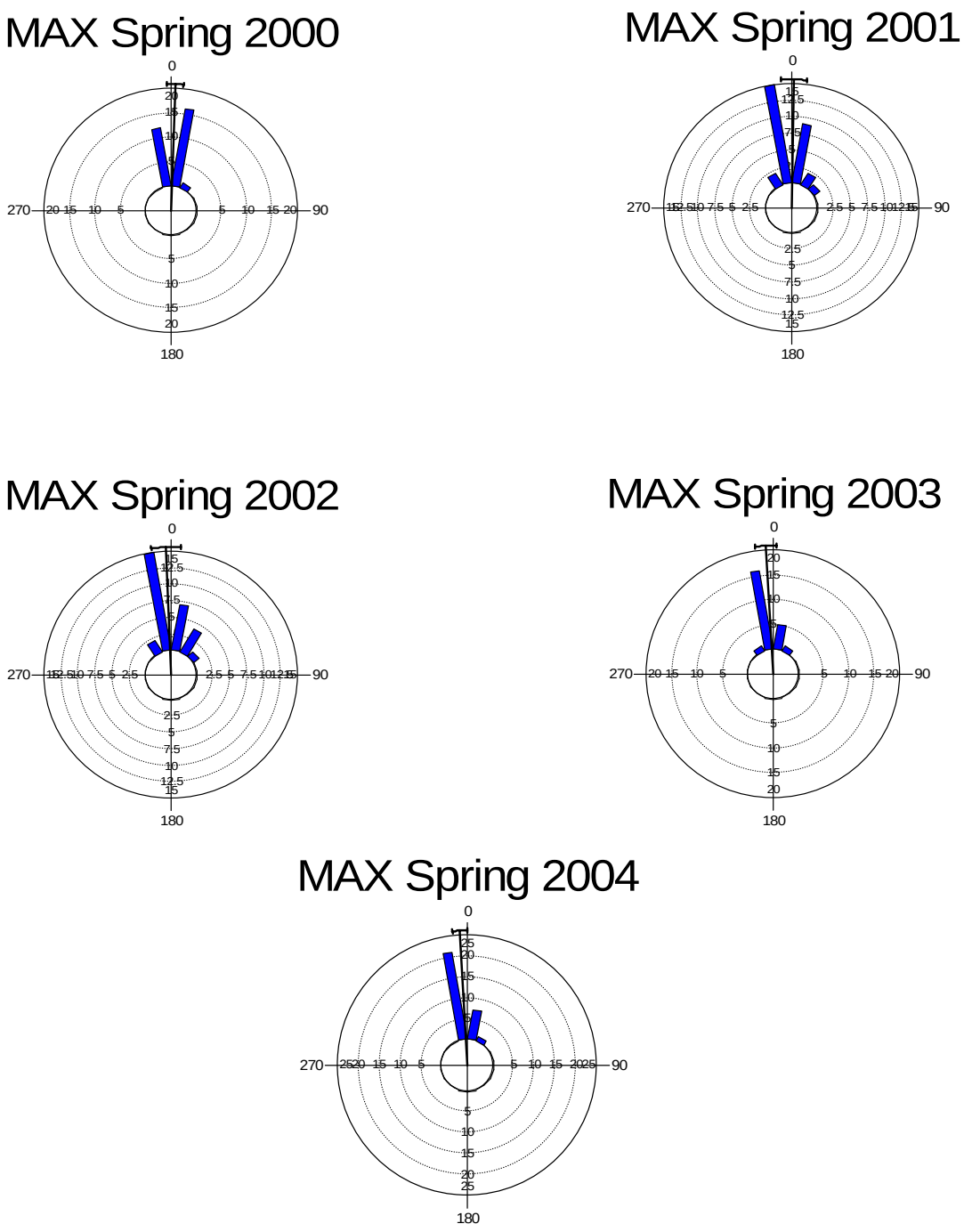


Figure 10. Spring directional patterns (15 March-31 May) for the Medford, Oregon (KMAX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

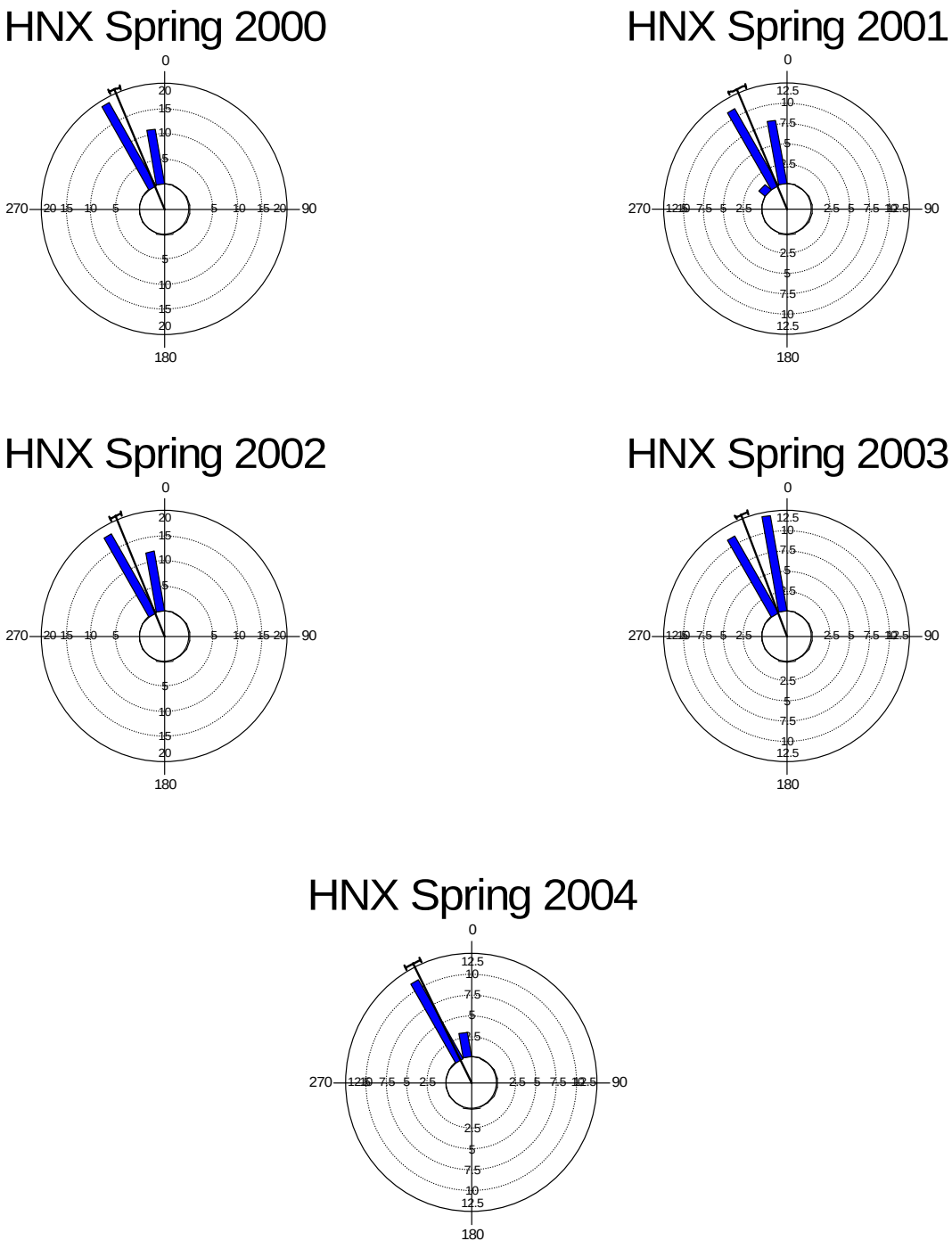


Figure 11. Spring directional patterns (15 March-31 May) for the Hanford, California (KHNX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

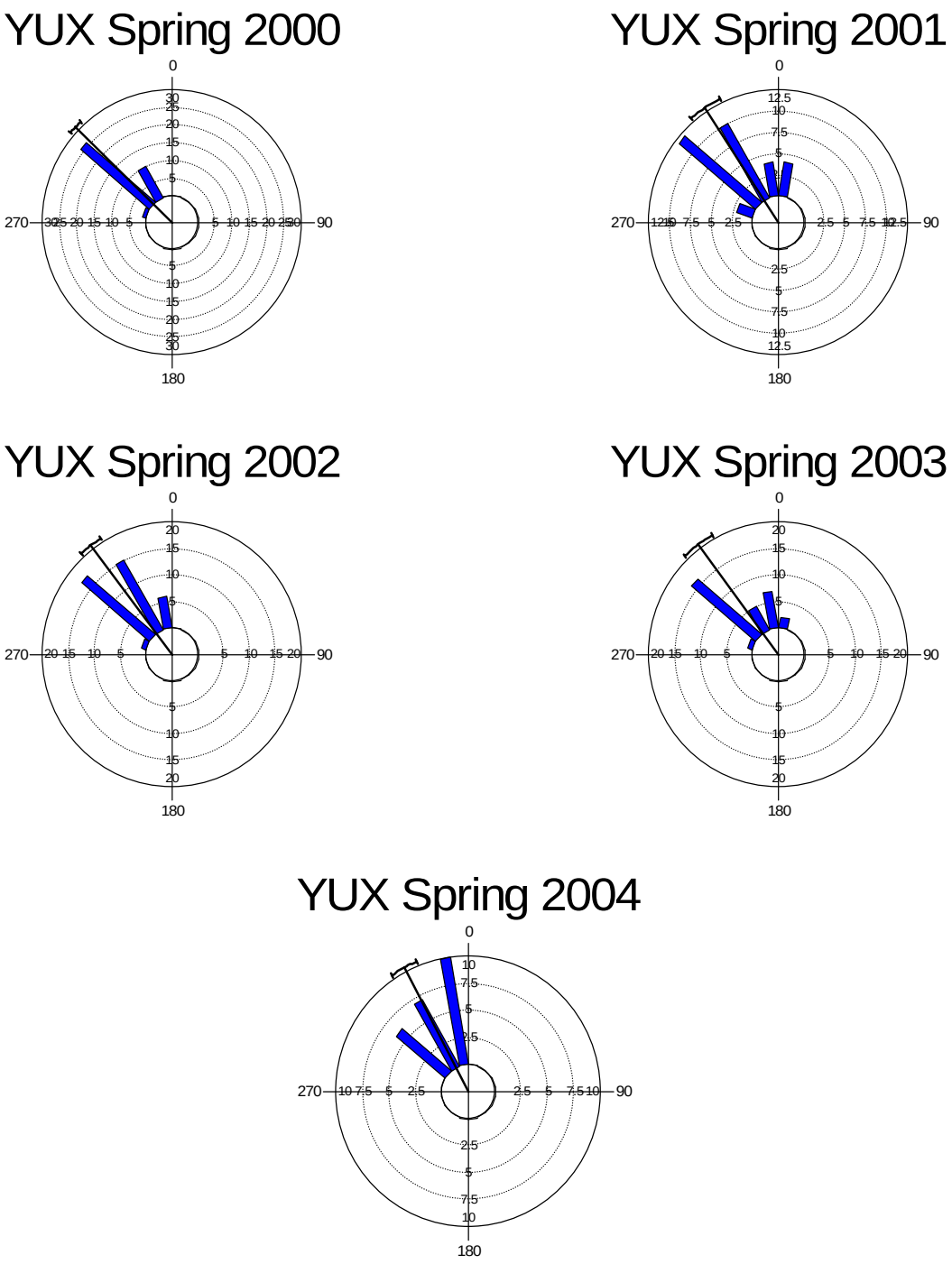


Figure 12. Spring directional patterns (15 March-31 May) for the Yuma, Arizona (KYUX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

Table 2. Circular statistics for flight directions of nightly movements during spring (2000-2004) for Medford, OR (KMAX), Hanford, CA (KHNX), and Yuma, AZ (KYUX).

KMAX Spring					
Variable	2000	2001	2002	2003	2004
Number of Observations	29	29	29	23	29
Mean Vector (μ)	1.751°	0.918°	357.795°	356.721°	356.925°
Length of Mean Vector (r)	0.984	0.964	0.952	0.98	0.988
Median	2°	357°	355°	355°	356°
Concentration	31.755	14.309	10.608	24.738	40.744
Circular Variance	0.016	0.036	0.048	0.02	0.012
Circular Standard Deviation	10.25°	15.427°	18.04°	11.64°	9.032°
Standard Error of Mean	1.903°	2.864°	3.349°	2.427°	1.677°
Rayleigh Test (Z)	28.087	26.972	26.263	22.07	28.288
Rayleigh Test (p)	7.15E-12	1.76E-11	3.09E-11	1.37E-09	6.07E-12
Rao's Spacing Test (U)	302.586	277.172	271.759	290.348	306.172
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

KHNX Spring					
Variable	2000	2001	2002	2003	2004
Number of Observations	30	20	30	23	14
Mean Vector (μ)	336.93°	336.961°	337.33°	339.083°	333.142°
Length of Mean Vector (r)	0.992	0.987	0.992	0.993	0.994
Median	337°	339°	338°	340°	335°
Concentration	65.851	38.731	60.322	67.056	70.492
Circular Variance	0.008	0.013	0.008	0.007	0.006
Circular Standard Deviation	7.088°	9.267°	7.408°	7.023°	6.108°
Standard Error of Mean	1.294°	2.072°	1.353°	1.464°	1.829°
Rayleigh Test (Z)	29.544	19.484	29.503	22.657	13.842
Rayleigh Test (p)	2.00E-12	1.23E-08	2.07E-12	8.85E-10	7.77E-07
Rao's Spacing Test (U)	321	296	320	309.348	315.286
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

KYUX Spring					
Variable	2000	2001	2002	2003	2004
Number of Observations	37	32	39	31	23
Mean Vector (μ)	314.08°	326.881°	322.535°	323.185°	331.887°
Length of Mean Vector (r)	0.986	0.932	0.958	0.936	0.969
Median	311°	323°	321°	315°	331°
Concentration	36.213	7.673	12.257	8.125	16.227
Circular Variance	0.014	0.068	0.042	0.064	0.031
Circular Standard Deviation	9.588°	21.437°	16.723°	20.788°	14.454°
Standard Error of Mean	1.576°	3.787°	2.677°	3.731°	3.013°
Rayleigh Test (Z)	35.978	27.82	35.815	27.176	21.582
Rayleigh Test (p)	0	7.01E-12	0	1.27E-11	1.95E-09
Rao's Spacing Test (U)	312.27	264.5	283.538	271.774	296.348
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

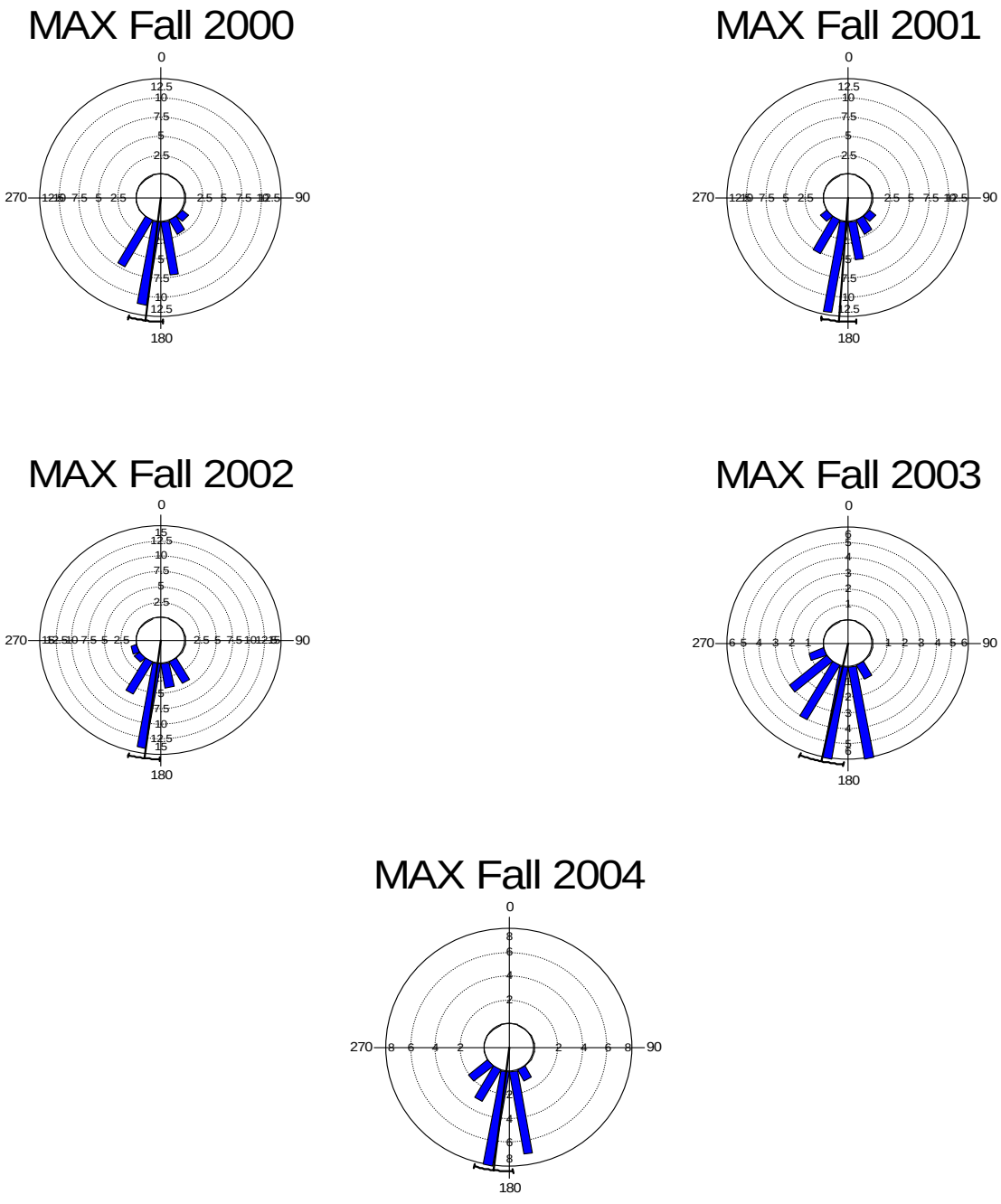


Figure 13. Fall directional patterns (15 August-15 November) for the Medford, Oregon (KMAX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

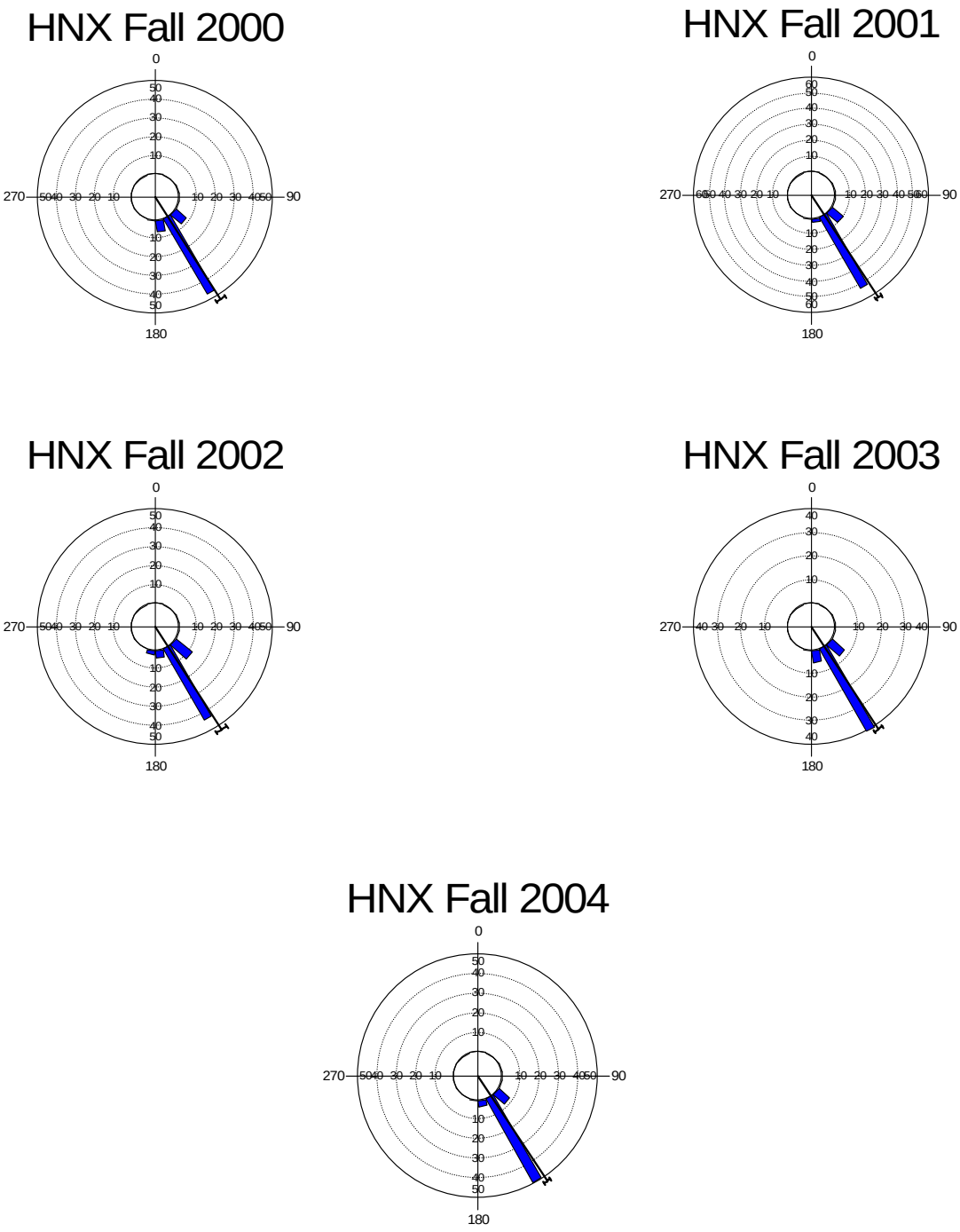


Figure 14. Fall directional patterns (15 August-15 November) for the Hanford, California (KHNX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

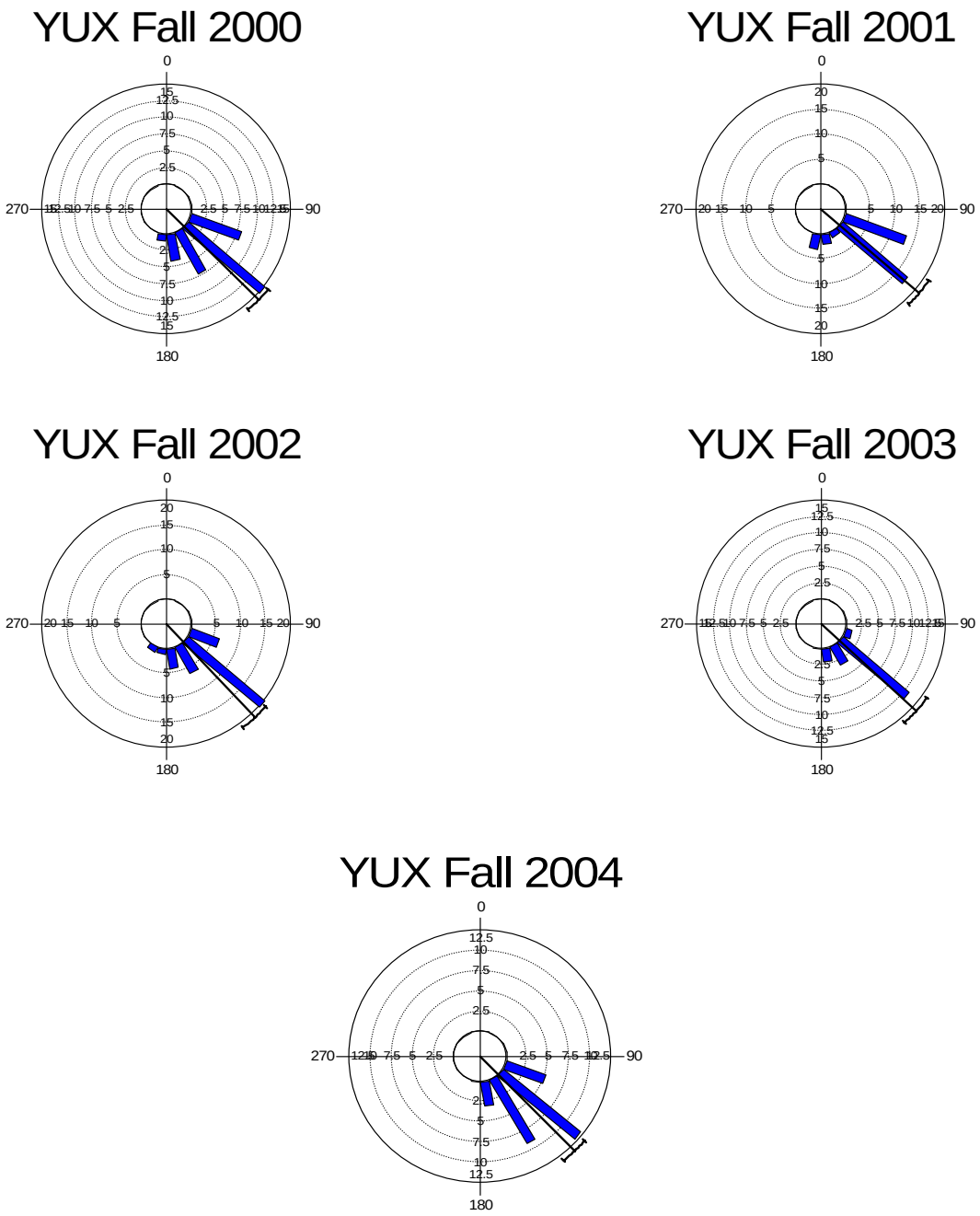


Figure 15. Fall directional patterns (15 August-15 November) for the Yuma, Arizona (KYUX) WSR-88D for the years 2000-2004. The solid radius line is the mean angle of the directional data, and the arc at the end of the line indicates the 95% confidence limits of the mean.

Table 3. Circular statistics for flight directions of nightly movements during fall (2000-2004) for Medford, OR (KMAX), Hanford, CA (KHNX), and Yuma, AZ (KYUX).

	MAX Fall				
Variable	2000	2001	2002	2003	2004
Number of Observations	28	26	30	21	21
Mean Vector (μ)	187.077°	184.223°	187.713°	192.333°	187.138°
Length of Mean Vector (r)	0.931	0.935	0.936	0.917	0.938
Median	193.5°	185.5°	186°	190°	183°
Concentration	7.51	7.931	8.092	6.296	8.341
Circular Variance	0.069	0.065	0.064	0.083	0.062
Circular Standard Deviation	21.687°	21.059°	20.833°	23.875°	20.497°
Standard Error of Mean	4.095°	4.127°	3.801°	5.204°	4.47°
Rayleigh Test (Z)	24.263	22.715	26.285	17.653	18.477
Rayleigh Test (p)	1.60E-10	6.22E-10	2.80E-11	3.49E-08	2.09E-08
Rao's Spacing Test (U)	258.286	253.308	262	248.714	262.857
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

	HNX Fall				
Variable	2000	2001	2002	2003	2004
Number of Observations	59	63	60	52	59
Mean Vector (μ)	147.599°	146.552°	147.022°	146.734°	146.181°
Length of Mean Vector (r)	0.987	0.994	0.981	0.989	0.992
Median	146°	146°	146°	146°	146°
Concentration	37.306	83.822	27.144	47.57	65.869
Circular Variance	0.013	0.006	0.019	0.011	0.008
Circular Standard Deviation	9.445°	6.277°	11.102°	8.352°	7.087°
Standard Error of Mean	1.23°	0.791°	1.433°	1.158°	0.923°
Rayleigh Test (Z)	57.418	62.248	57.789	50.907	58.104
Rayleigh Test (p)	0	0	0	0	0
Rao's Spacing Test (U)	308.797	326.286	297	312.154	318.898
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

	YUX Fall				
Variable	2000	2001	2002	2003	2004
Number of Observations	35	36	38	19	29
Mean Vector (μ)	134.441°	130.266°	136.805°	132.625°	136.143°
Length of Mean Vector (r)	0.946	0.935	0.931	0.959	0.957
Median	130°	125°	133.5°	130°	135°
Concentration	9.602	7.918	7.48	12.559	11.82
Circular Variance	0.054	0.065	0.069	0.041	0.043
Circular Standard Deviation	19.016°	21.077°	21.734°	16.511°	17.044°
Standard Error of Mean	3.213°	3.51°	3.523°	3.787°	3.164°
Rayleigh Test (Z)	31.349	31.443	32.907	17.486	26.544
Rayleigh Test (p)	0	0	0	5.11E-08	2.47E-11
Rao's Spacing Test (U)	275.714	292	258.158	281.053	276.172
Rao's Spacing Test (p)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

LITERATURE CITED

Gauthreaux, Sidney A., Jr. and Carroll G. Belser. 1998. Displays of bird movements on the WSR-88D: Patterns and quantification. Weather and Forecasting 13:453-464.

Gauthreaux, Sidney A., and Carroll G. Belser. 2003. Bird movements on Doppler weather surveillance radar. Birding 35 (6):616-628.

Gauthreaux, Sidney A., Jr. and Carroll G. Belser. 1999. "Reply" to displays of bird movements on the WSR-88D: Patterns and quantification. Weather and Forecasting 14:1041-1042.

Gauthreaux, Sidney A., Jr., Carroll G. Belser, and Donald E. Van Blaricom. 2003. Using a network of WSR88-D weather surveillance radars to define patterns of bird migration at large spatial scales. In: Berthold, P., E. Gwinner, and E. Sonnenschein (eds.) Avian Migration. Pp. 335-346. Springer-Verlag, Germany.

APPENDIX A

Table A-1. WSR-88D characteristics (from National Research Council 2002).

Parameter/Feature	
Radar System	**Value/Description**
Range of observation	
Reflectivity	460km
Velocity	230km
Angular Coverage	
Azimuth	Full circle or sector
Elevation	Operational limits; -1° to +20°
Antenna	
Type	S-Band, center-fed, parabolic dish
Reflector aperture	8.54-m (28-ft) diameter; circular
Beamwidth (one-way, 3 dB)	0.96° at 2.7 GHz; 0.88° at 3.0 GHz
Gain	45.8 dB at 2.85 GHz (midband)
Polarization	Linear horizontal
First side-lobe level	-29 dB
Steerability	360° azimuth; -1° to +45° elevation
Mechanical limits	-1° to +60°
Rotation rate	30° s^{-1} (azimuth and elevation)
Angular acceleration	15° s^{-2} (azimuth and elevation)
Pointing accuracy	±0.2°
Radome	
Type	Fiberglass skin foam sandwich
Diameter	11.89m (39 ft.)
RF Loss (two-way)	0.3 ± 0.06 dB over 2.7–3.0 GHz band
Transmitter	
Type	Master Oscillator Power Amplifier (MOPA)
Frequency range	2.7–3.0 GHz
Peak power output (nominal)	500 kW into antenna
Pulsewidth (nominal)	1.57 µs (short pulse); 4.5 µs (long pulse) ± 4%
RF duty cycle (maximum)	0.002
Pulse Repetition Frequency	
Long pulse	322–422 Hz ± 1.7%
Short pulse	322–1282 Hz ± 1.7%
Waveform types	Contiguous and batch
Receiver	
Type	Linear
Tunability (frequency range)	2.7–3.0 GHz
Bandwidth (3 dB)	0.63 MHz (short pulse); 0.22 MHz (long pulse)
Phase control	Selectable
Receiver channels	Linear output I/Q; log output
Dynamic range	95 dB max; 93 dB at 1 dB compression
Minimum detectable signal	-113 dBm
Noise temperature	450 K
Intermediate frequency	57.6 MHz
Sampling rate	600 kHz

Table A-1. Continued.

Parameter/Feature	
Radar System	**Value/Description**
Signal Processor	
Type	Hardwired/programmable
Parameters derived	Reflectivity; mean radial velocity; Doppler spectral width
Algorithms (respective)	Power averaging; pulse-pair; single-lag correlation
Accuracy (Standard Deviation)	
Reflectivity	< 1 dB
Velocity and spectrum width	< 1 m s^{-1}
Number of Pulses Averaged	
Reflectivity	6–64
Velocity and spectrum width	40–200
Range Resolution	
Reflectivity	1 km
Velocity and spectrum width	0.25 km
Azimuth Resolution	
Reflectivity	1°
Velocity and spectrum width	1°
Clutter canceller	Digital, infinite impulse response (IIR), 5-pole
Clutter suppression	30–50 dB
Filter notch half-width	0.5–4 m s^{-1}

Appendix B

Table B-1. Data[1] for spring season (15 March-31 May) of 2000 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Spring 2000													
		ESX				RGX				YUX			
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Mar	7:13	0			X	0			X	10	310	P	X
16-Mar	7:29	5	310	P	X	0			X	10	326	P	X
17-Mar	7:14	0			X	0			X	0			X
18-Mar	7:03	5	309		X	5				5		P	
19-Mar	5:55	0		P	X	0			X	10		MI	
20-Mar	6:42	0		P	X	0			X	5		MI, P	
21-Mar	7:54	0			X	0			X	0		P	X
22-Mar	6:42	5	305		X	5		P		5		MI	
23-Mar	7:02	0			X	5	42		X	5	309	ST	X
24-Mar	6:58	10	310		X	10	355	P	X	5	311		X
25-Mar	7:21	5	308		X	5	25		X	10	310		X
26-Mar	7:11	5	335		X	5	355		X			P	
27-Mar	6:56			P		0			X			P	
28-Mar	ND												
29-Mar	7:03	10		P		0			X	5	324	ST	X
30-Mar	5:52			P		0			X			P	
31-Mar	6:45	0			X	0			X	5	316	P	X
1-Apr	7:13	5		MI		0			X	5	308		X
2-Apr	7:38	5		MI		0			X	5	336		X
3-Apr	7:02	5	310	P	X	10	15		X	5	309		X
4-Apr	6:55	10	318		X	0			X			P	
5-Apr	6:49	5	340	P	X	0			X	10		P	
6-Apr	7:41			P		0			X			P	
7-Apr	7:06	5	318		X	5	8		X	5	300	HM	X
8-Apr	6:58	10	315		X	0			X	5		HM	
9-Apr	7:22	ND				0			X	15		MI	
10-Apr	6:48			P		0			X	15		MI	
11-Apr	7:13	10	310		X	10	20		X	10	309	ST	X
12-Apr	6:36	10	309		X			P		5	328		X
13-Apr	6:30			P				P		10		P, MI	
14-Apr	6:53			P		0			X	0		P	
15-Apr	6:47			P				P		15	315	ST	X
16-Apr	7:10	5	315		X			P		15	314		X
17-Apr	7:02			P				P		15		P, MI	
18-Apr	7:22	0			X	0			X	5		MI	
19-Apr	7:15	15	322		X	10	0		X	10	300		X
20-Apr	7:11	15	334		X	10	345		X	15	320		X
21-Apr	7:07			P				P		10		MI	
22-Apr	7:34	5	330		X	0			X	15	305		X
23-Apr	7:41	10		MI		5		MI		15	310		X

Table B-1 Continued

24-Apr	7:22	10	312		X	0		MI	X	10	307		X
25-Apr	6:41	15	320		X	5	35	MI	X	10	308		X
26-Apr	6:57	ND				ND				10	314		X
27-Apr	6:50	ND				ND				15	318		X
28-Apr	7:09	5		MI		ND				15		MI	
29-Apr	7:00	5		MI		ND				15		MI	
30-Apr	6:51	10	286		X	ND				10		MI	
1-May	7:41	10	332		X			P		10	304		X
2-May	7:01	10	330		X	10	27		X	15	316	P	X
3-May	7:24	10				0			X	15	310		X
4-May	ND												
5-May	ND												
6-May	7:04			P				P		15	323		X
7-May	6:31	5		MI				P		15		MI	
8-May	6:51	ND						P		10	299	HM	X
9-May	7:38			MAL		0			X	15	327		X
10-May	7:25	0			X	0			X	15		MI	
11-May	7:11	10		MI		0			X			RM	
12-May	7:02	15	309		X	10	9	P	X	10	303		X
13-May	6:55	10	345	MI	X	5	358		X	15	315		X
14-May	7:16	5	325	MI	X	0			X	10	320	HM	X
15-May	7:33			MI				P		10		MI	
16-May	6:53			P		0			X	5		MI	
17-May	7:15			P		5		MI		15	307		X
18-May	6:38	10	320	MI	X	5	18		X	10	305	ST	X
19-May	ND												
20-May	ND												
21-May	7:38	5	320	P,	X	10		MI		5		ST,MI	
22-May	6:56	10		MI, P		5	4		X	10		ST	
23-May	7:15	5		MI				P		10	337		X
24-May	7:31	5	330	P	X	5		MI		10	330		X
25-May	7:17			P		0			X	5		MI	
26-May	7:05	5		P, MI		5		MI		5	319		X
27-May	ND												
28-May	7:09	5		MI		0			X	5		MI	
29-May	6:59	5		MI		0			X	0		MI	X
30-May	7:15	0			X	0			X	ND			
31-May	7:28	5	320		X	0			X	ND			

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-2. Data[1] for spring season (15 March-31 May) of 2000 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Spring 2000													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Mar	7:13	5	350		X	0		0		5		5	
16-Mar	7:29	5		MI			P	0		5	P	0	
17-Mar	7:14	10	340		X	5		0		5		5	
18-Mar	7:03	5	345		X	5		5		5		5	
19-Mar	5:55	0		BT	X		P	0		0	P	0	P
20-Mar	6:42	0			X		P	0			P	ND	
21-Mar	7:54	5	345		X	0		10		5		5	
22-Mar	6:42	5	352		X	0		ND		5		5	
23-Mar	7:02	5	341		X	0		5			P	5	
24-Mar	6:58	5	330		X	5		5		0		5	
25-Mar	7:21	5	330		X	5		5		5		5	
26-Mar	7:11	5	335		X	5		5		5		10	
27-Mar	6:56	0			X		P	0		0			P
28-Mar	ND												
29-Mar	7:03	5		MI		0		5		5		0	
30-Mar	5:52	5	345	P	X		P	0	P	5	P	5	P
31-Mar	6:45			P			P	0		5		5	P
1-Apr	7:13	5		MI		5		10		5		5	
2-Apr	7:38	5	347		X	5	MI	10		5		5	
3-Apr	7:02	10	325		X	5		5		5		5	
4-Apr	6:55	5		MI		5		10		5		5	P
5-Apr	6:49	5		MI		5		5		5		5	
6-Apr	7:41	5		MI		0		10		5		5	
7-Apr	7:06	10	333		X	5		10			P	5	
8-Apr	6:58	0			X	5		5		5		5	
9-Apr	7:22	5		MI			P	10		5		10	
10-Apr	6:48	10	337		X	5	P	15		5		5	
11-Apr	7:13			P		5			P	5		5	
12-Apr	6:36			P		10			P	10	P	5	
13-Apr	6:30			P		0	P		P	0		0	
14-Apr	6:53	5	325		X	0		10		0		0	
15-Apr	6:47	5	335		X	15		10		5		10	
16-Apr	7:10			P		15			P		P		P
17-Apr	7:02	10		P			P	15			P		P
18-Apr	7:22	5		MI		0		15		15		5	
19-Apr	7:15	10	337		X	10		15		15		15	
20-Apr	7:11	10	334		X	5		15		15		10	
21-Apr	7:07	10		MI			P	10			P		P
22-Apr	7:34	5	340		X	0		10		10		5	
23-Apr	7:41	5		MI		5		20		15		5	

Table B-2 continued

24-Apr	7:22	15	344		X	10		20		20		15	
25-Apr	6:41	5	339		X	10		10		10		10	
26-Apr	6:57	10	337		X	10		15		5	P	15	
27-Apr	6:50	5	325		X	5	P	10		10		5	
28-Apr	7:09	0			X	5	P	5		0		5	
29-Apr	7:00	10	331		X	5		15		10		15	
30-Apr	6:51	10		MI		ND		25	P	10		5	
1-May	7:41	10		MI		10		10		ND		10	
2-May	7:01	10		MI			P	20		15	P	15	
3-May	7:24	15		MI		5	P	15		20		20	
4-May	ND												
5-May	ND												
6-May	7:04			P			P		P	10		5	
7-May	6:31			P			P		P	5		5	
8-May	6:51			P		10			P		P	5	
9-May	7:38	10	341		X	5		15		5		5	
10-May	7:25	0			X	0		5		5		5	
11-May	7:11			BT		5		20		20		10	
12-May	7:02			BT		10		15		5		5	
13-May	6:55	10	330		X	15		15		10		5	
14-May	7:16	10	337		X	15	MI		P	10		15	
15-May	7:33			P			P		P		P	0	
16-May	6:53	5		MI		ND		15		10		10	
17-May	7:15	10	330		X	10		10		15		10	
18-May	6:38	10	335		X	5		15		15		5	
19-May	ND												
20-May	ND												
21-May	7:38	5		P, MI		5		10		ND		10	
22-May	6:56	5		MI		5		15		5		5	
23-May	7:15	15		MI		0		10		5			P
24-May	7:31	5		MI		0		0		0		5	
25-May	7:17	5		MI		0		0		5		5	
26-May	7:05			RMF		5		5		5		5	
27-May	ND												
28-May	7:09			RMF		5		15		5		5	
29-May	6:59	5		RMF		0		10		0		5	
30-May	7:15	0			X	0		5		5		5	
31-May	7:28	5	333		X	0		5		0		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-3. Data[1] for spring season (15 March-31 May) of 2000 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Spring 2000													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	7:13			P			P	5	0		X		P
16-Mar	7:29	0			X	0		5		MI, BT			P
17-Mar	7:14	0			X	5		5	335		X		BT
18-Mar	7:03			P			P	10	355		X	10	BT
19-Mar	5:55	0			X		P	0			X		P, BT
20-Mar	6:42	0			X	5	MI			P			P
21-Mar	7:54	10	7		X	10		5	359		X	5	P
22-Mar	6:42			P			P			P			P
23-Mar	7:02	15	4	P	X	5	ST	5	348		X	10	BT
24-Mar	6:58	10	354		X	5		5	340		X	10	P
25-Mar	7:21	15	358		X	5		5	350		X	ND	
26-Mar	7:11	10	355		X	5	ST	10	350		X	ND	
27-Mar	6:56	0		P	X	0	P	5		MI		ND	
28-Mar	ND												
29-Mar	7:03	5		MI		5	ST	5	1		X	15	P
30-Mar	5:52	0		MI	X	5	P	5		MI, P		5	P
31-Mar	6:45	0			X	5	MI	5		ST, P		ND	
1-Apr	7:13	0		MI	X	5		5	330		X	ND	
2-Apr	7:38	15	4		X	10		15	350		X	ND	
3-Apr	7:02	10	10	I	X	5		10	345		X	ND	
4-Apr	6:55	5		MI		0		5	355		X	ND	
5-Apr	6:49	5		MI		5	MI	ND				ND	
6-Apr	7:41	5	345		X	5		10	350		X	ND	
7-Apr	7:06	10	340		X	5		10	350		X	ND	
8-Apr	6:58	0			X	0		5	358		X	10	
9-Apr	7:22	10		MI		5	ST	5	345		X		P
10-Apr	6:48	10	356		X	5		10	347		X		P
11-Apr	7:13	10	355	P	X		P	10	352		X	ND	
12-Apr	6:36			P			P			P		ND	
13-Apr	6:30			P			P	10	356		X	ND	
14-Apr	6:53			P		ND		10	350		X		P
15-Apr	6:47			P			P	10	0		X	10	P
16-Apr	7:10			P		ND				P			P
17-Apr	7:02			P		ND		10	345		X		P
18-Apr	7:22	0			X	ND		10	342		X	15	
19-Apr	7:15	15	352	P	X	10		10	345		X		P
20-Apr	7:11	20	2		X	10		10	340		X	10	ST
21-Apr	7:07			P			P	15	358		X	20	P
22-Apr	7:34	10	352		X	5		15	358		X	ND	

Table B-3 continued

23-Apr	7:41	10	4		X	10			10	341		X	ND	
24-Apr	7:22			P			P		15	354	P	X	ND	
25-Apr	6:41	20	3		X	15			10	340		X	ND	
26-Apr	6:57	15	353		X	5			10	345		X		RMF
27-Apr	6:50			P			P		5	345		X		RMF
28-Apr	7:09	0			X	5			5		MI			RMF
29-Apr	7:00	20	353		X	15	ST		15	341		X		RMF
30-Apr	6:51	20	11		X	15			15	350		X		RMF
1-May	7:41	0			X	5			10	353		X		RMF
2-May	7:01	15	15		X	15			10	355		X	ND	
3-May	7:24			P			P		20	351		X		RMF
4-May	ND													
5-May	ND													
6-May	7:04			P			P				P			P
7-May	6:31			P			P				P			P
8-May	6:51			P			P		20	352		X		P
9-May	7:38			P			P		10	350		X	10	
10-May	7:25			P			P		10	330		X	15	
11-May	7:11	25	5		X	15			10	341		X	15	
12-May	7:02	20	0		X	10			15	337		X	15	ST
13-May	6:55	15	0	P	X	15	P		10	343		X	15	P
14-May	7:16			P			P				P			P
15-May	7:33			P			P				P		10	
16-May	6:53	0			X	5			15	339		X	20	
17-May	7:15	5		P, I		15			20		MI, ST		25	
18-May	6:38	10	17	P	X	5	P		15	342		X	20	P
19-May	ND													
20-May	ND													
21-May	7:38	15	16	MI	X	5			10	340		X	10	
22-May	6:56	0			X	0			ND				10	
23-May	7:15	10	25	MI	X	5			10	6		X	10	
24-May	7:31	10	10		X	5			10	359		X	15	
25-May	7:17	0			X	5			5	339		X	10	
26-May	7:05			P			P		5	356		X	5	
27-May	ND													
28-May	7:09	5		MI		5			5	353		X	5	
29-May	6:59	10	15		X	0			5	353		X	5	
30-May	7:15	0			X	0			5		MI		5	
31-May	7:28	5	350		X	5			5		MI		ND	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-4. Data[1] for spring season (15 March-31 May) of 2000 for San Diego, CA (KNKX) and Santa Anna, CA (KSOX), WSR-88D stations.

Spring 2000							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	7:13	5	334		X	5	
16-Mar	7:29	5	325		X	5	
17-Mar	7:14	10	337	MI	X	5	
18-Mar	7:03	5	331		X	5	
19-Mar	5:55	5	345	P	X	5	
20-Mar	6:42			P			P
21-Mar	7:54	ND				0	
22-Mar	6:42	5	340		X	5	
23-Mar	7:02	5	333		X	5	
24-Mar	6:58	10	335		X	5	
25-Mar	7:21	5	330		X	5	
26-Mar	7:11	10	340		X	10	
27-Mar	6:56	0			X	0	
28-Mar	ND						
29-Mar	7:03	5		MI		5	
30-Mar	5:52	10		P, MI		5	
31-Mar	6:45			P			P
1-Apr	7:13	5		MI		5	
2-Apr	7:38	15	325		X	10	
3-Apr	7:02	10	335		X	10	
4-Apr	6:55			P		5	
5-Apr	6:49	20		P			P
6-Apr	7:41	10	321		X	15	P
7-Apr	7:06	ND				10	
8-Apr	6:58	5	350	P	X	10	
9-Apr	7:22	20	327	P	X	15	
10-Apr	6:48	15	320		X	15	
11-Apr	7:13	10	330		X	10	
12-Apr	6:36	10	340		X	15	
13-Apr	6:30	10		MI		0	
14-Apr	6:53	0			X	0	
15-Apr	6:47	10	333		X	15	
16-Apr	7:10	15	337		X		P
17-Apr	7:02			P			P
18-Apr	7:22	5	334		X	5	
19-Apr	7:15	10	325		X	15	
20-Apr	7:11	15	320		X	15	
21-Apr	7:07			P			P
22-Apr	7:34	5	317		X	5	
23-Apr	7:41	15	322		X	20	

Table B-4 continued							
24-Apr	7:22	15	320		X	20	
25-Apr	6:41	15	322		X	15	
26-Apr	6:57	15	325		X	15	
27-Apr	6:50			P		10	
28-Apr	7:09	5	335		X	0	
29-Apr	7:00	10	315		X	15	
30-Apr	6:51	20	325		X	15	
1-May	7:41	25	325		X	10	
2-May	7:01	20	325	P	X	20	
3-May	7:24	15	318	P	X	20	
4-May	ND						
5-May	ND						
6-May	7:04	20	325		X	15	
7-May	6:31	15	335		X	15	
8-May	6:51	20	320		X	15	
9-May	7:38	25	325		X	20	
10-May	7:25	15	325		X	5	
11-May	7:11	10	320		X	10	
12-May	7:02	10	320		X	15	
13-May	6:55			P		20	
14-May	7:16	15	320	P	X	15	
15-May	7:33	15		P, MI			P
16-May	6:53	5	330		X	0	
17-May	7:15	10	315		X	15	
18-May	6:38	10	317		X	10	
19-May	ND						
20-May	ND						
21-May	7:38	15	320		X	10	
22-May	6:56	10	311		X	15	
23-May	7:15	10		P, MI		10	
24-May	7:31	5		MI		5	
25-May	7:17	ND				10	
26-May	7:05	ND				5	
27-May	ND						
28-May	7:09	5		MI		5	
29-May	6:59	ND				5	
30-May	7:15	5		P, MI		0	
31-May	7:28	5	313		X	5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-5. Data[1] for spring season (15 March-31 May) of 2001 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Spring 2001													
		ESX				RGX				YUX			
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Mar	7:12	5	12	P	X	0		P	X	5		MI	
16-Mar	6:25	0		P	X	0		P	X	5		MI, P	
17-Mar	7:08	ND				5		MI		5		MI	
18-Mar	6:51	5		MI		10	19		X	5		MI	
19-Mar	6:06	10	339		X	10	15		X	5	325		X
20-Mar	6:51	10		MI		5	35	P	X	10		MI	
21-Mar	6:38	5		MI				P		5	324		X
22-Mar	6:53	10		MI, P				P		10		MI, P	
23-Mar	6:42	5	322	P	X	5	352		X	5	295		X
24-Mar	6:57	5	10		X			P		5	318		X
25-Mar	6:41	5	8		X			P		5		MI	
26-Mar	6:21	10		P		0			X	10		MI	
27-Mar	6:32			P				P				P	
28-Mar	6:41			P		0			X			P	
29-Mar	6:57			P		5		MI		10	308		X
30-Mar	6:40	5		MI		5	26		X	5	317	P, ST	X
31-Mar	6:59	5	19		X	5	44		X	10	322		X
1-Apr	6:51	5		MI		5		P, MI		10	338		X
2-Apr	ND												
3-Apr	6:31			P				P		5	316		X
4-Apr	6:45	10		P,MI				P		5	313		X
5-Apr	ND												
6-Apr	ND												
7-Apr	6:50			P				P		5		P, MI	
8-Apr	ND												
9-Apr	6:37			P		0			X			P	
10-Apr	ND												
11-Apr	ND												
12-Apr	7:02	10		MI, P		5	35		X	ND			
13-Apr	6:49	5	356		X	5	40		X	10	7		X
14-Apr	ND												
15-Apr	ND												
16-Apr	6:58	10	330		X	5	9		X	10	309		X
17-Apr	6:54	10	358		X	10	24		X	10	308		X
18-Apr	6:41	5		MI				P		15		MI	
19-Apr	7:02			P				P		5		P, MI	
20-Apr	6:54	10		P				P		5	7		X
21-Apr	7:18	ND				0			X	20		MI	
22-Apr	7:12	ND				10	39		X	10		MI,	
23-Apr	7:04	10	298		X	5	333		X	10	285		X
24-Apr	7:25	20	321		X	15	354		X	5	316		X
25-Apr	6:48	15	339		X	15	341		X	10	323	ST, P	X

Table B-5 continued													
26-Apr	6:40	15	340		X	5	355	P	X	15	315		X
27-Apr	ND												
28-Apr	ND												
29-Apr	ND												
30-Apr	6:50	5	332		X	0		P	X	5	323		X
1-May	ND												
2-May	7:02	5		MI		0			X	15		ST, MI	
3-May	6:24	5		P, MI		0			X	15		P, MI	
4-May	6:47	10		MI		5	31		X	10		MI	
5-May	6:41	10		MI		5	37		X	15	320	P	X
6-May	7:02	10		MI		5	18		X	5	307		X
7-May	7:25	10	319		X	ND				10		MI	
8-May	6:45	10	336		X	0			X	10		MI	
9-May	ND												
10-May	ND												
11-May	ND												
12-May	ND												
13-May	6:38	10	315		X	5		P, MI		10	314		X
14-May	7:00	5	340		X			P		10	323		X
15-May	7:21	10		MI		0			X	15		MI, ST	
16-May	6:45	10		MI, P		5	15		X	5		MI	
17-May	6:30	10	346		X	ND				5	351		X
18-May	6:23	10		P		ND				5	325	P	X
19-May	6:45	5		MI		ND				10	318	P	X
20-May	6:36	10		MI		ND				10	10		X
21-May	6:24	10		P,MI		ND				10		MI	
22-May	7:08	5	331		X	ND				10		MI	
23-May	6:58	5	351		X	ND				5		P, MI	
24-May	6:57	10		P, MI		ND				10	356		X
25-May	6:27	5	24		X	ND				5	350		X
26-May	6:45	5		MI		ND				10	346		X
27-May	7:03	5	357		X	ND				5		MI	
28-May	6:24	5		MI		ND				5		MI	
29-May	6:42	5		P, MI		ND				5	332		X
30-May	7:21	10		P, MI		ND				5		MI	
31-May	7:06	5		P, MI		ND				10	9		X

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-6. Data[1] for spring season (15 March-31 May) of 2001 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Spring 2001													
		HNX				VBX		VTX		EYX		MUX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Mar	7:12	5		MI		5		0		0		ND	
16-Mar	6:25	5		MI		5		5		0		ND	
17-Mar	7:08	5	331		X	5		5		5		10	
18-Mar	6:51	5	340		X	5		5		5		5	
19-Mar	6:06	5	339		X	5		5		5		10	
20-Mar	6:51	10		P, MI		5		5		0		5	
21-Mar	6:38	5	337		X	5		0		5			P
22-Mar	6:53	5		MI		5		5		0		5	
23-Mar	6:42	5	342		X	5		5		5		10	
24-Mar	6:57	10		P		5		5		5			P
25-Mar	6:41	0			X	5		5		5		5	
26-Mar	6:21	5		MI		5		5		0		10	
27-Mar	6:32	5		MI		5		10		5		5	
28-Mar	6:41	5		MI		ND		5		5		0	
29-Mar	6:57	5	353		X	10		10		5		10	
30-Mar	6:40	10		P		10		5		10		15	
31-Mar	6:59	5	347		X	10		5		10		5	
1-Apr	6:51	5		MI		5		5		0		0	
2-Apr	ND												
3-Apr	6:31	0			X	5		5		5			P
4-Apr	6:45	5		MI			P		P		P	15	
5-Apr	ND												
6-Apr	ND												
7-Apr	6:50			P			P		P		P		P
8-Apr	ND												
9-Apr	6:37			P			P	ND			P	0	
10-Apr	ND												
11-Apr	ND												
12-Apr	7:02	10	341		X	15	P	ND		15		20	
13-Apr	6:49	10	337		X	10		15		15		15	
14-Apr	ND												
15-Apr	ND												
16-Apr	6:58	10		MI		ND		15		15		20	
17-Apr	6:54	5	337		X	20		20		15		15	
18-Apr	6:41	10		P, MI		15		ND		5			P
19-Apr	7:02			P			P	ND		0	P		P
20-Apr	6:54			P			P	ND			P		P
21-Apr	7:18	5	323		X	10	P	10		5		10	
22-Apr	7:12	10	343		X	20		20		10		20	
23-Apr	7:04	15	339		X	20		20		15		20	

Table B-6 continued

24-Apr	7:25	10	336		X	20		20		20		20	
25-Apr	6:48	5	329		X	10		10		10		10	
26-Apr	6:40	10		MI, P		10	BT	10	BT	10		10	
27-Apr	ND												
28-Apr	ND												
29-Apr	ND												
30-Apr	6:50	10		MI		25		10		5		15	
1-May	ND												
2-May	7:02	10	307		X		P	10		10		5	
3-May	6:24	5	342		X	5		10		10		10	
4-May	6:47	10		MI		5		10		5		10	
5-May	6:41	10		MI		10		10		10		10	
6-May	7:02	5	344		X	10	P	10		5		20	
7-May	7:25	10	337		X	10		10		10	ST	ND	
8-May	6:45	5		MI		10		5		ND		ND	
9-May	ND												
10-May	ND												
11-May	ND												
12-May	ND												
13-May	6:38	ND				5		10		ND		10	
14-May	7:00	5		MI		15	P	10		5		15	P
15-May	7:21	5		MI		15		10		5		15	
16-May	6:45	5		MI		ND		20		5	ST	10	
17-May	6:30	5		MI		20		10		5		5	
18-May	6:23	5		MI		15		10		5	P	10	
19-May	6:45	5		MI		15		ND		5		5	
20-May	6:36	5		MI		5		10	P	5		10	
21-May	6:24	10		MI		5		5		5		15	
22-May	7:08	ND				0		5		5		5	
23-May	6:58	5		MI		5	P	5	P	5		5	
24-May	6:57	0			X	5	P	5		5		5	
25-May	6:27	5		MI		0		5		5	ST	5	
26-May	6:45	5		MI		0		10		5		5	
27-May	7:03	5		MI		5		5		0	P	0	
28-May	6:24	0			X	5		5		5	ST	5	
29-May	6:42	5	334		X	0		5		5		5	
30-May	7:21	5		MI		5		5		5		10	
31-May	7:06	5		MI		5		5		5		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-7. Data[1] for spring season (15 March-31 May) of 2001 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Spring 2001														
	MAX					BHX			DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code		dBZ	Dir	Code	Used	dBZ	Code
15-Mar	7:12			P		0			5		MI		5	
16-Mar	6:25	0			X	0	P		5		MI		5	
17-Mar	7:08	0			X	5			5	358		X	10	
18-Mar	6:51	10		P, MI		15	P		10	349	ST	X	10	
19-Mar	6:06	10	9		X	5	ST		5	357	P	X	10	
20-Mar	6:51	5	2		X	10	P		5	346	P	X	10	
21-Mar	6:38	5	354		X	10	P		5	354	P	X	10	
22-Mar	6:53			P		5			5	1		X	5	
23-Mar	6:42	10	350		X	5			5	342		X	10	
24-Mar	6:57			P			P				P			P
25-Mar	6:41	5		MI		5					P			P
26-Mar	6:21	0			X	0			5		MI		5	
27-Mar	6:32			P			P		5	3		X	10	
28-Mar	6:41	0			X	5	P		5	3		X	10	
29-Mar	6:57	0		P	X	5			5		MI		5	
30-Mar	6:40	5	25		X	5			5	355		X	10	
31-Mar	6:59	5		MI		5			10	355		X	15	
1-Apr	6:51			P			P		5	8		X	5	
2-Apr	ND													
3-Apr	6:31	0			X	5			5		MI, P		5	
4-Apr	6:45	5	334		X	5			5	7	P	X	10	
5-Apr	ND													
6-Apr	ND													
7-Apr	6:50			P			P				P			P
8-Apr														
9-Apr	6:37	0			X	5			5		MI		5	
10-Apr	ND													
11-Apr	ND													
12-Apr	7:02	10	7	P	X		P		10	349		X	10	
13-Apr	6:49	10	3		X	15			5	349		X	10	
14-Apr	ND													
15-Apr	ND													
16-Apr	6:58			P			P		10	337		X	15	
17-Apr	6:54			P		15			10	345		X	10	
18-Apr	6:41			P			P		5		MI		15	P
19-Apr	7:02			P			P		10		MI,P		15	P
20-Apr	6:54	5		MI		0			10		P, MI			P
21-Apr	7:18	5	18		X	10			15	350		X	20	
22-Apr	7:12	10	47		X	15			15	348		X	15	
23-Apr	7:04	20	357		X	15			15	350		X	20	
24-Apr	7:25	20	357		X	15			15	331		X	15	

Table B-7 continued

25-Apr	6:48	15	350		X	10		10	347		X	15	
26-Apr	6:40	20	353		X	15		5	356		X	10	
27-Apr	ND												
28-Apr	ND												
29-Apr	ND												
30-Apr	6:50	0			X	5		20	359		X	10	
1-May	ND												
2-May	7:02	5		MI		15	P	10		MI		15	
3-May	6:24	15		MI		15		5	329		X	10	
4-May	6:47	15		MI		5	MI			P		ND	
5-May	6:41	15		MI		5		5	333		X	10	
6-May	8:01	15	357		X	15		10	333		X	15	
7-May	7:25	15	13		X	10		10	345		X	15	
8-May	6:45	10	32	MI	X	5	MI	10	343		X	10	
9-May	ND												
10-May	ND												
11-May	ND												
12-May	ND												
13-May	6:38	15	0		X	15		10	348		X	10	
14-May	7:00			P			P	15		P, MI			P
15-May	7:21			P		0		10	350		X	15	
16-May	6:45	20		P, MI		15		5		MI		15	
17-May	6:30	5	19		X	10		10	345		X	15	
18-May	6:23	10	348		X	5		10		MI		15	
19-May	6:45			P		10		10		MI		5	
20-May	6:36	15		MI		15		5	331		X	10	
21-May	6:24	10	358		X	10	ST	5	337		X	10	
22-May	7:08	10	357		X	5		5	338		X	10	
23-May	6:58	5	344		X	5		5		MI		10	
24-May	6:57	5	349		X	5		5		MI		5	
25-May	6:27	5	359		X	0		5	357		X	10	
26-May	6:45	10	353		X	5		5	356	P	X	10	
27-May	7:03	5	4		X	0		5		MI		5	
28-May	6:24	0			X	0		0			X	5	
29-May	6:42	0			X	0	P	5		MI		5	
30-May	7:21	5	337		X	5		0		MI	X	5	
31-May	7:06			RMF			RMF	0		MI	X	ND	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-8. Data[1] for spring season (15 March-31 May) of 2001 for San Diego, CA (KNKX) and Santa Anna, CA (KSOX), WSR-88D stations.

Spring 2001							
		NKX			SOX		
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	7:12	5	333		X	5	
16-Mar	6:25	5		MI		0	
17-Mar	7:08	5	340		X	5	
18-Mar	6:51	5	325		X	ND	
19-Mar	6:06	5	333	P	X	5	
20-Mar	6:51	10	331		X	5	
21-Mar	6:38	5	335	ST	X	5	
22-Mar	6:53	5	329		X	5	
23-Mar	6:42	10	328		X	10	
24-Mar	6:57	5	345		X	10	P
25-Mar	6:41	10	340		X	5	
26-Mar	6:21	10	335		X	15	
27-Mar	6:32	5	330		X	10	
28-Mar	6:41	10	326		X	10	
29-Mar	6:57	5	313		X	5	
30-Mar	6:40	5	315	P	X	10	
31-Mar	6:59	15	325		X	10	
1-Apr	6:51	5		MI		0	
2-Apr	ND						
3-Apr	6:31	10	338	P	X	5	
4-Apr	6:45			P			P
5-Apr	ND						
6-Apr	ND						
7-Apr	6:50			P			P
8-Apr	ND						
9-Apr	6:37			P			P
10-Apr	ND						
11-Apr	ND						
12-Apr	7:02	10	315		X	15	
13-Apr	6:49	15	322		X	20	
14-Apr	ND						
15-Apr	ND						
16-Apr	6:58	10	334	ST	X	15	
17-Apr	6:54	15	328		X	20	
18-Apr	6:41	10	347		X	10	
19-Apr	7:02	10		MI, P			P
20-Apr	6:54			P			P
21-Apr	7:18	10	330		X	5	
22-Apr	7:12	15	311		X	20	
23-Apr	7:04	10	310		X	15	
24-Apr	7:25	10	317		X	15	
25-Apr	6:48	20	324		X	15	

Table B-8 continued							
26-Apr	6:40	15	318		X	15	
27-Apr	ND						
28-Apr	ND						
29-Apr	ND						
30-Apr	6:50	15	325		X	20	
1-May	ND						
2-May	7:02	10	310		X	10	
3-May	6:24	10	324		X	15	
4-May	6:47	5	328		X	10	
5-May	6:41	10	318	ST	X	15	
6-May	7:02	10	318		X	15	
7-May	7:25	5	317		X	10	
8-May	6:45	5	324	ST	X	10	
9-May	ND						
10-May	ND						
11-May	ND						
12-May	ND						
13-May	6:38	10	318		X	15	
14-May	7:00	10	319		X	15	P
15-May	7:21	10	316	ST	X	15	
16-May	6:45	10	314		X	10	
17-May	6:30	5	325		X	10	
18-May	6:23	5	319	P	X	10	
19-May	6:45	ND				ND	
20-May	6:36	5	324		X	10	P
21-May	6:24	5	305		X	ND	
22-May	7:08	15		ST, MI		5	
23-May	6:58	10	319		X	5	
24-May	6:57	5	317		X	5	
25-May	6:27	5	315		X	5	
26-May	6:45			P		5	P
27-May	7:03	0			X		P
28-May	6:24	5		MI		5	
29-May	6:42	5		MI		5	
30-May	7:21	5		MI		5	
31-May	7:06	5	335	ST	X	5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-9. Data[1] for spring season (15 March-31 May) of 2002 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Spring 2002														
		ESX				RGX				YUX				
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	Time	dBZ	Dir	Code	Used
15-Mar	5:58	5		P				P		5:58	10		P, MI	
16-Mar	5:45	0				0		P	X	5:45	5		MI	
17-Mar	6:29			P				P		6:29	5		P	
18-Mar	ND													
19-Mar	6:00	5		P, MI		5	26		X	6:00	0			X
20-Mar	6:14	ND				5	10		X	6:14	5	316		X
21-Mar	6:26	ND				5	358		X	6:26	5	355		X
22-Mar	6:39	ND						P		6:39	5	358		X
23-Mar	6:25	ND						P		6:25			P	
24-Mar	6:42	ND						P		5:45	5		P	
25-Mar	6:00	5	318		X	0		P	X	6:00	5	305		X
26-Mar	6:13	10	312		X	5	44		X	6:13	5	314		X
27-Mar	6:56	10	318		X	5		MI		6:56	10	319		X
28-Mar	6:42			P		0			X	6:42	10		P	
29-Mar	6:30	5		MI		5		MI		6:30	10	357		X
30-Mar	6:18	5		MI		0			X	6:18	15		ST, P	
31-Mar	6:36	5	307		X	0			X	6:36	15		ST	
1-Apr	6:25	10	318		X	5		MI		6:25	10	345	P	X
2-Apr	7:11	5	350		X	5	31		X	7:11	10	314	P	X
3-Apr	7:28	5	350		X	5	10		X	7:28	5	322	ST	X
4-Apr	6:19	5	338		X			P		6:19	10	335		X
5-Apr	6:37	5	339		X	0			X	6:37	5	328		X
6-Apr	6:55	10		MI, P		0			X	6:55	5		MI	
7-Apr	6:44	ND				5	25		X	6:44	10	329		X
8-Apr	6:30	5	350		X	0		P	X	6:30	10	330	P	X
9-Apr	6:44	5		MI				P		6:44	5	335		X
10-Apr	7:00	10		P, MI		5		MI		7:00	15	350	P	X
11-Apr	6:48	5	350		X	0				6:48	10	307	P, ST	X
12-Apr	6:36	10		MI		5	357		X	6:36	5	305	P	X
13-Apr	6:54	5	318		X	5	25		X	6:54	5	303		X
14-Apr	6:43	10		MI		0			X	6:43	5	338	P, ST	X
15-Apr	6:30	5		P, MI		0			X	6:30	15		MI, P	
16-Apr	6:46	5		P, MI				P		6:46	10	329		X
17-Apr	6:32	5		MI				P		6:32	10	326		X
18-Apr	6:49	5	340	P	X			P		6:49	20		P, MI	
19-Apr	6:36			P				P		5:10	15		MI	
20-Apr	6:53	5	355		X	5		P, MI		6:25	10	300		X
21-Apr	6:43	10	320		X	5	357		X	6:43	5	304		X
22-Apr	6:42	10	330		X	5	10		X	6:42	5	311		X
23-Apr	6:29	5	36		X	5	1		X	6:29	10		MI	
24-Apr	7:11			P		5		P, MI		6:43	15		P	

Table B-9 continued														
25-Apr	6:26	10		P, MI				P		6:26	5	318	ST	X
26-Apr	6:41			P				P		6:41	20		P, MI	
27-Apr	6:58	5		MI		0			X	6:58	10	312		X
28-Apr	6:46	15	320	P	X	5	350	P	X	6:46	10	309	P,ST	X
29-Apr	6:32	10		MI		0			X	6:32	5	321		X
30-Apr	7:16	0			X	0			X	7:16	5		MI	
1-May	7:02	5	320		X	5		MI		7:02	10		MI	
2-May	6:49	5	321	P	X	5		P		6:49	10	300		X
3-May	6:36	10	315		X	5	340		X	6:36	10	300	P	X
4-May	6:53	10	314		X	5	358		X	6:53	10	290	P	X
5-May	7:09	5	307		X	5	19		X	7:09	ND			
6-May	6:28	5	333		X	0			X	6:28	10	330		X
7-May	6:54	10		P		0			X	6:54	20		ST	
8-May	ND													
9-May	6:40	10		MI		0			X	6:40	10		P	
10-May	6:25	5		MI		0			X	6:25			P	
11-May	6:47	ND				5		MI		4:06	10		MI	
12-May	7:20	20	290		X	10	340		X	7:20	5		MI	
13-May	6:52	10	355		X	5		MI		6:52	5		MI	
14-May	7:04	5	327		X	5	350		X	7:04	10	330	P	X
15-May	6:34	10	350	P	X	5	357		X	6:34	5	330	ST	X
16-May	6:50	10	300		X	5	351		X	4:24	10	317		X
17-May	7:07	5	304		X	5	18		X	7:07	5	330		X
18-May	6:29	5	338		X	5		MI		5:16	5	320		X
19-May	ND													
20-May	7:02	0			X	0			X	7:02	5		MI	
21-May	7:15	5		MI		0			X	4:34	10		MI	
22-May	6:30	5	311		X			P		6:30	5	340		X
23-May	6:59	5		P, MI		0			X	6:59	15		ST	
24-May	6:47	5	309		X	5	358		X	5:34	10		MI	
25-May	6:55	5	303		X	5				6:55	5			
26-May	7:02	5	300		X	5	358		X	4:21	10		MI	
27-May	7:06	5		MI		5	17		X	4:25	5		MI	
28-May	6:11	5	306		X	5	8		X	6:11	5			
29-May	6:51	5	330		X	5	356		X	6:51	0			X
30-May	6:45	5	345		X	5	11		X	6:45	5		MI	
31-May	6:28	0		P	X			P		6:28	0			X

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-10. Data[1] for spring season (15 March-31 May) of 2002 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Spring 2002													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Mar	5:58			P			P		P		P	0	BT
16-Mar	5:45	0		P	X	0		0	P	0	P	0	
17-Mar	6:29			P			P	0			P		P
18-Mar	ND												
19-Mar	6:00	5	340		X	5		10		5		5	
20-Mar	6:14	5	335		X	5		10		5		5	
21-Mar	6:26	5	330		X	5		5		5		5	
22-Mar	6:39			P		0	P		P		P	0	
23-Mar	6:25			P			P		P		P		0
24-Mar	6:42	5		MI		0		5		5		5	
25-Mar	6:00	5	338		X	5		10		5		10	
26-Mar	6:13	5	330		X	5		10		5		10	
27-Mar	6:56	10		MI		5		5		10	P	5	
28-Mar	6:42	5	340	P	X		P	5		10	P	5	P
29-Mar	6:30	5	347		X	5		10		10		5	
30-Mar	6:18	5	344		X	5		10		10		5	
31-Mar	6:36	10	340		X	5		15		5	P	10	
1-Apr	6:25	5		MI		5		10		5		5	
2-Apr	7:11	5	348		X	10		5		5		5	
3-Apr	7:28	5	334		X	5	P	10		5		5	
4-Apr	6:19	5	335		X	5		10		5		15	
5-Apr	6:37	5		MI		0		15		5		5	
6-Apr	6:55	10		MI		0		10		5	P	5	
7-Apr	6:44	5		MI		5		15		5		10	
8-Apr	6:30	10		MI		5		15		10	P	10	
9-Apr	6:44	10		P		5		15		10		15	
10-Apr	7:00	5		MI		5		20		15	P	15	P
11-Apr	6:48	10		MI		5		15		15	P	10	
12-Apr	6:36	10	345		X	10		15		10	P	5	
13-Apr	6:54	10	352		X	5		15		20	P	10	
14-Apr	6:43	5		P		ND		5		5	P	15	P
15-Apr	6:30	5		MI		0		15		5	P	20	
16-Apr	6:46	5	350	P, MI		5			P	10		10	
17-Apr	6:32	5		MI		0		10		5	ST, P	ND	
18-Apr	6:49	10		MI		0		0		15	BT	0	
19-Apr	6:36	15	349		X	0		15		10	P	5	
20-Apr	6:53	10	333		X	10		15		10		15	
21-Apr	6:43	10	340		X	5		15		15		15	
22-Apr	7:39	10	338		X	10		15		10		10	
23-Apr	6:29	10	330		X	10		15		5		15	
24-Apr	7:11	10		MI, P		0		15		10		10	

Table B-10 continued													
25-Apr	6:26			P		10		10	P	10	P	15	
26-Apr	6:41	5	326		X	0	P	0		0		0	
27-Apr	6:58	5	330		X	0		15		15		15	
28-Apr	6:46	10	324		X	10	P	15	P	10		15	P
29-Apr	6:32	5		P		5		15		10		10	
30-Apr	7:16	5		MI			P	10		15	P	15	
1-May	7:02	15		P		0		20		5		20	
2-May	6:49	10	334		X	5		15		10		15	BT
3-May	6:36	5		MI		5		20		20	P	20	P
4-May	6:53	10		MI		5		20		20		15	
5-May	7:09	10		MI		5		15		20		10	
6-May	6:28	5		MI		5		5		15		15	
7-May	6:54	5	341		X	0		15		10		15	
8-May													
9-May	6:40	ND				5		10		10		15	
10-May	6:25			P		0		0		10		10	
11-May	6:47			RMF		5		20		25	P	10	
12-May	7:20			RMF		10		15		ND		25	P
13-May	6:52			BT, RMF		5	ST	10		ND		10	
14-May	7:04	ND				5		20		15		15	
15-May	6:34	10		P		5		15		20	P	15	
16-May	6:50	5	334		X	5		20	P	15		15	
17-May	7:07	5	338		X	5		25	P	15		15	
18-May	6:29	10	331		X	5		20		20	P	10	
19-May	ND												
20-May	7:02			P		0			P		P		P
21-May	7:15	5		MI		0		25		10		15	
22-May	6:30	10		MI		5		15		10		15	
23-May	6:59	10	325		X	10		15		15	P	10	
24-May	6:47	10		MI		5		15		10		5	
25-May	6:55	5		MI		5		10		5		10	
26-May	7:02	5		MI		5		10		5		10	
27-May	7:06	5		MI		5		10		10		5	
28-May	6:11	5		MI		5		15		15		5	
29-May	6:51	5	339		X	0		5		ND		5	
30-May	6:45	5		MI		0		5		ND		5	
31-May	6:28			P		0		5			P	5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-11. Data[1] for spring season (15 March-31 May) of 2002 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Spring 2002													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	5:58			P			P	5		P		5	P
16-Mar	5:45			P			P	5		P		10	P
17-Mar	6:29	0			X	0		ND				ND	
18-Mar	ND												
19-Mar	6:00	5	45		X	5		10	353		X	10	
20-Mar	6:14	5	350		X	5		5	351		X	ND	
21-Mar	6:26	5	355		X	5	P	5	357		X	10	
22-Mar	6:39			P			P			P			P
23-Mar	6:25			P			P			P			P
24-Mar	6:42	5	4		X	0		5	5		X	10	
25-Mar	6:00	5	345		X	5		5	355		X	10	
26-Mar	6:13	5		MI		5		5	357		X	10	
27-Mar	6:56	0			X	0		10		P, MI		15	P
28-Mar	6:42	0			X	0		15		P		ND	
29-Mar	6:30	5		MI		10		15		P		20	P
30-Mar	6:18	10		MI		10		5	1		X	10	
31-Mar	6:36	5		MI		10		10	358		X	15	
1-Apr	6:25	5	343		X	10		10	346	P	X	15	
2-Apr	7:11	10	350		X	5		5	357		X	10	
3-Apr	7:28	15	348		X	10		5	13		X	5	
4-Apr	6:19	5	350	P	X	0		10		P		0	P
5-Apr	6:37	10		MI		0		5	357	P	X	10	
6-Apr	6:55	0			X	0		10	358		X	15	
7-Apr	7:41	10	357		X	5		10	340		X	15	
8-Apr	6:30	15		P, MI		10	P	5	357		X	10	P
9-Apr	6:44			P		0	P	10		P		10	
10-Apr	7:00			P		5	P	10	350		X	15	P
11-Apr	6:48	0			X	5		10	353		X	10	
12-Apr	6:36	5	7		X	10		5	354		X	10	P
13-Apr	6:54			P			P	15	354		X	20	
14-Apr	6:43			P			P	10	10		X	15	
15-Apr	6:30	0			X	0		5	355		X	10	
16-Apr	6:46			P			P			P			P
17-Apr	6:32	0			X		P	5	2	P	X	10	P
18-Apr	6:49	0			X	5		15		P, MI		20	
19-Apr	6:36	10		MI		15		5	342		X	10	
20-Apr	6:53	20	358		X	15		10	343		X	15	
21-Apr	7:12	15	0		X	10		15	347		X	20	
22-Apr	7:39	10	0		X	10		10	350	P	X	15	
23-Apr	6:29	5	340		X	10		10	340		X	ND	

Table B-11 continued

24-Apr	7:11	15	30		X	10			5	350		X	10	
25-Apr	6:26	5	30		X	0			15		P		15	
26-Apr	6:41			P			P		10		P		10	P
27-Apr	6:58			P		15			5	351	P	X	10	
28-Apr	6:46	10		P		10			10	357		X	10	
29-Apr	6:32			P			P		5	347		X	15	P
30-Apr	7:16	0		P	X	0			10		P			P
1-May	7:02	5	350		X	10			5	345	P	X	10	
2-May	6:49	5		MI		15			10	350	P	X	15	
3-May	6:36	10	325		X	5			10	340	P	X	15	
4-May	6:53	5		P		0	P		10	353	P	X	15	P
5-May	7:09	0		P	X	5	P		5	347	P	X	10	
6-May	6:28	10		MI, P		10	P		20	354		X	15	P
7-May	6:54	5		P, MI		10			5	322		X	5	
8-May	ND													
9-May	6:40	0		P	X	0			15	0	P	X	20	P
10-May	6:25	10		MI		15			20		BT, P		20	
11-May	6:47	20	345		X	15			10	345	BT, P	X	15	
12-May	7:20	10	346		X	10	P		10	344	BT, P	X	10	
13-May	6:52	10		MI		10			5	351	BT, P	X	10	
14-May	7:04	15	24		X	10			5	350	P, ST	X	10	P
15-May	6:34	10	10	P	X	5			20		BT, P		10	P
16-May	6:50	10	25		X	10			10	342	BT	X	15	
17-May	7:07	10	340		X	15			10	354	P	X	15	
18-May	6:29	20		P,MI		10			10	351	BT, P	X	10	P
19-May														
20-May	7:02			P		10					P			P
21-May	7:15	10		P, MI		15			10	349	BT, P	X		P
22-May	6:30	5	335		X	10			10		BT		15	P
23-May	6:59	15	2	P	X	10			5	337	BT	X	10	
24-May	6:47	10	3		X	5			5	344	BT	X	5	P
25-May	6:55	15		P		10			5	351	BT	X	5	
26-May	7:02	10	346		X	5			5	359	BT	X	10	
27-May	7:06	0			X	5			5	353	BT	X	5	
28-May	6:11			P			P		5	357		X	5	
29-May	6:51	10		MI, P		5			5	355		X	10	
30-May	6:45	10		MI		0			5		MI, BT		10	P, BT
31-May	6:28			P			P		10		P, MI		10	P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-12. Data[1] for spring season (15 March-31 May) of 2002 for San Diego, CA (KNKX) and Santa Anna, CA (KSOX), WSR-88D stations.

Spring 2002							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	5:58			P		0	P
16-Mar	5:45	0			X	0	
17-Mar	6:29			P			P
18-Mar	ND						
19-Mar	6:00	5	335		X	5	
20-Mar	6:14	5	338	ST	X	5	
21-Mar	6:26	5	338		X	5	
22-Mar	6:39	5		ST, MI		0	
23-Mar	6:25			P			P
24-Mar	6:42	0			X	0	
25-Mar	6:00	5	332		X	10	
26-Mar	6:13	5	330		X	10	
27-Mar	6:56	5		MI		5	
28-Mar	6:42			P		0	
29-Mar	6:30	5	322		X	15	
30-Mar	6:18	5	317		X	10	
31-Mar	6:36	10	327	ST	X	10	
1-Apr	6:25	10	327		X	10	
2-Apr	7:11	10	323		X	10	
3-Apr	7:28	10	318	ST	X	10	
4-Apr	6:19	10	330		X	15	
5-Apr	6:37			P		0	
6-Apr	6:55	0			X	0	
7-Apr	6:44	5	324		X	10	
8-Apr	6:30	10	311	ST	X	15	
9-Apr	6:44	15	332	P	X	20	
10-Apr	7:00	10	316		X	15	
11-Apr	6:48	15	317	P	X	20	P
12-Apr	6:36	10	315		X	15	
13-Apr	6:54	10	335		X	15	
14-Apr	6:43	20	328		X	15	P
15-Apr	6:30	0			X	0	
16-Apr	6:46	5	343		X	5	
17-Apr	6:32	5	332		X	10	
18-Apr	6:49	10	325		X	5	
19-Apr	6:36	5	318		X	5	
20-Apr	6:53	10		MI		10	
21-Apr	6:43	10	323	ST	X	15	
22-Apr	7:39	10	325	ST	X	15	
23-Apr	6:29	15	327	ST	X	15	
24-Apr	7:11	0			X	5	
25-Apr	6:26	10	336		X	10	
26-Apr	6:41			P		0	

Table B-12 continued							
27-Apr	6:58	5	328		X	15	
28-Apr	6:46	15	322	P	X	20	P
29-Apr	6:32	10		MI		10	
30-Apr	7:16	15		S		15	
1-May	7:02	15		ST, MI		10	
2-May	6:49	10	318	P	X	20	
3-May	6:36	25		P		15	
4-May	6:53	5	318		X	10	P
5-May	7:09	10	315		X	15	
6-May	6:28	10	316	P	X	15	
7-May	6:54	5	319		X	5	
8-May	ND						
9-May	6:40	15	320	P	X	10	
10-May	6:25	10	320	P	X	15	
11-May	6:47	10	315	P	X	15	
12-May	7:20	25		P		15	
13-May	6:52	25		P		10	P
14-May	7:04	20	325		X	20	
15-May	6:34	10	320		X	15	
16-May	6:50	15	320		X	15	
17-May	7:07	10	320		X	15	
18-May	6:29	5	325		X	15	
19-May	ND						
20-May	7:02	10		MI		ND	
21-May	7:15	5	323		X	10	
22-May	6:30	10	315		X	15	
23-May	6:59	10	315		X	10	
24-May	6:47	10	320	ST	X	10	
25-May	6:55	10				10	
26-May	7:02	5	323	ST	X	10	
27-May	7:06	10		ST		5	
28-May	6:11	5	325	ST	X	10	
29-May	6:51	5		ST, MI		5	
30-May	6:45	5		ST, MI			P
31-May	6:28	0			X	5	MI

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-13. Data[1] for spring season (15 March-31 May) of 2003 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Spring 2003														
		ESX				RGX				YUX				
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	Time	dBZ	Dir	Code	Used
15-Mar	6:27			P		0			X	6:27			P	
16-Mar	6:08			P				P		6:08			P	
17-Mar	6:16	ND				0		P	X	6:16			P	
18-Mar	7:34	0			X	0		P	X	4:38	5		P	
19-Mar	6:31	5		P, MI				P		6:31	5		MI	
20-Mar	6:13	0			X	0		P	X	6:13	5		P	
21-Mar	7:37	5		P, MI		5	25		X	6:08	5		MI	
22-Mar	6:20	5	14		X	0		P	X	5:51	5	311	ST	X
23-Mar	5:50	5		P, MI				P		4:21	5		MI	
24-Mar	6:27	5		MI				MI		6:27	5	300		X
25-Mar	6:20	5	358		X	0			X	6:20	5		MI	
26-Mar	6:29	5		MI				P		5:45	15		P	
27-Mar	6:37	0			X	0			X	4:54	5		MI	
28-Mar	6:16	5		MI		5		MI		6:16	5		MI	
29-Mar	6:36	5		MI		5		MI		6:36	5	300		X
30-Mar	6:44	5	312		X	5	26		X	6:44	5		MI	
31-Mar	6:29	5	14		X	0		P	X	5:45	10	356	P	X
1-Apr	6:02	5		P, MI		0		P	X	6:02	5	348	P	X
2-Apr	6:19			P				P		6:19	10		P, MI	
3-Apr	6:17	5		MI		0		P	X	6:17	5		P, MI	
4-Apr	5:30			P		0		P	X	5:30	10		P, MI	
5-Apr	ND													
6-Apr	ND													
7-Apr	6:16	5	310		X	5	15		X	6:16	5	300		X
8-Apr	6:45	10	335		X	5	357		X	6:45	5	322	P	X
9-Apr	6:01	10	335	P	X	5	345		X	6:01	10		P, MI	
10-Apr	6:48	5	6		X	0			X	6:48	10		P, ST	
11-Apr	6:31	5	340		X	5		MI		6:31	10	342	P	X
12-Apr	6:42	5	335		X			P		6:42	10		MI	
13-Apr	6:50	5		MI				P		6:50	10	341	P	X
14-Apr	6:54			P		0			X	6:54			P	
15-Apr	6:28	5	320		X			P		6:28	10	306	P	X
16-Apr	6:53	10	350	P	X			P		6:53	10	315		X
17-Apr	6:25	10		P		0			X	6:25			P	
18-Apr	6:47			P		0			X	6:47			P	
19-Apr	6:57	10	312		X	5	18		X	6:57	10	300	P	X
20-Apr	5:51	10	331		X			P		5:51	10	340	P	X
21-Apr	6:24	10		P				P		6:24	5	3	P	X
22-Apr	5:42			P		0		P	X	5:42	5		P, MI	
23-Apr	6:28	5	341		X			P		6:28	10	312	P, ST	X
24-Apr	6:16	15		MI		0			X	6:16			P	
25-Apr	6:21	15		MI				P		6:21	5	15	P	X
26-Apr	5:59	10	34		X			P		5:59	15		P	

Table B-13 continued														
27-Apr	6:22	10		MI		5	350	P	X	6:22	ND			
28-Apr	6:27	10	0		X	0			X	6:27	10		P, ST	
29-Apr	6:44	10		MI				P		6:44	10		P, I	
30-Apr	7:11	5	311		X	0			X	7:11	15	303		X
1-May	6:00	10	345		X	10				6:00			P	
2-May	6:20	10		P, MI		10				6:20	15		P	
3-May	6:55	5		MI				P		6:55	5		P, MI	
4-May	6:51	15		MI		0			X	6:51	5	308	P?	X
5-May	7:34	10				5		MI		6:50	20		P	
6-May	6:49	15		MI				P		6:49	10		P	
7-May	6:53	10		P				P		6:53	25		P	
8-May	ND													
9-May	6:41	15		MI				P		6:41	10	298		X
10-May	6:53	15	319		X	10	25		X	6:53	10	310		X
11-May	6:34	10		MI		10		MI		6:34	20		ST, I	
12-May	6:36	10	358		X	5	2		X	6:36	10	319		X
13-May	6:51	10	32	P	X	5		MI		6:51	5	306	P	X
14-May	6:11	10		P, MI				P		6:11	5		P, MI	
15-May	6:30	10		MI		0			X	6:30	20		P, MI	
16-May	7:02	5	26		X	5		MI		7:02	5	314		X
17-May	6:38	5	31		X	5		MI		6:38	15		ST, I	
18-May	6:33	10		MI		5	0		X	6:33	5	310		X
19-May	7:20	5	317		X	5	12		X	6:21	5	306		X
20-May	7:46	5	317		X	5	355		X	5:50	5		MI	
21-May	ND													
22-May	7:29	5	332		X	5	345		X	7:29	5	336	P, ST	X
23-May	6:52	5	333		X	10		P		6:52	5	330		X
24-May	7:14	5	350		X	0			X	7:14	10		MI	
25-May	6:49	5	345		X	0			X	6:49	5	340		X
26-May	7:06	5		MI		5		MI		7:06	5		MI	
27-May	7:49	5		MI		5	345		X	6:51	5		MI	
28-May	6:49	5	9		X	0			X	6:49	5	335		X
29-May	6:06			P				P		6:06	5	345	P	X
30-May	7:11			P		0			X	7:11	5	337	P	X
31-May	6:53	5		MI		0			X	6:53	5		MI	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-14. Data[1] for spring season (15 March-31 May) of 2003 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Spring 2003													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Mar	6:27	0			X		P	5		0			P
16-Mar	6:08			P		0		0		0	P	0	P
17-Mar	6:16			P		0		0	P	0		0	
18-Mar	7:34	ND				0		0		0		5	P
19-Mar	6:31	5		P		0			P		BT	5	
20-Mar	6:13	0			X	0		5	P	ND		5	
21-Mar	7:37	5	333		X	0		10		ND		10	
22-Mar	6:20	5		MI		5		15	P	ND		15	
23-Mar	5:50	0			X	0		5		ND		5	
24-Mar	6:27	5		MI		0		10		5	P	0	
25-Mar	6:20	5		MI		0		10		10		15	
26-Mar	6:29	0					P	0		0	BT	5	
27-Mar	6:37	5		P		0		0		0		5	
28-Mar	6:16	5	340		X	0		10		10		5	
29-Mar	6:36	5	342		X	0		10		5		10	
30-Mar	6:44	5		MI		5		15		10		15	
31-Mar	6:29	ND				5		10		5	ST	10	
1-Apr	6:02			P		0		0	P		P	5	
2-Apr	6:19			P		0			P		P	0	
3-Apr	6:17	5	345		X	0		10	P	10	P	5	
4-Apr	5:30			P			P	0	P		P		P
5-Apr	ND												
6-Apr	ND												
7-Apr	6:16	10	340		X	5		15		10		15	
8-Apr	6:45	10	342		X	5		15		5		10	
9-Apr	6:01	5	336		X	5		10		10		5	
10-Apr	6:48	5	336		X	0		10		10	P	10	P
11-Apr	6:31	5	350		X	5		10		10		10	
12-Apr	6:42	10		P		0			P		P		P
13-Apr	6:50			P			P	15			P		P
14-Apr	6:54			P			P	0			P		P
15-Apr	6:28	10	338			5		15		20	P	15	
16-Apr	6:15	10		P		5		10	P	10		10	
17-Apr	6:25	10		P, MI		0		10		10		5	
18-Apr	6:47	10		MI		0		10		10		5	
19-Apr	6:57	10	340		X	5		15		5	P	15	
20-Apr	6:35	10	336	P	X	5		15		10		10	
21-Apr	6:24			P			P		P		P		P
22-Apr	5:42	10		MI		0		15			P	10	
23-Apr	6:28	10	348		X	5		15	P	10		15	P

Table B-14 continued

24-Apr	6:16	10		P		5		15		15		10	
25-Apr	6:21	10		P, MI		0		15	P	10		10	
26-Apr	5:59	5	331		X	5		10	P	10		10	
27-Apr	6:22	10	357	P	X	5			P	15		15	
28-Apr	6:27	10		P, MI		5		15	P	15		15	
29-Apr	6:44	0			X	0		10		10	P	10	
30-Apr	7:11	5	333		X	10		15		10		15	
1-May	7:13	10	334	P	X	5		15		15		15	
2-May	6:20	10		P			P		P		P		P
3-May	6:55	15		P		0		10	P		P		P
4-May	6:51	5		MI		5		20		10	BT	15	
5-May	7:34	10				5		20		20		15	
6-May	6:49	10				0		20	P	10		10	
7-May	6:53	10				0		10			P	10	
8-May	ND												
9-May	6:41	5		MI		0		25		10		15	
10-May	6:53	10	340		X	5		15		15		10	
11-May	6:34	10	342		X	10		20		15		15	
12-May	7:20	10	333		X	10		15		10		15	
13-May	6:51	5	322		X		P	15			P		P
14-May	6:55	10		MI		0		10		10		5	
15-May	6:30	10		MI		10		15		10		20	
16-May	7:02	10		MI		10		15		15		15	
17-May	6:38	5		MI		5		20		15		15	
18-May	6:33	10		MI		10		20		20		10	
19-May	7:20	10		MI		5		15		20		10	
20-May	7:46	5	337		X	5		10		10		10	
21-May	ND												
22-May	7:29	5		MI		5		10		10		10	
23-May	6:52	10		P, MI		5		10		10		10	
24-May	7:14	5		MI		5		5		10		10	
25-May	6:49	5		MI		5		15	ST	5		15	P
26-May	7:06	5	344		X	5		5		5		5	
27-May	7:49	5		MI		0		5		10		5	
28-May	6:49	5		MI		5		5		5		5	
29-May	7:04	5		MI		5		5		0		5	
30-May	7:11	5		MI		0		10		0		5	
31-May	6:53	0			X	5		5		0		ND	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-15. Data[1] for spring season (15 March-31 May) of 2003 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Spring 2003														
		MAX				BHX			DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code		dBZ	Dir	Code	Used	dBZ	Code
15-Mar	6:27	0		P	X		P		5		MI		ND	
16-Mar	6:08			P			P				P		ND	
17-Mar	6:16	0		P	X	0			5		MI		ND	
18-Mar	7:34	5	348		X	5			5		BT		ND	
19-Mar	6:31			P			P				P			P
20-Mar	6:13			P			P		5		MI		15	P
21-Mar	7:37			P			P		5	355		X	10	
22-Mar	6:20	0		P	X		P				P			P
23-Mar	5:50	10	355		X	5			5	358		X	10	
24-Mar	6:27			P		15	P		10	0		X	15	
25-Mar	6:20			P			P				P			P
26-Mar	6:29	0			X	0	P				BT		10	
27-Mar	6:37	10		P, MI		10					P		5	
28-Mar	6:16	0			X	5	ST, RP		10		P, MI		5	
29-Mar	7:20	10	359		X	ND			10	347		X	15	
30-Mar	6:44	10	14		X	ND			10	0		X	15	
31-Mar	6:29			P			P		10		BT, P		15	P
1-Apr	6:02			P			P				P			P
2-Apr	6:19			P			P				P			P
3-Apr	6:17			P			P		5	0	P	X		P
4-Apr	5:30			P			P				BT, P		10	P
5-Apr	ND													
6-Apr	ND													
7-Apr	6:16	10	353		X	15	ST		5	350		X	10	
8-Apr	6:45	15		P, MI		15			5	358		X	10	
9-Apr	6:01	15	352		X	10			5	350		X	10	
10-Apr	6:48			P			P		5	355		X	10	
11-Apr	6:31			P			P		5	345		X	15	
12-Apr	6:42						P				P			P
13-Apr	6:50			P			P		5	355	BT	X	10	P
14-Apr	6:54	0			X	10			10		BT,P, MI		15	
15-Apr	6:28	0			X		P		10	342		X	15	
16-Apr	6:53			P			P		10		P		10	
17-Apr	6:25			P			P		10	2	P	X	15	P
18-Apr	6:47	10		MI		15			5	355	BT	X	10	
19-Apr	6:57	20	345		X	15			10	352		X	15	
20-Apr	6:35	5		P		ND			10	340		X	15	BT
21-Apr	6:24			P		ND			10		P, MI		10	
22-Apr	5:42	15		P, MI		10			5	354		X	15	

Table B-15 continued

23-Apr	6:28			P			P			P			P
24-Apr	6:16	5		MI, P			P	5	354		X	15	
25-Apr	6:21			P			P	10		P			P
26-Apr	5:59	10		P		20		5	345	P	X	15	
27-Apr	6:22			P			P			P			P
28-Apr	6:27			P			P	10	351	P	X	15	P
29-Apr	6:44			P			P	5	2		X	10	
30-Apr	7:11	25	350		X	20		5	335		X	10	
1-May	7:13	10	351	P	X	15		10	342		X	15	
2-May	6:20			P			P			P			P
3-May	6:55			P			P			P			P
4-May	6:51	0			X	10		15	353	BT	X	15	
5-May	7:34	5				20		15				15	
6-May	6:49			P		10		10				10	
7-May	6:53			P			P	20				15	P
8-May	ND												
9-May	8:24	15	350		X	10		10	341	BT	X	15	
10-May	8:21	15	358		X	15		10	340		X	10	
11-May	6:34			P		10	P	10	351	P	X	15	P
12-May	7:20	25	358		X	15		10	348		X	15	
13-May	6:51	20	2		X	10		5	345		X	10	
14-May	6:55	10	27		X	10		10	353		X	15	
15-May	6:30	5		MI		10		5	358		X	10	
16-May	7:02	10		MI		5		5	355	BT	X	10	
17-May	6:38	0			X	5		10		MI		15	
18-May	6:33	5	333		X	10		5	352		X	10	
19-May	7:20	15	13		X	10		10		MI		20	
20-May	7:46	10	350		X	10		5	340	BT	X	10	
21-May	ND												
22-May	7:29	15	356		X	10		10		MI		10	
23-May	6:52	10	357		X	5		5	348		X	10	
24-May	7:14	10		P		5	P	5	357		X	10	
25-May	6:49	10	352		X	5		5	354	BT	X	5	
26-May	7:06	10	18		X	10				BT		5	
27-May	7:49	5	0		X	5		5	356		X	5	
28-May	6:49	5	345		X	5	BT	5		MI		5	
29-May	7:04	10		P			P	5		P, MI		5	P
30-May	7:11	5		P, MI			P	5		MI		5	
31-May	6:53	0			X		P	10		BT, MI		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-16. Data[1] for spring season (15 March-31 May) of 2003 for San Diego, CA (KNKX) and Santa Anna, CA (KSOX), WSR-88D stations.

Spring 2003							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	6:27			P			P
16-Mar	6:08			P			P
17-Mar	6:16	0		P	X	0	
18-Mar	7:34	5	342	P	X	0	
19-Mar	6:31	10	334		X	10	
20-Mar	6:13	5	331		X	5	MI, P
21-Mar	7:37	5	335		X	5	
22-Mar	6:20	5	336	ST	X	5	
23-Mar	5:50	5	346		X	10	
24-Mar	6:27	5		MI		5	
25-Mar	6:20	5	340	P	X	5	
26-Mar	6:29	15		P, MI		5	P
27-Mar	6:37	5	327	ST	X	5	
28-Mar	6:16	5		MI		5	
29-Mar	6:36	5	329		X	5	
30-Mar	6:44	10	321		X	10	
31-Mar	6:29	10	340		X	10	
1-Apr	6:02	5	340		X	5	
2-Apr	6:19	5		MI		0	
3-Apr	6:17	ND				5	
4-Apr	5:30	15		P			P
5-Apr	ND						
6-Apr	ND						
7-Apr	6:16	10	320		X	15	
8-Apr	6:45	5	332		X	5	
9-Apr	6:01	5	330		X	10	
10-Apr	6:48	10	320		X	10	
11-Apr	6:31	10	329		X	10	
12-Apr	6:42	15		P		10	
13-Apr	6:50	10	334		X	15	P
14-Apr	6:54			P			P
15-Apr	6:28	10	330		X	15	
16-Apr	6:53	15	330	P	X	20	
17-Apr	6:25	5	340	P	X		P
18-Apr	6:47	5	330		X	10	
19-Apr	6:57	10	315		X	15	
20-Apr	6:35	10	326	P	X	10	
21-Apr	6:24			P			P
22-Apr	5:42	15		P		10	
23-Apr	6:28	5	325		X	5	
24-Apr	6:16	10	320	P	X	15	P

Table B-16 continued							
25-Apr	6:21	10	325	P	X	10	
26-Apr	5:59	20	322		X	20	
27-Apr	6:22	15	320		X	15	
28-Apr	6:27	5	332	P	X	10	
29-Apr	6:44	15	324		X	10	
30-Apr	7:11	15	320		X	20	
1-May	7:13	15	324	P	X	20	
2-May	6:20	15		P			P
3-May	6:55			P			P
4-May	6:51	10	315		X	15	
5-May	7:34	20				20	
6-May	6:49	20				5	
7-May	6:53	15				10	
8-May	ND						
9-May	6:41	15	318		X	20	
10-May	6:53	20	320		X	20	
11-May	6:34	10	320	P	X	15	
12-May	7:20	15	320		X	20	
13-May	6:51	10	322	P	X	15	P
14-May	6:55	10		MI		15	
15-May	6:30	10	317		X	20	
16-May	7:02	10	324		X	20	
17-May	6:38	15	321		X	20	
18-May	6:33	10	310		X	10	
19-May	7:20	5	314	ST	X	10	
20-May	7:46	5	335	ST	X	10	
21-May	ND						
22-May	7:29	5	325		X	5	
23-May	6:52	5		MI		10	
24-May	7:14	5	320		X	10	
25-May	6:49	10		ST		10	
26-May	7:06	5	334		X	10	
27-May	7:49	5		MI		ND	
28-May	6:49	5		MI		5	
29-May	7:04	5		MI		5	
30-May	7:11	5		MI		5	
31-May	6:53	5		MI		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-17. Data[1] for spring season (15 March-31 May) of 2004 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Spring 2004													
		ESX				RGX				YUX			
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Mar	6:23	5		MI		0			X	5		P, MI	
16-Mar	6:49	5		P		0			X	5		MI, P	
17-Mar	6:49	5	321		X	5	35		X	5		MI	
18-Mar	6:23	5	356		X	5		MI		5	341		X
19-Mar	7:14	5	325		X	5	27		X	5	308		X
20-Mar	6:38	5	315		X	0			X			P	
21-Mar	6:41	5	354		X	5	32		X	5		P, ST	
22-Mar	6:41	5		MI		5		MI		15		P, MI	
23-Mar	6:56	5	2		X	0			X	10	328		X
24-Mar	6:44	5		MI		0			X	5		MI	
25-Mar	6:35	5		MI		0			X	15		P, ST	
26-Mar	6:44	5		P		0			X	5		MI	
27-Mar	6:39	5		MI		0			X	5		MI	
28-Mar	6:35	5	305		X	5	18		X	5		MI	
29-Mar	6:52	10	332		X	5	354		X	5	331	ST	X
30-Mar	6:20	5	358		X	0			X	10	344	P	X
31-Mar	6:19	5	357		X	0			X	10	320		X
1-Apr	6:04			P		0			X	10		P	
2-Apr	7:21			P		0			X			P	
3-Apr	7:25					0			X	10		P, MI	
4-Apr	6:43	5		MI, P		0			X	10	317		X
5-Apr	7:10	5	355	P	X			P		5	330	P	X
6-Apr	6:55	5		P				P		15	340		X
7-Apr	6:24	5		P, MI		0			X	10	342	P	X
8-Apr	7:04			P		0			X	5		P, ST	
9-Apr	7:21	5		P, MI		0			X	5		P, MI	
10-Apr	7:25	0			X	0			X	10		P, MI	
11-Apr	7:29	5		MI		5	14		X	5		MI	
12-Apr	7:30	10	334	P	X	5	5		X	ND			
13-Apr	7:01	5	358	P	X	0			X	ND			
14-Apr	7:13	5	5		X	0			X			P	
15-Apr	6:44	5		MI		0			X	10	355	P	X
16-Apr	7:20	10		MI				P		10	337	P	X
17-Apr	7:14			P		0			X	5		MI	
18-Apr	7:09	10	336		X			P		25	315		
19-Apr	7:00	5		MI		0			X	5		P, MI	
20-Apr	7:18	5		MI				P		10		P, MI	
21-Apr	7:23	5		P, MI		0			X	10		P, MI	
22-Apr	7:29			P		5		MI		10		P, MI	
23-Apr	7:21	10		MI		5		MI		15		P, MI	
24-Apr	7:30	10		P, MI		5	353		X	10		P	

Table B-17 continued

25-Apr	7:36	10	318		X	5	350		X	15		P, MI	
26-Apr	7:26	10	336	P	X	5	350		X	5	310	P	X
27-Apr	7:42			P		0			X			P	
28-Apr	7:04	10		MI		0			X	10		P, MI	
29-Apr	6:55			P		0			X	10		MI	
30-Apr	7:33	10				5				15			
1-May	ND												
2-May	ND												
3-May	ND												
4-May	6:50	5	20	P	X	5		P, MI		20		P, MI	
5-May	6:11	5	345		X	5		MI		10		MI	
6-May	6:16	5	4		X	5		MI		10	325		X
7-May	6:55	10		MI		0			X	15			
8-May	7:06	10		MI		5		MI		5	348	P, ST	X
9-May	7:02	5	334		X	5		P, MI		10	344		X
10-May	6:51	5		MI				P		20		P	
11-May	6:28	10		P, MI		0			X	15			
12-May	7:49	5		P, MI		5		MI		10	311		X
13-May	7:56	5	327	P	X	5	19		X	10	315		X
14-May	7:15	5	11		X	5	345		X	15		MI	
15-May	7:49	5		MI		5		MI		5	344		X
16-May	7:11	5	40		X	5		MI		10	345		X
17-May	7:00	5		P, MI		0			X	10	356	P	X
18-May	7:16	10		MI		5		P, MI		10		MI	
19-May	7:02	5		MI		5	339	P	X	10		MI	
20-May	7:31	5		MI				P		5		MI	
21-May	7:15	5		MI		0			X	5		MI	
22-May	7:27	5	339		X	0			X	5	327		X
23-May	7:17	5		MI		5		MI		5		MI	
24-May	7:21	10		P, MI		5		P, MI		10		MI	
25-May	6:08	5		MI		0			X	10		MI	
26-May	6:39	5		MI				P		5		MI, P	
27-May	7:14	5	30	P	X			P		ND			
28-May	7:20			P				P		10		P, MI	
29-May	7:27			P		5		MI		10		P, MI	
30-May	7:17	5		MI		0			X	5		MI	
31-May	7:08	5		P, MI		0			X	10		MI	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-18. Data[1] for spring season (15 March-31 May) of 2004 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Spring 2004													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Mar	6:23	ND				5		0		5		5	
16-Mar	6:49	ND				5	P	5		5		5	
17-Mar	6:49	5	335		X	5		5		5		5	
18-Mar	6:23	5		MI		5		5		10		10	
19-Mar	7:14	5		MI		5		15		5		5	
20-Mar	6:38	5	330		X	5		5		5		5	
21-Mar	7:39	5		MI		5		10	P	5		5	
22-Mar	6:41	5	342		X	5		5		5		5	
23-Mar	6:56	5		MI		0		0		5		5	
24-Mar	6:44	5		MI		0	P	5		5		5	
25-Mar	6:35			P		0			P		P		P
26-Mar	6:44			P			P	15	P	5		5	
27-Mar	6:39	5		BT, P		5		15		15	P	5	
28-Mar	6:35	10	330	BT, P	X		P	15		10		10	
29-Mar	6:52	ND				10		10		5	ST	5	
30-Mar	6:20	5		P		5	P	0		5			P
31-Mar	6:19	ND				0		10		5		5	
1-Apr	6:04	10		P, MI			P	0	P		P	0	
2-Apr	7:21	10		P, MI			P	20		ND			P
3-Apr	7:25	10		MI			P	15		15	P	10	
4-Apr	6:43	ND				0	P	10		5		15	
5-Apr	7:10	ND				5			ST	5		15	
6-Apr	6:55	ND					P	15		15		5	
7-Apr	6:24	ND				5		15		15		10	
8-Apr	7:04	ND					P	10		15	P	10	P
9-Apr	7:21	ND				5		15		10	P	5	
10-Apr	7:25	ND				10		10		20		5	
11-Apr	7:29	ND				10		15		5		5	
12-Apr	7:30	10		P,		5		10	ST	10		5	
13-Apr	7:01	5		MI		5		10		5		5	
14-Apr	7:13			P		5		10	P	5		5	
15-Apr	6:44	ND				5		15		15	ST	5	
16-Apr	7:20	5	342		X	5			P		P		P
17-Apr	7:14	10		P, MI			P	5			P		P
18-Apr	7:09	10		P		ND		20		15	P	10	
19-Apr	7:00	5	329		X	5			P	10	P	5	
20-Apr	7:18	5		MI			P		P	ND		5	
21-Apr	7:23	5		MI		0	P	5		ND		5	
22-Apr	7:29	10	330		X	5		10		ND		10	
23-Apr	7:21	10	336		X	5		15		15		5	

Table B-18 continued

24-Apr	7:30	10	335		X	5		ND		5	P	5	P
25-Apr	7:36	10		MI		10	ST	ND		5	P	10	P
26-Apr	7:26	10		BT, P		15	ST	10		10		10	
27-Apr	7:42	5		MI		5		0		5		5	
28-Apr	7:04	15		P, MI		5	MI	0		0	P		P
29-Apr	6:55	ND				5		10		5		10	
30-Apr	7:33	10				5			P	5	P	5	
1-May	ND												
2-May	ND												
3-May	ND												
4-May	6:50	5	327	P	X	ND		10		0		0	
5-May	6:11	5	323		X	5		ND		5		10	
6-May	6:16	10		MI		5		15			P		P
7-May	6:55	5		MI		5		10	P	10	P	5	
8-May	7:06	5	339		X	5		10		15	P	5	
9-May	7:02			P		5			P		P		P
10-May	6:51	5		MI			P	0		5		5	
11-May	6:28	5		MI		0	P	10		20	P	10	
12-May	8:33	10		MI		10		25	P	15	P	10	
13-May	7:56	10		P, MI		5		15		15		10	
14-May	7:15	5		MI		5		15		10		5	
15-May	7:49	10		MI		0		10		20	P	5	
16-May	7:11	5	341		X	0		5		10		10	
17-May	7:00	5		MI		0		5		10		5	
18-May	7:16	5		MI		5		20		10		5	
19-May	7:02	5		MI			P	25		5		5	
20-May	7:31	5		MI		0		10		5		5	
21-May	7:07	5		MI		0		15		5		5	
22-May	7:27	5		MI		5		20		5		5	
23-May	7:17	10		MI		0		5		5		5	
24-May	7:21	5	325		X	5		10		5		5	
25-May	6:08	10		P, MI		5		10		5		5	
26-May	6:39	10		P, MI			P	10		10		5	
27-May	7:14	5		P		5			P	10		10	
28-May	7:20	5		MI			P	0		5		0	
29-May	7:27	5		MI		0		10		5		5	P
30-May	7:17	5		MI		0		5			P	5	
31-May	7:08	5		MI		0		0			P	5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-19. Data[1] for spring season (15 March-31 May) of 2004 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Spring 2004													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	6:23	0			X	0		10		MI, BT		0	
16-Mar	6:49	0			X	10	P	5	343	BT	X	5	
17-Mar	6:49	5	27		X	10		10	358		X	10	
18-Mar	6:23	5		MI		10	MI	5	8		X	5	
19-Mar	7:14	5	6		X	5		5	355		X	5	
20-Mar	7:51	5	359		X	5	P	5	354		X	10	
21-Mar	7:39	10	350		X	0				BT, P			P
22-Mar	6:41	5	0		X	0		5	358		X	5	
23-Mar	6:56	5		MI		5		5		MI, BT		5	
24-Mar	6:44			P		0	P	5	355		X	5	
25-Mar	6:35			P			P			P			P
26-Mar	6:44			P			P			P			P
27-Mar	6:39	0			X	0		5		MI, BT		5	MI
28-Mar	6:35	10	356		X	5		10	358		X	15	
29-Mar	6:52	10		P, MI			P	5	345		X	5	
30-Mar	6:20	0			X	0		5		P,MI		5	MI
31-Mar	6:19	0			X	0		5	1		X	5	
1-Apr	6:04	0		P	X	0	P			P			P
2-Apr	7:21	10	356		X	5		5	358		X	5	
3-Apr	7:25	15	353		X	5		10	359		X	15	
4-Apr	6:43	5	352		X	0		5	358		X	5	
5-Apr	7:10	5	355		X	0		5	356	ST	X	10	
6-Apr	6:55	0			X		P	10	356		X	ND	
7-Apr	6:24	5		MI		5		10	343		X	15	
8-Apr	7:04	10		MI		5		10	351	BT	X	10	
9-Apr	8:19	5	342		X	5		10		BT		15	
10-Apr	7:25	10	4		X	5		5	346		X	5	
11-Apr	7:29	15	347		X	5	ST	10	340	BT, P	X		P
12-Apr	7:30	10		P, MI		5		5	340		X	5	
13-Apr	7:01			P			P	10				10	
14-Apr	7:13	0			X		P	10		P			P
15-Apr	6:44			P			P	5	343		X	10	
16-Apr	7:20	5		MI						P		5	
17-Apr	7:14	10		P			P	10		P		10	P
18-Apr	7:09	0		P	X		P	10		P		5	P
19-Apr	7:00			P			P			P			P
20-Apr	7:18			P			P			P			P
21-Apr	7:23	0			X	10	MI	10		P		20	
22-Apr	7:29	20	358		X	10		5	341		X	5	

Table B-19 continued

23-Apr	7:21	5		MI, P		10		15	354		X	20	
24-Apr	7:30	15	351		X	10	ST	10	346		X	15	
25-Apr	7:36	10	356		X	15		10	350		X	10	
26-Apr	7:26	10	356		X	5				BT, P			P
27-Apr	7:42			P		0	P	10	345	P	X		P
28-Apr	7:04	0			X	5		5		MI		10	
29-Apr	6:55	15	353		X	5		5	345		X	5	
30-Apr	8:17	20				10				P		10	
1-May	ND												
2-May	ND												
3-May	ND												
4-May	6:50	10	10		X	10		10	340	P	X	10	
5-May	6:11	20	350		X	5		5	337		X	5	
6-May	6:16	5	350	P	X	10		5	350		X	5	
7-May	6:55			P		10		5	341		X	10	
8-May	7:06	10	9		X	10		5	340		X	10	
9-May	7:02			P			P			P			P
10-May	6:51			P			P	5	345	P	X	10	P
11-May	6:28	15				15		15				10	
12-May	8:33	20		P, MI		15	P	10	344	P	X	15	P
13-May	7:56	5	6		X	5	P	10	346	P	X	5	
14-May	7:15	15	359		X	5		5	345	P	X	15	
15-May	7:49	20		P		5		10	344		X	5	
16-May	7:11	10	353		X	10		5	345		X	10	
17-May	7:00			P			P	5		P			P
18-May	7:16	5		P		10		5	341		X	10	
19-May	8:15	5	341		X	10		5	340	P	X	10	P
20-May	7:31	ND				15		10	356		X	10	
21-May	8:06	20		MI, P		15		5	0		X	10	
22-May	7:27	0			X	5		10	358		X	10	
23-May	8:15	15	352		X	5		5	354		X	10	
24-May	8:19	5	356		X	5		5	354		X	10	
25-May	6:08	10		MI		5		5	1		X	10	
26-May	6:39			P		0	P	10	5		X	10	
27-May	7:14			P			P			P			P
28-May	7:20			P		0		5		P			P
29-May	7:27	5		MI		10		5		MI		15	
30-May	7:17	0			X	5		5	350		X	10	
31-May	8:21	5	5		X	0		5		MI		10	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table B-20. Data[1] for spring season (15 March-31 May) of 2004 for San Diego, CA (KNKX) and Santa Anna, CA (KSOX), WSR-88D stations.

Spring 2004							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Mar	6:23	5	327	P	X	5	
16-Mar	6:49	5	339	P	X	10	
17-Mar	6:49	5	33		X	5	
18-Mar	6:23	10	335		X	10	
19-Mar	7:14	5	335		X	5	
20-Mar	6:38	5	330		X	5	
21-Mar	7:39	5	330		X	5	
22-Mar	6:41	5	344	ST	X	5	
23-Mar	6:56	5	325		X	10	
24-Mar	6:44	5		MI		5	
25-Mar	6:35	5	343	ST	X	10	
26-Mar	6:44	10		MI		5	P
27-Mar	6:39	5	312	P	X	10	P
28-Mar	6:35	5	322		X	10	
29-Mar	6:52	5	334		X	5	
30-Mar	6:20			P			P
31-Mar	6:19	5	324		X	ND	
1-Apr	6:04			P			P
2-Apr	7:21	5		P, MI			P
3-Apr	7:25	5	326	P	X	ND	
4-Apr	6:43	10	330	P	X	15	
5-Apr	7:10	10	328	ST	X	15	
6-Apr	6:55	5	327		X	10	
7-Apr	6:24	5	317		X	10	
8-Apr	7:04			P		10	P
9-Apr	7:21	15	327		X	15	P
10-Apr	7:25	5	318		X	10	MI, P
11-Apr	7:29	5	325		X	5	
12-Apr	7:30	10	337	ST	X	5	
13-Apr	7:01	15	324		X	10	
14-Apr	7:13	10				15	P
15-Apr	6:44	15	327		X	10	
16-Apr	7:20	5	329		X	10	P
17-Apr	7:14			P			P
18-Apr	7:09	10	324		X	15	
19-Apr	7:00	10		MI		15	
20-Apr	7:18	10	325		X	15	
21-Apr	7:23	5	327		X	5	
22-Apr	7:29	15		MI		20	
23-Apr	7:21	5	321		X	5	
24-Apr	7:30	5	315		X	10	
25-Apr	7:36	10	314		X	10	P

Table B-20 continued							
26-Apr	7:26	5	320		X	10	
27-Apr	7:42	25		P, ST		10	P
28-Apr	7:04	10	347		X	5	
29-Apr	6:55	5	307		X	5	
30-Apr	7:33	20				10	
1-May	ND						
2-May	ND						
3-May	ND						
4-May	6:50	15	325		X	10	
5-May	6:11			P		15	P
6-May	6:16	5	344		X	10	
7-May	6:55	5	327	P	X	10	
8-May	7:06	10	330		X	10	P
9-May	7:02			P			P
10-May	6:51	5	320		X	5	
11-May	6:28	10				ND	
12-May	8:33	15		MI		5	
13-May	7:56	10	319		X	15	
14-May	7:15	10		ST, MI		10	
15-May	7:49	10	318		X	5	
16-May	7:11	5	323		X	10	
17-May	7:00	5	325		X	10	
18-May	7:16	5	318		X	10	
19-May	7:02	10		MI		5	
20-May	7:31	5		MI		5	
21-May	7:07	5	336		X	5	
22-May	7:27	10	320		X	10	
23-May	7:17	5		MI		5	
24-May	7:21	5	323		X	5	
25-May	6:08	5		P		5	
26-May	6:39	10		MI		10	
27-May	7:14	5	318		X	5	
28-May	7:20	5		MI		0	
29-May	7:27	5	325		X	5	
30-May	7:17	5		MI		5	
31-May	7:08	5		P, MI		0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Appendix C

Table C-1. Data[1] for fall season (15 August-15 November) of 2000 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Fall 2000													
		ESX				RGX				YUX			
Date	Time	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Aug	6:57	5	126		X	0			X	10		MI,P	
16-Aug	6:13			P		5		P, MI		ND			
17-Aug	ND												
18-Aug	7:58	5		MI		0			X	5			X
19-Aug	6:53	5		MI		0			X	10	115	P	X
20-Aug	ND												
21-Aug	6:43	5		MI		0			X	10		P, MI	
22-Aug	6:43			P		5	195		X	10		MI, P	
23-Aug	5:38	5		MI		0			X	15		MI, P	
24-Aug	6:02	5		P		5		MI		10	167	P	X
25-Aug	6:27	5	141		X	0			X	15	122		X
26-Aug	6:27	10	129		X	5		MI		10	113		X
27-Aug	6:22	5	138		X	5		MI		5		P	X
28-Aug	6:42	10		P		5		MI, P				P	
29-Aug	6:37			P		5	151	P	X	10		MI,P	
30-Aug	6:34	5	121		X	5		MI		15		MI	
31-Aug	6:57	ND				0			X	10	121		X
1-Sep	6:22	5		MI				P		15	133		X
2-Sep	7:16	5		MI		0		P	X	10	130		X
3-Sep	6:13	5		MI		0			X	15	124		X
4-Sep	6:39	5		MI		5		MI, P		15	115		X
5-Sep	6:29	5		MI		5	141		X	15		MI	
6-Sep	7:17	5	144		X	0			X	10	118		X
7-Sep	6:42			P		5	93		X	15	163	P	X
8-Sep	6:34	5	131		X	5	135		X	15	124		X
9-Sep	6:26	5	101		X	5	124		X	5		P	
10-Sep	6:17	5	115		X	5	131		X	5		MI	
11-Sep	7:08	10	150		X	5		MI		15		ST	
12-Sep	6:20	5	152		X	0			X	ND			
13-Sep	6:40	10		MI		0			X	15	117		X
14-Sep	6:33	5		MI		ND				5	134		X
15-Sep	6:28	5		MI		0			X	10		MI	
16-Sep	6:52	5		MI		ND				10	114		X
17-Sep	7:17	10	145	P	X	ND				10		MI	
18-Sep	7:09	5	160		X	ND				15		P, ST	
19-Sep	7:03	10				5				15		P	
20-Sep	6:57	5				15				10		P	
21-Sep	6:51	5		P, MI		5		P,MI		15	131		X
22-Sep	6:44	5		MI		5	195		X	10	140		X
23-Sep	7:07	10	142		X	5	240		X	15	152		X
24-Sep	6:32	5		MI		5		MI		10	158		X

Table C-1 continued

25-Sep	6:56	5		MI		5		MI		20	141		X
26-Sep	6:51	5		MI		5	230		X	10		P	
27-Sep	6:46	5		MI		5	203		X	10		P, MI	
28-Sep	6:43	0		P		5	198		X	15	117	P	X
29-Sep	ND												
30-Sep	ND												
1-Oct	7:05	5		MI		5		MI		5	106	P, ST	X
2-Oct	7:00	5		MI		5	169		X	10	123		X
3-Oct	ND												
4-Oct	ND												
5-Oct	ND												
6-Oct	6:16	5		MI		5	225	P	X	10			
7-Oct	6:11	5	160		X	5		MI		15		P	
8-Oct	6:03	5		MI		10		MI		15			
9-Oct	5:53			P				P		15		P	
10-Oct	6:09			P				P		10	140		X
11-Oct	6:21	5	129	P	X	0			X	ND			
12-Oct	ND												
13-Oct	6:41	10	184		X	5	207		X	15	135		X
14-Oct	6:35	5	180		X	5	132		X	10	134		X
15-Oct	6:02	5	135		X	5	121		X	10	123		X
16-Oct	6:28	5		MI		5		MI		5	174	P	X
17-Oct	6:50	5		MI		5		MI		5		MI	
18-Oct	6:11	5		P		5		MI		15		P, MI	
19-Oct	6:03	10	192	P	X	5	171		X	10		MI	
20-Oct	6:24	5		MI				P		5		MI	
21-Oct	6:16			P		0			X			P	
22-Oct	6:09			P		0			X			P	
23-Oct	6:25			P		5	137		X	5		P, MI	
24-Oct	6:29	5	124	P	X	5		MI		10	144		X
25-Oct	6:16	5		MI				P		ND			
26-Oct	6:33			P				P		5		MI	
27-Oct	5:54			P		5	143	P,	X	5	130		X
28-Oct	6:42	0			X			P		5		P	
29-Oct	6:32			P		0		P	X			P	
30-Oct	6:21	5	155	P	X	0		P	X	5	127		X
31-Oct	6:24	5	175	P	X	0		P	X	10	151		X
1-Nov	6:42			P		0			X	5	173	P	X
2-Nov	ND												
3-Nov	6:26	0		P	X			P				P	
4-Nov	6:47	5	97		X	0		P	X	5	127		X
5-Nov	6:38	0			X	0		P	X	5			X
6-Nov	5:58			P		0		P	X			P	
7-Nov	6:14	5		MI		0		P	X	5		P	
8-Nov	6:31	5		MI				P		5		MI	
9-Nov	6:23			P				P		5		MI	
10-Nov	6:13			P				P				P	

Table C-1 continued													
11-Nov	ND												
12-Nov	6:21	5		MI		5		MI		5	180		X
13-Nov	6:01			P				P		0		MI	X
14-Nov	6:17			P		0		P	X			P	
15-Nov	6:30			P		5		P, MI		0			X

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-2. Data[1] for fall season (15 August-15 November) of 2000 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Fall 2000													
		HNX				EYX		MUX		VBX		VTX	
Date	Time	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Aug	6:57	5	148		X	5		5		5	P	5	
16-Aug	6:13	10	136		X	10		5			P	5	
17-Aug	ND												
18-Aug	7:58	5	127		X	5		5		0	P	0	P
19-Aug	6:53	10	150	P	X	5		5		10	P	5	
20-Aug	ND												
21-Aug	6:43	5	148	P	X	10		5		0	P	5	
22-Aug	6:43	10	155		X	15	P	0		20	P	5	
23-Aug	5:38	10	150		X	15	P	5		15	P	5	
24-Aug	6:02	5	135		X	10		5		5		10	P
25-Aug	6:27	15	145	P	X	10		10		15	P	10	
26-Aug	6:27	10	146		X	15		5		10	P	15	P
27-Aug	6:22	10	145		X	15		5		10		15	
28-Aug	6:42	10	141	P	X	15	P	5		5		15	
29-Aug	6:37	5	143	P	X	10			P	5		10	
30-Aug	6:34	10	147	P	X	15	P	5		10	P	5	
31-Aug	6:57	5	143	P	X	10	P	5		5	P	10	
1-Sep	6:22	5	142		X	5			P	0		5	
2-Sep	7:16	10	144		X	5		5		10		5	
3-Sep	6:13	15	150		X	10		5		15		5	
4-Sep	6:39	10	145		X	15		10		5		5	
5-Sep	6:29	10	143		X	10		10		5		5	
6-Sep	7:17	5	153		X	5		15		10		5	
7-Sep	6:42	5	127		X	ND		5		10		0	
8-Sep	6:34	10	132		X	10		15	P	15		15	
9-Sep	6:26	10	145		X	10		10		10		5	
10-Sep	6:17	5	135	P	X	10		5		ND		10	
11-Sep	7:08	10	145		X	5			P	10		0	
12-Sep	6:20	5	147		X	15		15		5	BT	5	
13-Sep	6:40	10	140		X	5		0		5	BT	0	
14-Sep	6:33	15	145		X	20		20		15		10	
15-Sep	6:28	15	150		X	15	ST	5		10		5	
16-Sep	6:52	15	160		X	15		10		10		5	
17-Sep	7:17	10	156		X	5		15		10	BT	10	
18-Sep	7:09	5	145		X	15		15		15		5	
19-Sep	7:03	10				10		15		10		5	
20-Sep	6:57	10				5		5		5		5	
21-Sep	6:51	5	135		X	5		0		5		0	
22-Sep	6:44	15	145		X	0	P	10			P	P	
23-Sep	7:07	10	140		X	5		15		15	BT	10	
24-Sep	6:32	5	140		X	5		5		10		5	

Table C-2 continued

25-Sep	6:56	5	148		X	5		5	P	10		5	P
26-Sep	6:51	5	142	P, ST	X	10	ST	10		10		10	
27-Sep	6:46	10	153		X	10		10	P	5		10	
28-Sep	6:43	10	150		X	10		5		ND		5	
29-Sep	ND												
30-Sep	ND												
1-Oct	7:05	5	141		X	5		10		5		5	
2-Oct	7:00	10	150		X	5		5		5		5	
3-Oct	ND												
4-Oct	ND												
5-Oct	ND												
6-Oct	6:16	5	145		X	10		5		0		5	
7-Oct	6:11	5	147		X	10		5		5		5	
8-Oct	6:03	5	165		X	5		10		10		5	
9-Oct	5:53			P		5			P		P	0	
10-Oct	6:09			P		0		10			P	0	
11-Oct	6:21			P		0		5			P	0	
12-Oct	ND												
13-Oct	6:41	10	165		X	10		10		5		10	
14-Oct	6:35	10		MI		5		5			P	5	
15-Oct	6:02	5	150		X	5		5		5		5	
16-Oct	6:28	10	155		X	5		5		5		ND	
17-Oct	6:50	ND				ND		5			P		P
18-Oct	6:11	10	155		X	5		5		10		ND	
19-Oct	6:03	5		MI		10		5		0		5	
20-Oct	6:24	5	154		X	5			P	0		5	
21-Oct	6:16	10	176		X		P	5			P		P
22-Oct	6:09	5		MI		0	P	5		0		5	
23-Oct	6:25	5	146		X	ND		5		0		5	
24-Oct	6:29	10		MI		0		0		0		5	
25-Oct	6:16			P		0			P		P	ND	
26-Oct	6:33			P			P		P		P		P
27-Oct	5:54	10	157		X	0		10		5	P	5	
28-Oct	6:42			P		0			P		P	0	
29-Oct	6:32	5		P, MI			P	10	P	5		0	
30-Oct	6:21	10	150		X	0		10		0		5	
31-Oct	6:24	5	175		X	5		10		10		5	
1-Nov	6:42	5		MI		ND		5		10		5	
2-Nov	ND												
3-Nov	6:26	5		MI		ND		5		5		5	
4-Nov	6:47	5		MI		ND		5			P	5	
5-Nov	6:38	5	152		X	0		0		0		5	
6-Nov	5:58	5		MI		ND		0		0		0	
7-Nov	6:14	5		MI		5		0		0		5	
8-Nov	6:31	5		MI			P	0		0		ND	
9-Nov	6:23			P		0		0			P	0	
10-Nov	6:13	0	165		X	0		0		0		0	

Table C-2 continued													
11-Nov	ND												
12-Nov	6:21	5		MI		5		0		0		5	
13-Nov	6:01			P			P	0		0		0	
14-Nov	6:17	0	146		X	0		0		0		0	
15-Nov	6:30	5		P, MI		0	P		P	0		0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-3. Data[1] for fall season (15 August-15 November) of 2000 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Fall 2000													
		MAX				BHX		DAX				BBX	
Date	Time	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:57	0			X	5		5	140		X	10	
16-Aug	6:13	0			X	5		5		P, MI		10	
17-Aug	ND												
18-Aug	7:58	ND				5		10		MI		10	
19-Aug	6:53	ND				5		10		MI		5	
20-Aug	ND												
21-Aug	6:43	10		MI		10		10	120	P	X	ND	
22-Aug	6:43	5		MI		15		15		P		10	
23-Aug	5:38	5	152		X	10		10		MI		10	
24-Aug	6:02	0			X	5		5	140		X	10	
25-Aug	6:27	ND				10		5		P		ND	
26-Aug	6:27	5		MI		10		5	120	P	X	ND	
27-Aug	6:22	5		MI		10		10	140		X	10	
28-Aug	6:42	5		I		10		10	125		X	15	
29-Aug	6:37	5	128		X	10		5	127	P	X	10	P
30-Aug	6:34	5		MI		10		5	125	P	X	10	
31-Aug	6:57	0			X	0		10		P		10	P
1-Sep	6:22			P			P			P			P
2-Sep	7:16	0			X	5	P	ND				15	P
3-Sep	6:13			P		15		10	134		X	15	
4-Sep	6:39	15		P		20		10	139	P	X	15	
5-Sep	6:29	5	216		X	10		15	140		X	20	
6-Sep	7:17	5		MI		15		5	133		X	10	
7-Sep	6:42	5		MI		15		ND				15	
8-Sep	6:34	0			X	5		10		P, MI		10	
9-Sep	6:26	5	143		X	10		10	145		X	ND	
10-Sep	6:17	10	171		X	15		10	144		X	ND	
11-Sep	7:08	5		MI		10		5	132		X	ND	
12-Sep	6:20	10	203		X	15		10	175	P	X	ND	
13-Sep	6:40	0			X	5	P	10		MI		ND	
14-Sep	6:33	ND				5		15	120		X	15	
15-Sep	6:28	5		MI		15	ST	10	138		X	15	
16-Sep	6:52	15	188		X	15		20	150		X	20	
17-Sep	7:17	15	219		X	10		ND				ND	
18-Sep	7:09	10	196		X	10		10	140		X	ND	
19-Sep	7:03	10				15		10				15	
20-Sep	6:57	10				15		15				15	
21-Sep	6:51	5	174		X	10	P	5		MI		10	
22-Sep	6:44	10	173		X	10		15	161		X	20	
23-Sep	7:07	10		MI		10		15	140		X	15	
24-Sep	6:32	10		MI		15		5	146		X	10	

Table C-3 continued

25-Sep	6:56	10				10			10		MI		10	
26-Sep	6:51	15		MI		5			10	137	P	X	10	
27-Sep	6:46	10	210		X	15			10		MI		5	
28-Sep	6:43	15	191		X	10			10	148		X	15	
29-Sep	ND													
30-Sep	ND													
1-Oct	7:05	5	175		X	5			5		MI		10	
2-Oct	7:00	15	193		X	10			10	155		X	15	
3-Oct	ND													
4-Oct	ND													
5-Oct	ND													
6-Oct	6:16	15		MI		10			5	145		X	10	
7-Oct	6:11	10				10			5	165		X	10	
8-Oct	6:03	10		I		10			5		MI		10	
9-Oct	5:53			P			P				P		ND	
10-Oct	6:09			P		10	ST		5	147		X	10	
11-Oct	6:21	15	199		X	15			5		MI		ND	
12-Oct	ND													
13-Oct	6:41	10	194		X	10			10	160		X	15	
14-Oct	6:35	15	165		X	15			5	151		X	10	
15-Oct	6:02	15	160		X	10			5	153		X	10	
16-Oct	6:28	5		MI		5			5	169		X	10	
17-Oct	6:50	5		MI, P		5			5	141		X	10	
18-Oct	6:11	5				5			5	141		X	10	
19-Oct	6:03	10				5			ND				5	
20-Oct	6:24			P			P				P			P
21-Oct	6:16	15	203		X	20			5	168	P	X		P
22-Oct	6:09	5	203		X	5			10		P, MI		10	P
23-Oct	6:25	10		MI		10			5	139		X	5	
24-Oct	6:29			P			P		5		MI		5	
25-Oct	6:16			P			P				P			P
26-Oct	6:33	5	213		X	10					P		15	P
27-Oct	5:54	0			X		P		5		MI		10	
28-Oct	6:42			P			P				P			P
29-Oct	6:32			P			P		10		P			P
30-Oct	6:21	10	197		X	15			10	155		X	15	
31-Oct	6:24	5	179		X	5			5	145		X	10	
1-Nov	6:42			P			P		5	144		X	10	
2-Nov	ND													
3-Nov	6:26	10	197		X	5			5		MI		10	
4-Nov	6:47	5	197		X	5			5		MI		10	
5-Nov	6:38			P		0			5		MI		5	
6-Nov	5:58	5	195		X	5			5	168		X	5	
7-Nov	6:14			P		0			5		MI		15	BT
8-Nov	6:31			P			P		5	165		X	0	
9-Nov	6:23	0			X	5					P		20	P
10-Nov	6:13	5				5			5		P		20	P

Table C-3 continued													
11-Nov	ND												
12-Nov	6:21	0			X	0		5		MI		5	BT
13-Nov	6:01			P			P			P			P
14-Nov	6:17	0			X	0		5		MI		20	BT
15-Nov	6:30	5	191		X	0				P			P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-4. Data[1] for fall season (15 August-15 November) of 2000 for San Diego, CA (KNKX) and Santa Ana, CA (KSOX) WSR-88D stations.

Fall 2000							
		NKX				SOX	
Date	Time	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:57	0			X	5	
16-Aug	6:13	0			X	5	
17-Aug	ND						
18-Aug	7:58	5	142		X	5	
19-Aug	6:53	5	146	P	X	10	
20-Aug	ND						
21-Aug	6:43	5	144		X	10	
22-Aug	6:43	5	153		X	5	
23-Aug	5:38	0			X	5	
24-Aug	6:02	ND				5	
25-Aug	6:27	10	150		X	5	
26-Aug	6:27	5	155		X	5	
27-Aug	6:22	0			X	5	
28-Aug	6:42	5		MI, P		20	P
29-Aug	6:37	0			X	5	
30-Aug	6:34	10	160		X	10	
31-Aug	6:57	10	145		X	5	
1-Sep	6:22	ND				5	
2-Sep	7:16	10	150		X	10	
3-Sep	6:13	15	150		X	5	
4-Sep	6:39	10	145		X	10	
5-Sep	6:29	10	140		X	5	
6-Sep	7:17	10	126	ST	X	5	
7-Sep	6:42			P		5	
8-Sep	6:34	10	135	ST	X	15	
9-Sep	6:26	10	136		X	15	
10-Sep	6:17	10		MI		5	
11-Sep	7:08	10	150		X	5	
12-Sep	6:20	ND				10	
13-Sep	6:40	ND				5	
14-Sep	6:33	15	135		X	15	
15-Sep	6:28	15		P		10	
16-Sep	6:52	15		P, ST		5	
17-Sep	7:17	5	148		X	5	
18-Sep	7:09	10	140		X	10	
19-Sep	7:03	5		ST		5	
20-Sep	6:57	0		ST	X	5	
21-Sep	6:51	0			X	5	
22-Sep	6:44	0		P	X		P
23-Sep	7:07	10	148		X	10	
24-Sep	6:32	15	141	ST	X	15	ST
25-Sep	6:56	10	152	ST	X	10	

Table C-4 continued							
26-Sep	6:51	10	135	P	X	10	P
27-Sep	6:46	5	145	ST	X	10	P
28-Sep	6:43	5	130		X	10	
29-Sep	ND						
30-Sep	ND						
1-Oct	7:05	10	137		X	10	
2-Oct	7:00	ND				5	
3-Oct	ND						
4-Oct	ND						
5-Oct	ND						
6-Oct	6:16	5	145	ST	X	10	
7-Oct	6:11	5	135		X	10	
8-Oct	6:03	10		MI		10	
9-Oct	5:53	5		ST, MI		5	
10-Oct	6:09	5		P		0	
11-Oct	6:21	5	153		X	ND	
12-Oct	ND						
13-Oct	6:41	10	140		X	5	
14-Oct	6:35	10	130	ST	X	10	
15-Oct	6:02	5	140	ST	X	5	
16-Oct	6:28			P		5	
17-Oct	6:50			P		5	
18-Oct	6:11			P		10	
19-Oct	6:03	10	144		X	5	
20-Oct	6:24	5		MI		5	
21-Oct	6:16			P		5	
22-Oct	6:09			P		0	
23-Oct	6:25	5		MI		5	
24-Oct	6:29	5	150	ST	X	5	
25-Oct	6:16	5		MI		5	
26-Oct	6:33			P			P
27-Oct	5:54	0			X	5	P
28-Oct	6:42			P		5	
29-Oct	6:32			P			P
30-Oct	6:21	10	135	P	X	5	
31-Oct	6:24	5	140		X	5	
1-Nov	6:42	5	155		X	5	
2-Nov	ND						
3-Nov	6:26			P		0	
4-Nov	6:47	5	144		X	5	
5-Nov	6:38	0			X	0	
6-Nov	5:58	5		MI		0	
7-Nov	6:14			P		5	
8-Nov	6:31	0			X	0	
9-Nov	6:23	0			X	0	
10-Nov	6:13			P			P
11-Nov	ND						

Table C-4 continued							
12-Nov	6:21	5		MI		0	
13-Nov	6:01	0			X	0	
14-Nov	6:17			P		0	
15-Nov	6:30	0			X		P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-5. Data[1] for fall season (15 August-15 November) of 2001 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Fall 2001													
		ESX				RGX				YUX			
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Aug	7:06	5		MI		10		MI		10		P, MI	
16-Aug	7:01	10		P, MI		5		MI				P	
17-Aug	6:55	5		P, MI		0			X	10		P, MI	
18-Aug	7:20	0			X	5		P, MI		10		P, MI	
19-Aug	7:16			P		5		P, MI		5	117	P	X
20-Aug	7:13	5		MI		0			X	5	110		X
21-Aug	6:45	5		MI		5		P, MI		5	113	P	X
22-Aug	6:40	5	135		X	0			X	5	111		X
23-Aug	7:05	5		MI		ND				5		MI	
24-Aug	7:23	5	151		X	5	171		X	10		P, MI	
25-Aug	6:56	5				5		MI		5		MI	
26-Aug	6:57	5		MI		5		MI				P	
27-Aug	6:55	5				5		P, MI				MI	
28-Aug	7:20	5		P, MI		5	137		X	5		MI, P	
29-Aug	7:13	5		P, MI		5		MI		10		MI, P	
30-Aug	7:05	5	142		X	5		MI		5	117		X
31-Aug	7:01	5	145		X	0			X	5	121		X
1-Sep	6:57	5		MI		0			X	5	125	P	X
2-Sep	6:54	5		MI		0			X	5		MI	
3-Sep	7:18	5		P		5		MI				P	
4-Sep	6:51	5	135		X	0			X	10	124		X
5-Sep	6:09	5	93	P	X	5	128		X	5	124		X
6-Sep	7:00			P		0			X	5	110		X
7-Sep	6:54	5	130	P	X	5	178		X	10	125		X
8-Sep	7:18	5	136		X	0			X	5		MI	
9-Sep	7:11	5		MI		5		MI		10		MI	
10-Sep	6:56	0			X	5		MI		10		ST, MI	
11-Sep	ND												
12-Sep	7:30	0			X	0			X	10	122		X
13-Sep	7:02	5		MI		5		MI		5		MI	
14-Sep	6:51	10				5	180		X	15		MI, P	
15-Sep	7:00	5		MI		5	164	P	X	5	123		X
16-Sep	7:09	5	114		X	5	143		X	5	110		X
17-Sep	6:51	10	155		X	10	170		X	5	116	P	X
18-Sep	6:37	5	179		X	10	138		X	5		MI	
19-Sep	7:03	5		P, MI		5	189	ST	X	10		MI	
20-Sep	7:01	5	109		X	5		MI				P	
21-Sep	6:19	5		MI		5	196		X	10	125		X
22-Sep	7:04	5	172		X	5		MI		5	130		X
23-Sep	6:25	5		MI		0			X	10		MI	
24-Sep	6:54	5		MI		0		P	X	15		P, MI	

Table C-5 continued

25-Sep	6:05	0		P	X	5		MI				P	
26-Sep	6:36	5		MI		5		MI				P	
27-Sep	5:56	0			X	0		ST	X	5	135		X
28-Sep	6:07	0			X	10	189		X	15		ST, MI	
29-Sep	5:43	10	167		X	0			X	10		MI	
30-Sep	6:14	10		P, MI		5	185		X	15		P, MI	
1-Oct	6:57	5		MI, P		10	170		X			P	
2-Oct	6:43	5	141	P	X	5	208		X	10		P	
3-Oct	7:04	5	145	P	X	5	163		X	10	117		X
4-Oct	6:52	5	115		X	10		MI		5	114		X
5-Oct	6:45	0			X	5	202		X	10		MI	
6-Oct	6:53	0		P	X	5	218		X	10		P, MI	
7-Oct	6:19	5	142		X	0			X			P	
8-Oct	6:41	0			X	0			X	10	119		X
9-Oct	6:34	10	176	P	X	5	208		X	5	133	P	X
10-Oct	6:03	5	173	P	X	0			X	10	185		X
11-Oct	6:18			P		5	170		X	5	116	P	X
12-Oct	5:27	5	175		X	5	193		X	10	185		X
13-Oct	6:27	5	173		X	5	230		X	5	131		X
14-Oct	6:01	5	162		X	5	145		X	5	177		X
15-Oct	6:29	5	192		X	0			X	10		MI,P	
16-Oct	6:46	0			X	0			X	5	118		X
17-Oct	6:13	0			X	5	165		X	0		MI	X
18-Oct	6:40	5	182		X	5		MI		5	139		X
19-Oct	ND												
20-Oct	ND												
21-Oct	ND												
22-Oct	6:01			P		0			X	10		P, MI	
23-Oct	6:00			P		5	160		X	10		ST, P	
24-Oct	5:52	0			X	5		MI		5	160	ST, P	X
25-Oct	5:26	0			X	5		MI		5	159		X
26-Oct	5:46	0			X	0			X	5	133		X
27-Oct	5:29	0			X	0			X	10		MI	
28-Oct	5:41	0			X	0		P	X	5		MI	
29-Oct	6:15	0			X	0		P	X	5	134	MI	X
30-Oct	5:32			P		0			X	10		P, MI	
31-Oct	6:19			P		10	140	P	X	5	128	P	X
1-Nov	5:35			P		5	159		X	5		MI	
2-Nov	5:09	0			X	0			X	5		MI	
3-Nov	4:49	5		P, MI		0			X			P	
4-Nov	5:19			P		0			X			P	
5-Nov	5:01	ND				5		MI		5		MI	
6-Nov	5:06	ND				0		P	X	5		P	
7-Nov	5:05			P		0			X	5		MI	
8-Nov	5:10			P		0			X	5	180		X
9-Nov	5:04	ND				5	137		X	5		P, MI	
10-Nov	5:33	ND				0			X	5		MI	

Table C-5 continued													
11-Nov	5:10	ND				0			X	5		MI	
12-Nov	4:30	ND						P		5		P	
13-Nov	5:47			P		0			X	5	130	ST, P	X
14-Nov	5:18	0			X	5		P, MI		0		P	X
15-Nov	5:02	0		P	X	0			X	5		MI	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-6. Data[1] for fall season (15 August-15 November) of 2001 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Fall 2001													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Aug	7:06	5	136		X	10		0		10		0	P
16-Aug	7:01	ND				10		0		15	P	5	
17-Aug	6:55	10	146		X	10		5		15	P	5	
18-Aug	7:20	5	135		X	5		5			P	5	
19-Aug	7:16	5	142		X	5		0		0		5	
20-Aug	7:13	5	142		X	5		5		0		5	
21-Aug	6:45	5	151		X	5		5		5		5	
22-Aug	6:40	10	148		X	5		0		0	P	5	
23-Aug	7:05	5	148		X	5		5		5		5	
24-Aug	7:23	5	148		X	10		5			P	5	
25-Aug	6:56	10	136		X	15		5			P	10	
26-Aug	6:57	5	139		X	5		10		10	BT	10	
27-Aug	6:55	5	136		X	5		5		5	P	5	
28-Aug	7:20	5		MI		10		15		10		5	
29-Aug	7:13	5	141		X	ND		5		0		0	
30-Aug	7:05	10	154	P	X	5	P	15		5		5	
31-Aug	7:01	10	145		X	10		5		10		5	
1-Sep	6:57	10	142		X	15		15		15		5	
2-Sep	6:54	10	146		X	15		0			BT	10	
3-Sep	7:18	5	157		X	5	ST	5		ND		10	
4-Sep	6:51	10	152		X	15		5		5	ST	5	
5-Sep	6:09	10	142		X	5		10		5	P	15	
6-Sep	7:00	5	146		X	10		10		10		5	
7-Sep	6:54	5	138		X	5		10		5		5	
8-Sep	7:18	10	148		X	5	MI	10		5		10	
9-Sep	7:11	15	145		X	5		0		10		5	
10-Sep	6:56	10	152		X	10		0		10		5	
11-Sep	ND												
12-Sep	7:30	10	143		X	15		15		10		5	
13-Sep	7:02	15	137		X	15		ND		15		5	
14-Sep	6:51	10	152		X	10		ND		15		5	
15-Sep	7:00	10	136		X	5		ND		15		15	
16-Sep	7:09	15	140		X	5		ND		10		10	
17-Sep	6:51	10	139		X	5		ND		15		10	
18-Sep	6:37	10	140		X	10		ND		15		15	
19-Sep	7:03	10	145		X	5		ND		15		15	
20-Sep	7:01	10	145		X	15	ST	ND			P	5	P
21-Sep	6:19	5	146		X	5		ND		10		10	
22-Sep	7:04	5	145		X	10		ND		10		5	
23-Sep	6:25	0		P	X	5		0		5	P	5	

Table C-6 continued

24-Sep	6:54	15		P		0			P		P	5	P
25-Sep	6:05	15	150		X	15		10		10	P	5	P
26-Sep	6:36	10	149		X	10		10		5		15	
27-Sep	5:56	10	148		X	15		10		15		15	
28-Sep	6:07	10	147		X	5		10			P	5	
29-Sep	5:43	5		MI		5		10		5		5	
30-Sep	6:14	10		MI		0		5		10	BT	15	BT
1-Oct	6:57	10	155		X	5		10			P	15	
2-Oct	6:43	10	147		X	10		5		10	P	5	
3-Oct	7:04	5	146		X	5	P	10		5	P	5	
4-Oct	6:52	10	144		X	10		5		5		5	
5-Oct	6:45	10	153		X	5		10		5		5	
6-Oct	6:53	10	154		X	5		15		5		5	
7-Oct	6:19	5	144		X	10		10		5		5	
8-Oct	6:41	ND				5	ST	10		5		5	
9-Oct	6:34	5	150		X	5		10		5	P	10	
10-Oct	6:03	10		MI		ND		5		5	P	5	
11-Oct	6:18	5	146		X	ND		5			P	5	
12-Oct	5:27	10		MI		ND		10		5		10	
13-Oct	6:27	10		MI		5		10		5		5	
14-Oct	6:01	10		MI		5		10		5		5	
15-Oct	6:29	15		MI		0		5		0		0	
16-Oct	6:46	5	144		X	ND		5		5		5	
17-Oct	6:13	10	147		X	5		5		5		5	
18-Oct	6:40	10		MI		5		10		15		5	
19-Oct	ND												
20-Oct	ND												
21-Oct	ND												
22-Oct	6:01	5	154		X	5		10			P	5	
23-Oct	6:00	10	140		X	5		5		5		5	
24-Oct	5:52	5		MI		0		5		5		5	
25-Oct	5:26	5		MI		0		5		5		0	
26-Oct	5:46	10		MI		ND		0		0		0	
27-Oct	5:29	5	156		X	ND		0		5		0	
28-Oct	5:41	5		MI		ND		0		0		5	
29-Oct	6:15			P		0			P	ND		0	P
30-Oct	5:32			P		0		0		ND		0	P
31-Oct	6:19	10	158		X	0		5		ND		5	
1-Nov	5:35	5		MI		0		10		ND		5	
2-Nov	5:09	5	152		X	ND		5		ND		5	
3-Nov	4:49	5	160		X	ND		5		ND			P
4-Nov	5:19	5	146		X	ND		5		ND			P
5-Nov	5:01	5		MI		5		5		ND		5	
6-Nov	5:06	5	146		X	0		5		ND		5	
7-Nov	5:05	5	156		X	0		5		ND		5	
8-Nov	5:10	5	163		X		P	5		ND			P
9-Nov	5:04	5		MI		0		0		ND		ND	

Table C-6 continued													
10-Nov	5:33			P		0			P	ND		ND	
11-Nov	5:10	0			X	ND			P	ND		0	
12-Nov	4:30			P				0		ND		0	
13-Nov	5:47	5	149		X	ND		0		ND		5	
14-Nov	5:18	5		MI			P	ND		ND		5	
15-Nov	5:02	5	146		X	0		10		ND		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-7. Data[1] for fall season (15 August-15 November) of 2001 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Fall 2001													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	7:06	5		MI		15	MI	10		P, MI		ND	
16-Aug	7:01	5		MI		10		15		P, MI		ND	
17-Aug	6:55	0			X	5		15		MI		ND	
18-Aug	7:20	0			X	5		15		P, MI		ND	
19-Aug	7:16	0			X	5		10		MI		ND	
20-Aug	7:13	0			X	5		5	135		X	ND	
21-Aug	6:45			P		10	MI	5	133		X	ND	
22-Aug	6:40			P			P	10		P, MI		ND	
23-Aug	7:05	0			X	5	MI	5	137		X	10	
24-Aug	7:23	0			X	5		10	161	P	X	15	P
25-Aug	6:56	0			X	5		10		MI		10	
26-Aug	6:57	5		ST, MI		15		5	157		X	10	
27-Aug	6:55	5	174		X	10		10	153		X	10	
28-Aug	7:20	5		MI		10		15		MI		10	
29-Aug	7:13	5		MI		15	ST	10		MI		5	
30-Aug	7:05	0			X	5	ST	5	160		X	10	
31-Aug	7:01	0			X	5	ST	15		MI		10	
1-Sep	6:57	0			X	5		10		MI		5	
2-Sep	6:54	0			X	5	ST	10	130		X	10	
3-Sep	7:18	0			X	5	ST	10	130		X	10	
4-Sep	6:51	0			X	5	ST	5	130		X	10	
5-Sep	6:09	5	194		X	10		10	147		X	15	
6-Sep	7:00	10	183		X	10		10	143		X	15	
7-Sep	6:54	10	186		X	10		15		P, MI		10	
8-Sep	7:18	5	161		X	ND		5	111		X	10	
9-Sep	7:11	10		MI		15		5	119		X	10	
10-Sep	6:56	10		MI		20		10	127		X	15	
11-Sep	ND												
12-Sep	7:30	10	196	P	X	15		10		MI		15	
13-Sep	7:02	10	225		X	15		10	150	P	X	15	
14-Sep	6:51	5	168		X	10		10	154	ST	X	10	
15-Sep	7:00	10	152		X	15	P	10	158		X	15	
16-Sep	7:09	15	184		X	15		10	160		X	10	
17-Sep	6:51	5		MI		15	P	10	160		X	15	
18-Sep	6:37	5		MI		15		10	155		X	10	
19-Sep	7:03	10		MI		15	ST	10	145		X	15	
20-Sep	7:01	5	124		X	10		5	139	P	X	10	
21-Sep	6:19	5		MI		20		10	145		X	10	
22-Sep	7:04	5		MI		10		5		MI		10	
23-Sep	6:25	0			X	5		5		MI		15	

Table C-7 continued

24-Sep	6:54			P			P				P			P
25-Sep	6:05	10		MI		10			15	151		X	20	
26-Sep	6:36	5		MI		15			10	142		X	15	
27-Sep	5:56	0		P	X	5			5		MI		15	
28-Sep	6:07	15		MI		10			20	162		X	20	
29-Sep	5:43	5		MI		15			5	191		X	10	
30-Sep	6:14	15		MI		10			10	187		X	15	
1-Oct	6:57	15		MI		10			10	165		X	15	
2-Oct	6:43	10	200		X	15			5	140	ST	X	10	
3-Oct	7:04	10	185	P	X	10			5	136	P	X	5	
4-Oct	6:52	10		MI		15			5	110		X	10	
5-Oct	6:45	10	185		X	10			5	157		X	15	
6-Oct	6:53	15	188		X	20	ST		10	164		X	10	
7-Oct	6:19			P			P		10	154		X	10	
8-Oct	6:41	10	201		X	10			15	152		X	20	
9-Oct	6:34	15	192		X	10			5	159		X	10	
10-Oct	6:03			P			P		5		MI		5	
11-Oct	6:18	15	195		X	15			15	160		X	20	
12-Oct	5:27	10	170		X	10			5	169		X	10	
13-Oct	6:27	ND				10			10	172		X	15	
14-Oct	6:01	5	188		X	5			5	160		X	10	
15-Oct	6:29	5		P, MI		ND			10		MI		10	
16-Oct	6:46	0			X	5	P		5		MI		5	P
17-Oct	6:13	10	146		X	15			10	170		X	15	
18-Oct	6:40	5	213		X	10			5	164		X	10	
19-Oct	ND													
20-Oct	ND													
21-Oct	ND													
22-Oct	6:01			P			P		10		MI		10	
23-Oct	6:00	10	209		X	10			5	168		X	10	ST
24-Oct	5:52	5	184		X	5			5	167		X	10	
25-Oct	5:26	5		MI		5			5		MI		5	
26-Oct	5:46	0			X	5			5		MI		ND	
27-Oct	5:29			P			P				P			P
28-Oct	5:41	0			X		P		5	169	MI	X		P
29-Oct	6:15			P			P				P			P
30-Oct	5:32	0		P	X		P		5		MI			P
31-Oct	6:19	5		MI		10			10	162		X	15	
1-Nov	5:35	10		P, MI		10			10	176		X	15	
2-Nov	5:09	10	176		X	15	P		5	164		X	10	P, BT
3-Nov	4:49	5		MI		5			10	149		X	10	
4-Nov	5:19	5		MI		5			5	159		X	10	BT
5-Nov	5:01	0			X	5			5		MI		5	
6-Nov	5:06	5	201		X	5			5	144		X	10	P
7-Nov	5:05	0			X	5	ST		5	177		X	10	
8-Nov	5:10	0			X	0			5		MI		5	
9-Nov	5:04	0			X	0			5		MI		5	

Table C-7 continued													
10-Nov	5:33	0			X		P			P			P
11-Nov	5:10			P			P			P			P
12-Nov	4:30	0		P	X		P			P			P
13-Nov	5:47	0		P	X		P	5		MI, P			P
14-Nov	5:18	0			X	0		10	147	P	X	10	P, BT
15-Nov	5:02			P		ND		10		MI, P		15	P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-8. Data[1] for fall season (15 August-15 November) of 2001 for San Diego, CA (KNKX) and Santa Ana, CA (KSOX) WSR-88D stations.

Fall 2001							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	7:06			P		10	
16-Aug	7:01	0			X	5	
17-Aug	6:55	5	149		X	10	
18-Aug	7:20	5	144	P	X	10	
19-Aug	7:16	5		MI		5	
20-Aug	7:13			P		10	
21-Aug	6:45	5	131		X	5	
22-Aug	6:40	5	141		X	5	
23-Aug	7:05	10	140		X	5	
24-Aug	7:23	10	139		X	5	
25-Aug	6:56	10	120		X	5	
26-Aug	6:57	5	139		X	10	
27-Aug	6:55	10	135		X	10	
28-Aug	7:20	5	139		X	10	
29-Aug	7:13	5		MI		5	
30-Aug	7:05	5	157		X	5	
31-Aug	7:01	5		MI		5	
1-Sep	6:57	5	144		X	5	
2-Sep	6:54	10	140		X	10	
3-Sep	7:18	10	146		X	5	
4-Sep	6:51	10	144		X	10	
5-Sep	6:09	5	135		X	10	
6-Sep	7:00	5	140		X	5	
7-Sep	6:54	5	137		X	10	
8-Sep	7:18	5	143		X	5	
9-Sep	7:11	5	147		X	5	
10-Sep	6:56	5	153		X	5	
11-Sep	ND						
12-Sep	7:30	10	142		X	5	
13-Sep	7:02	10	135	ST	X	5	ST
14-Sep	6:51	ND				10	
15-Sep	7:00	5		MI		15	
16-Sep	7:09	5	135		X	10	
17-Sep	6:51	5	144		X	10	
18-Sep	6:37	5	159		X	10	
19-Sep	7:03	10	131		X	5	
20-Sep	7:01	5	134	P, ST	X	5	P
21-Sep	6:19	5	167	ST		10	
22-Sep	7:04	10	165	ST	X	15	
23-Sep	6:25	10	144	ST	X	10	
24-Sep	6:54	10	161	ST, P	X	5	
25-Sep	6:05	5	164	P	X	5	

Table C-8 continued

26-Sep	6:36	5	145	ST	X	5	
27-Sep	5:56	5	140	ST	X	10	
28-Sep	6:07	10	155		X	5	
29-Sep	5:43	5	146	ST	X	5	
30-Sep	6:14	10		MI		15	
1-Oct	6:57	10	178		X	15	
2-Oct	6:43	5	154	ST	X	5	
3-Oct	7:04	5	152		X	5	
4-Oct	6:52	5		MI		5	
5-Oct	6:45	0			X	10	
6-Oct	6:53	5	143		X	5	
7-Oct	6:19	10	150		X	10	
8-Oct	6:41	0			X	5	
9-Oct	6:34	5	155		X	10	
10-Oct	6:03	10	160		X	5	
11-Oct	6:18	5		ST, MI		5	
12-Oct	5:27	5	150		X	5	
13-Oct	6:27	5	140		X	5	
14-Oct	6:01	10	164		X	5	
15-Oct	6:29	10		MI		5	
16-Oct	6:46	5	138	ST	X	5	
17-Oct	6:13	5	152	ST	X	5	
18-Oct	6:40	5	149	ST, P	X	5	
19-Oct	ND						
20-Oct	ND						
21-Oct	ND						
22-Oct	6:01	5	140	ST	X	5	
23-Oct	6:00	5		MI		5	
24-Oct	5:52	5		ST, MI		5	
25-Oct	5:26	5	159	ST	X	5	
26-Oct	5:46	5	163	ST	X	5	
27-Oct	5:29	0			X	0	
28-Oct	5:41	5	145		X	5	
29-Oct	6:15	5		MI		5	
30-Oct	5:32	ND				0	P
31-Oct	6:19			P		5	
1-Nov	5:35	5	146		X	5	
2-Nov	5:09	0			X	5	
3-Nov	4:49			P			P
4-Nov	5:19			P			P
5-Nov	5:01	5	160		X	5	
6-Nov	5:06			P		5	
7-Nov	5:05	5	176		X	0	
8-Nov	5:10	0			X	0	
9-Nov	5:04	0			X	0	
10-Nov	5:33	0			X	0	
11-Nov	5:10	0			X	0	

Table C-8 continued							
12-Nov	4:30			P			P
13-Nov	5:47	5	149		X	5	
14-Nov	5:18	0			X	0	
15-Nov	5:02	0			X	0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-9. Data[1] for fall season (15 August-15 November) of 2002 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations

Fall 2002														
		ESX				RGX				YUX				
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	Time	dBZ	Dir	Code	Used
15-Aug	7:24	5		P, MI		5		MI		7:24	5		MI	
16-Aug	6:55			P		0			X	6:55	10		P	
17-Aug	6:56	5		P		0			X	6:56	5		MI	
18-Aug	6:30	5		MI		0			X	6:30			P	
19-Aug	6:58	0			X	0			X	6:58	10		P	
20-Aug	7:08	10		P, MI		0			X	7:08	10		MI	
21-Aug	6:49	5		MI		0			X	6:49	10		P, MI	
22-Aug	6:15	5		P		0			X	6:15	5	121		X
23-Aug	6:11	5	110		X	0			X	6:11	5	126		X
24-Aug	6:27	5	109		X	0			X	6:27	5	110		X
25-Aug	6:32	5		MI		5	132		X	6:32	5	116		X
26-Aug	7:21	5	148		X	0			X	7:21	10		P, MI	
27-Aug	6:37	5		MI		0			X	6:37	15		P, MI	
28-Aug	6:46	5		MI		5		P		6:46	15		MI	
29-Aug	7:12	5		P		5		MI		7:12	10	117	P	X
30-Aug	7:17	5		P, MI				P		7:17	5		MI	
31-Aug	6:53	5	130	P	X	5		MI		6:53	5	140	P	X
1-Sep	6:46	5	140		X	5	143		x	6:46			P	
2-Sep	6:49	5	120	P	X	5		MI		6:49	10		MI	
3-Sep	6:51	5		P, MI		0			X	6:51	10		MI, P	
4-Sep	7:33			P		0			X	7:33	10		P, MI	
5-Sep	ND													
6-Sep	6:53	0			X	0			X	6:53	15		P	
7-Sep	6:58	0			X	0		P	X	6:58	15		P	
8-Sep	6:48	5	135	P	X	5		MI		6:48	15		P	
9-Sep	7:04	10	170		X	0			X	7:04	10	128	P	X
10-Sep	6:50	10		P		5	178		X	6:50	5	136	P	X
11-Sep	6:34	5	145	P	X	5	167		X	6:34	5	127		X
12-Sep	6:34	10		P		5	182		X	6:34	5	113		X
13-Sep	6:51	10	149	P	X	5	MI			6:51	5	118		X
14-Sep	7:26	5		MI		0			X	7:26	5		MI	
15-Sep	6:48	5		MI				P		6:48	15		P, MI	
16-Sep	6:49	5	144		X	5	135		X	6:49	5	124	P	X
17-Sep	6:06	5	135		X	0			X	6:06	5	100		X
18-Sep	6:51	5	180		X	5	222		X	6:51	5	190	P	X
19-Sep	6:22	5	177		X	5	207		X	4:39	5	155		X
20-Sep	6:25	5	125		X	5	126		X	6:25	10		ST, P	
21-Sep	6:04	5	161		X	5	204		X	6:04	5	125		X
22-Sep	6:48	5	172		X	5	213		X	6:48	5	130		X
23-Sep	6:36	5		MI		5		MI		6:36	5	137		X
24-Sep	6:52	5		MI		10	146		X	6:08	5		P, MI	
25-Sep	6:28	5	107	P	X	5	188		X	6:28	10	124	P	X
26-Sep	6:04	5		MI		5	150		X	6:04	10	135		X

Table C-9 continued

27-Sep	6:06	0		P	X	5	157	P	X	6:06	10	132	P	X
28-Sep	6:38	0			X	5		RT		6:38	10	165		X
29-Sep	6:27	5	145		X	0			X	6:27	10	160		X
30-Sep	5:58	5		MI		5		P		5:58	10	138		X
1-Oct	6:23			P		0			X	6:23	10	129		X
2-Oct	6:30	10		P		5		MI		6:30	15	137		X
3-Oct	6:12	5	177		X			P		6:12	5	150		X
4-Oct	6:17	5	207		X	5	178		X	6:17	5	160		X
5-Oct	5:53	5	185		X	5	225		X	5:53	10	138		X
6-Oct	6:57	5	216		X	5	226		X	6:57	15	140		X
7-Oct	6:46	5	166	P	X	5	175		X	6:46	5	138		X
8-Oct	6:32	5	138		X	5	140		X	6:32	10		ST, MI	
9-Oct	6:53	5		MI		5		MI		6:53	10		ST, P	
10-Oct	6:40	0		P	X			P		6:40	5	120		X
11-Oct	6:27	5	165		X	5		MI		6:27	5	131		X
12-Oct	6:26	5	194		X	0			X	6:26	5	150	MI	X
13-Oct	6:24	5	160		X	5		MI		6:24	5	152		X
14-Oct	6:56	5		MI		0			X	6:56	5		MI	
15-Oct	6:14	5		MI		0		P	X	6:14	5		MI	
16-Oct	6:45			P		0			X	4:48	10	125		X
17-Oct	6:27	5		MI, P		5	182		X	6:27			MI, P	
18-Oct	6:30	5	125		X	5		MI		6:30	5		MI	
19-Oct	6:16	5		MI		5	174		X	6:16	5		MI	
20-Oct	6:00	5		MI		0		MI	X	6:00	5		P, MI	
21-Oct	6:41	0			X	0		P	X	6:41	5		MI	
22-Oct	6:11			P		0			X	6:11			P	
23-Oct	6:25	5		P		0			X	6:25			P	
24-Oct	6:42	5		MI				P		6:42	5		MI	
25-Oct	6:47			P				P		6:47			P	
26-Oct	7:08			P				P		7:08	ND			
27-Oct	6:29	5	187		X	0			X	6:29	5	176		X
28-Oct	6:46	0		P	X	5		MI						
29-Oct	6:27			P		0			X	6:27	5		MI	
30-Oct	ND													
31-Oct	6:27	5		MI		5		MI, P						
1-Nov	6:16	5		MI		0			X	6:16	5		mi	
2-Nov	ND													
3-Nov	6:25	0			X	0			X	6:25	0		P	X
4-Nov	6:11			P		5		MI		6:11	0		P	X
5-Nov	6:23	0			X			P		6:23			P	
6-Nov	6:20	0			X	0			X	6:20	0			X
7-Nov	6:26			P				P		6:26			P	
8-Nov	6:22			P				P		6:22	5		P, MI	
9-Nov	6:24	0		P	X	0			X	6:24	5		MI	
10-Nov	6:27	0			X	0			X	6:27	5		MI	
11-Nov	6:42	0			X	0			X	6:42	5	214		x
12-Nov	5:52	0			X			P		5:52	0			X
13-Nov	5:59			P		0			X	5:59	0		P	X

Table C-9 continued														
14-Nov	5:13			P		0			X	5:13	5		P	
15-Nov	5:27	0			X	0			X					

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-10. Data[1] for fall season (15 August-15 November) of 2002 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Fall 2002													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Aug	7:24	5	147		X	5	ST	0		5		5	
16-Aug	6:55	10	142		X	10	ST	5		0		5	
17-Aug	6:56	10		MI		5		0		5	P	5	P
18-Aug	6:30	10	141	P	X	15	ST	0		0		5	
19-Aug	6:58	5	135		X	5		5		0		5	
20-Aug	7:08	ND				5		10		0		5	
21-Aug	6:49	15		BT		10		0		0		5	
22-Aug	6:15	10	141		X	10		0		5		5	
23-Aug	6:11	5	135		X	10		0		5		ND	
24-Aug	6:27	10	146		X	15		0		5		5	
25-Aug	6:32	5	147		X	10		5		5	MI	5	MI
26-Aug	7:21	10	140		X	5		5		5	MI	5	MI
27-Aug	6:37	5	141		X	10		10		10		5	
28-Aug	6:46	10	147		X	5	ST	0		5		5	
29-Aug	7:12	10	145		X	5		0		5	MI	5	P
30-Aug	7:17	10	154		X	15		5		5		0	
31-Aug	6:53	10	135		X	10	P	15		5			P
1-Sep	6:46	ND				15		5		10		5	
2-Sep	6:49	15		P		5		5	MI	5		10	
3-Sep	6:51	ND				5		10			P	15	P
4-Sep	7:33	ND				0		0			P		P
5-Sep	ND												
6-Sep	6:53	15	149		X	10	P	0		10		15	
7-Sep	6:58	15	150		X	15		10		10		10	
8-Sep	6:48	ND				15	ST	10		5		5	
9-Sep	7:04	5	150		X	10	ST	5		5		10	
10-Sep	6:50	10	143		X	10		5		10		5	
11-Sep	6:34	10	131		X	5		15		5		15	
12-Sep	6:34	5	152		X	5		10		ND		5	
13-Sep	6:51	5	154		X	5		10		15		10	
14-Sep	7:26	5	140		X	10		10		10	P	5	
15-Sep	6:48	10	140		X	15	ST	15		10		5	
16-Sep	6:49	15	140		X	10	ST	15		5		5	
17-Sep	6:06	10	159		X	5		10		15		15	
18-Sep	6:51	10		MI		5		20		5		ND	
19-Sep	6:22	10	138		X	5		15		5		15	
20-Sep	6:25	10	144		X	10		15		10		15	
21-Sep	6:04	10	135		X	15		15		10	P	5	P
22-Sep	6:48	5	135		X	10	P	10		5	P	5	
23-Sep	6:36	5	140		X	10		10		5		10	
24-Sep	6:52	10	143		X	5		10		10	P	15	
25-Sep	6:28	10	138		X	5	ST	10			P	5	

Table C-10 continued													
26-Sep	6:04	5	146		X	5		10	P	10		10	
27-Sep	6:06	10	150		X	5	MI	10		5		15	
28-Sep	6:38	5	148		X	0		10		10		5	
29-Sep	6:27	10	150		X	5		5		10		5	
30-Sep	5:58	5	148		X	5		10		5		10	
1-Oct	6:23	15	170	P	X	15		15		5		10	
2-Oct	6:30	10	164		X	15		15		5		10	
3-Oct	6:12	10		MI,P		10		10		5		5	
4-Oct	6:17	5	148		X	0		10		5		5	
5-Oct	5:53	5	151		X	10		10		5		10	
6-Oct	6:57	5	142		X	5		10		5		5	
7-Oct	6:46	5	140		X	10		10		10		5	
8-Oct	6:32	5	144		X	5		10	ST	10		10	
9-Oct	6:53	10		MI		5	P	10	P	5		5	
10-Oct	6:40	5	150		X	5		10	P	5		5	
11-Oct	6:27	10	155		X	0		15		5		5	
12-Oct	6:26	5		MI		0		5		10		5	
13-Oct	6:24	5	180		X	5		10		10		5	
14-Oct	6:56	10		MI		5	MI	10		10		15	
15-Oct	6:14	10	155		X	5		15	P	5		10	
16-Oct	6:45	5	190	P	X		P	10		5			P
17-Oct	6:27	5	153		X		P	10		5		5	P
18-Oct	6:30	5		MI		5		10		5		5	
19-Oct	6:16	5	124		X	5		10		10		5	
20-Oct	6:00	10		MI		5		10		5		5	
21-Oct	6:41	5	135		X	0		10		5		5	
22-Oct	6:11	5	150		X	5	MI	5		5		5	
23-Oct	6:25	5	164		X	0		10		0		0	
24-Oct	6:42	5		P		0			P	0	BT	0	BT
25-Oct	6:47	5	141		X		P	5		0	BT		P
26-Oct	7:08	10		MI,P			P	10		5	BT	5	
27-Oct	6:29	5	155		X	0		5		0		5	
28-Oct	6:46	5	145		X	0		5		5		5	
29-Oct	6:27	5		MI			P	5		5		5	
30-Oct	ND												
31-Oct	6:27	5		MI		0		5		5		5	MI
1-Nov	6:16	5		MI		0		5		0		5	
2-Nov	ND												
3-Nov	6:25	5		MI		0		5			P		P
4-Nov	6:11	5		MI			P	5			P	0	
5-Nov	6:23	5		MI		0		5		0			P
6-Nov	6:20			P		0			P		P	0	
7-Nov	6:26			P			P		P		P		P
8-Nov	6:22			P			P		P		P		P
9-Nov	6:24	5	135		X	0		5		10	MI	0	
10-Nov	6:27	10		MI		0		15		5		5	
11-Nov	6:42	5	165		X	0		5		5		5	
12-Nov	5:52	5		MI		0		10	MI	5		5	

Table C-10 continued													
13-Nov	5:59	5	152		X	0		5		5		5	
14-Nov	5:13	10		MI			P	5		5		5	
15-Nov	5:27	15		P, MI		0		0		5		0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-11. Data[1] for fall season (15 August-15 November) of 2002 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Fall 2002													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	7:24	0			X	0		5		BT		ND	
16-Aug	6:55	0			X	5		10		BT, MI		ND	
17-Aug	6:56	0			X	5		10		MI		ND	
18-Aug	6:30	0			X	0		10		MI		ND	
19-Aug	6:58	0			X	0		5	149	BT	X	ND	
20-Aug	7:08	0			X	5		5	150	BT	X	ND	
21-Aug	6:49	0			X	5		15		BT, MI		ND	
22-Aug	6:15	0			X	5		5		BT, MI		ND	
23-Aug	6:11	0			X	5		5	128	BT	X	ND	
24-Aug	6:27	0			X	5		10		BT		ND	
25-Aug	6:32	0			X	5		10		BT		ND	
26-Aug	7:21	0			X	10		10	142	BT	X	ND	
27-Aug	6:37	0			X	5		5	130	BT	X	10	BT
28-Aug	6:46	0		P	X	5		5	120		X	ND	
29-Aug	7:12	0			X	5		10		MI		ND	
30-Aug	7:17	0			X	10				BT		10	BT
31-Aug	6:53	0			X	5		10	148	BT, P	X	10	
1-Sep	6:46	5		MI		5		5	172	BT	X	5	
2-Sep	6:49	5		MI		10		10		BT		10	
3-Sep	6:51	0			X	5		5	137	BT	X	5	
4-Sep	7:33	0			X	5		10		BT, MI		5	
5-Sep	ND												
6-Sep	6:53	0			X	5	MI	5	146	BT, P	X	15	P
7-Sep	6:58	0			X	5		10	142	BT	X	15	
8-Sep	6:48	0			X	5		10	158	BT	X	10	
9-Sep	7:04	5		MI		10		5	160		X	10	
10-Sep	6:50	5		MI		15		5	160		X	10	
11-Sep	6:34	5		MI		15		5	157		X	15	
12-Sep	6:34	5		MI		15		10		BT, MI		10	
13-Sep	6:51	0			X		P			P			P
14-Sep	7:26	0			X	5		5		BT, MI		10	
15-Sep	6:48	0			X	5		5	154		X	10	
16-Sep	6:49			P		10		10	145		X	15	
17-Sep	6:06	0			X	0		15	155	BT	X	15	
18-Sep	6:51	5	233		X	15	P	5	182	BT, ST	X	10	BT, P
19-Sep	6:22	5		MI		15		5	164	BT	X	15	
20-Sep	6:25	5	150		X	10		5	152		X	10	
21-Sep	6:04	10		MI		15	ST	5	160	BT,P	X	10	
22-Sep	6:48	5	188		X	10		5	145		X	10	
23-Sep	6:36	5	157		X	10		5	160	BT	X	5	
24-Sep	6:52	5	185		X	10		5	177	BT	X	5	
25-Sep	6:28	5	185		X	10				BT		10	

Table C-11 continued

26-Sep	6:04	10	180		X	10		5		MI		10		
27-Sep	6:06	5	183		X	10		5	150		X	10		
28-Sep	6:38	5	177		X	5		10	165	BT	X	10		
29-Sep	6:27	5		MI		10		5	149		X	5		
30-Sep	5:58			P		5		15	152		X	20		
1-Oct	6:23	10	202		X	15		10	180		X	15		
2-Oct	6:30	10	192		X	15		10	170	BT	X	20		
3-Oct	6:12			P		10		15		P, MI		10		
4-Oct	6:17	10	192		X	10		5	149	BT	X	10		
5-Oct	5:53	15	203		X	15		10	177	BT	X	15	P	
6-Oct	6:57	10	203		X	5		10	170		X	15		
7-Oct	6:46	5	195		X	10		5	152		X	15		
8-Oct	6:32	ND				10		10	160		X	10		
9-Oct	6:53	5		MI		5		10		MI			P	
10-Oct	6:40	5	197		X	5		5	161		X	ND		
11-Oct	6:27	5	240		X	5		5	160		X	ND		
12-Oct	6:26	5		MI		10		10		MI		ND		
13-Oct	6:24	10		MI		10		5	169		X	ND		
14-Oct	6:56	5		MI		10		5	148	BT	X	ND		
15-Oct	6:14	5	177		X	10		5	158	P	X	10	P	
16-Oct	6:45	10		MI		5		10	166	P	X	15	P	
17-Oct	6:27	5		MI		5		10	171		X	15		
18-Oct	6:30	5	180		X	5		5	160	BT	X	10		
19-Oct	6:16	5	185		X	5		5	156		X	10		
20-Oct	6:00	5	200		X	5		10	162		X	10		
21-Oct	6:41	5	191		X	10	ST	10	148	BT	X	5		
22-Oct	6:11	5		MI		5		5		MI		5		
23-Oct	6:25	5		MI		5		10		BT, MI		5		
24-Oct	6:42	5		MI		5	P			P			P	
25-Oct	6:47	5	216		X	15		5	146	P	X	10		
26-Oct	7:08	5	207		X	10		5	161		X	10		
27-Oct	6:29	5		RT		5		5	161	BT	X	10		
28-Oct	3:21	5	158		X	5		0			X	5		
29-Oct	6:27	5	1162		X	5		5	149	BT	X	5		
30-Oct	ND													
31-Oct	6:27	0			X	5		0			X	5		
1-Nov	6:16	5		MI		5		5		MI		5		
2-Nov	ND													
3-Nov	6:25	5	185		X	5		5	150		X	10		
4-Nov	6:11	5	187		X	5		5		MI		5		
5-Nov	6:23	0			X		P	5		MI		5		
6-Nov	6:20	0			X		P			P			P	
7-Nov	6:26			P			P			P			P	
8-Nov	6:22			P			P			P			P	
9-Nov	6:24			P			P			P			P	
10-Nov	6:27			P			P	5	150		X	10		
11-Nov	6:42			P			P	15	173	BT	X	20		
12-Nov	5:52	5	146	P	X	10				P			P	

Table C-11 continued													
13-Nov	5:59	10		MI		5		10	174	BT	X	15	
14-Nov	5:13	5	179		X	10		10	162		X	15	
15-Nov	5:27	0			X	0		0			X	5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-12. Data[1] for fall season (15 August-15 November) of 2002 for San Diego, CA (KNKX) and Santa Ana, CA (KSOX) WSR-88D stations.

Fall 2002							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	7:24	5		MI		5	
16-Aug	6:55	5		MI		10	
17-Aug	6:56	5		MI		10	
18-Aug	6:30	5		MI		5	
19-Aug	6:58	5		MI		10	
20-Aug	7:08	0			X	5	
21-Aug	6:49	5		MI		5	
22-Aug	6:15	5	150		X	5	
23-Aug	6:11	5		P		5	
24-Aug	6:27	5	134	ST	X	5	
25-Aug	6:32	5		ST		5	
26-Aug	7:21	5	144		X	10	
27-Aug	6:37	0			X	5	
28-Aug	6:46	5	142		X	5	
29-Aug	7:12	10	135		X		P
30-Aug	7:17	10		ST, MI		5	MI
31-Aug	6:53	5	135	P	X	5	
1-Sep	6:46	5	144	P	X	5	
2-Sep	6:49	0			X	5	
3-Sep	6:51	5	145		X	5	
4-Sep	7:33	5	147	P	X	15	P
5-Sep	ND						
6-Sep	6:53			P		10	P
7-Sep	6:58	15		ST		5	
8-Sep	6:48	10	175	ST	X	5	
9-Sep	7:04	10	145		X	15	P
10-Sep	6:50	5	140		X	10	
11-Sep	6:34	5	145	ST	X	5	
12-Sep	6:34	5	150	ST	X	5	
13-Sep	6:51	5	145	ST	X	5	
14-Sep	7:26	10	130	ST	X	ND	
15-Sep	6:48			P		5	P
16-Sep	6:49	5	148	ST	X	5	
17-Sep	6:06	5	146	ST	X	10	
18-Sep	6:51	10	163	ST	X	5	
19-Sep	6:22	10	149	ST	X	10	
20-Sep	6:25	10	140	ST	X	10	
21-Sep	6:04	10	135	ST	X	10	
22-Sep	6:48	10	140	ST	X	10	
23-Sep	6:36	10	15	P	X	15	
24-Sep	6:52	10		ST, P		10	
25-Sep	6:28	5	139		X	5	
26-Sep	6:04	10	142	ST	X	10	

Table C-12 continued							
27-Sep	6:06	5		MI, P		5	
28-Sep	6:38	15		P		0	
29-Sep	6:27	10	158		X	5	
30-Sep	5:58	5	133		X	5	
1-Oct	6:23	5	150		X	10	
2-Oct	6:30	5	151		X	5	
3-Oct	6:12	10	144		X	5	
4-Oct	6:17	10		ST, MI		5	
5-Oct	5:53	10	143	ST	X	5	
6-Oct	6:57	10	140		X	10	
7-Oct	6:46	10	140		X	10	
8-Oct	6:32	10	137	ST	X	10	
9-Oct	6:53	10	141		X	5	
10-Oct	6:40	5		MI		5	
11-Oct	6:27	10		MI		10	
12-Oct	6:26	10	133		X	10	
13-Oct	6:24	10	137		X	10	
14-Oct	6:56	10	147		X	10	
15-Oct	6:14	5		MI		10	
16-Oct	6:45			P, MI			P
17-Oct	6:27	5	154		X	10	
18-Oct	6:30	5		ST, MI		5	
19-Oct	6:16	5	156	ST	X	5	
20-Oct	6:00	5		MI		5	
21-Oct	6:41			P		5	
22-Oct	6:11	5	157	P	X	5	
23-Oct	6:25			P		5	
24-Oct	6:42			P		5	MI
25-Oct	6:47			P			P
26-Oct	7:08	5		P		5	
27-Oct	6:29	5	146		X	5	
28-Oct	6:46	5		MI			P
29-Oct	6:27	0			X	5	
30-Oct	ND						
31-Oct	6:27	0			X	0	
1-Nov	6:16	5		MI		5	
2-Nov	ND						
3-Nov	6:25	5		MI		5	
4-Nov	6:11	5		MI		5	
5-Nov	6:23			P			P
6-Nov	6:20			P			P
7-Nov	6:26	0			X		P
8-Nov	6:22			P			P
9-Nov	6:24			P			P
10-Nov	6:27	5	155		X	5	
11-Nov	6:42	5		MI		5	
12-Nov	5:52	ND				5	
13-Nov	5:59	5		ST		5	

Table C-12 continued							
14-Nov	5:13	5		ST			P
15-Nov	5:27	5		MI		5	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-13. Data[1] for fall season (15 August-15 November) of 2003 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations

Fall 2003														
		ESX				RGX				YUX				
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	Time	dBZ	Dir	Code	Used
15-Aug	6:59			P		5		P		6:59	5	120	P	X
16-Aug	6:55	5	153	P	X	5	165		X	6:55	5		MI	
17-Aug	7:07	5	146		X	5		MI		7:07	5	115		X
18-Aug	6:57	5		MI		5		MI		6:57	10		MI, P	
19-Aug	7:14			P		0			X	7:14	10		P	
20-Aug	7:02	10		P, MI				P		7:02	10	130	P	X
21-Aug	ND													
22-Aug	ND													
23-Aug	ND													
24-Aug	6:21	5		P, MI		5		MI		6:21	15		P	
25-Aug	7:10	5	125	P	X			P		7:10			P	
26-Aug	7:00	ND				5		MI		7:00			P	
27-Aug	7:18	5		P, ST		0			X	7:18	10		ST, P	
28-Aug	7:08	10		P, MI		0			X	7:08	15		P, MI	
29-Aug	7:29	5	120		X	0			X	7:29	15		P, MI	
30-Aug	6:09	5	160	P	X	0			X	6:09			P	
31-Aug	6:45	10		P, MI				P		6:45			P	
1-Sep	7:05			P		5	140		X	7:05	10		P, MI	
2-Sep	6:13	10		P, MI		5		P		6:13	10	120		X
3-Sep	6:36			P				P		6:36			P	
4-Sep	7:10			P		10		P		7:10			P	
5-Sep	7:13	10		P, MI		5		MI		7:13	10		P, MI	
6-Sep	6:20	5	115	P	X	0			X	6:20	10		P	
7-Sep	6:12	5		MI		0			X	6:12	10	126	P	X
8-Sep	6:40	5		MI		5		MI		6:40	10		P, MI	
9-Sep	7:08	5	134		X	0			X	5:55	15	120	P	X
10-Sep	6:38	10	160	P	X	5	165		X	6:38	5	132	ST, P	X
11-Sep	7:09	5	170	P	X	5	145		X	7:09	5	140	P	X
12-Sep	7:17	5	150		X	5	140		X	7:17	5	127	P	X
13-Sep	7:11	5	175		X	0			X	7:11	10		MI	
14-Sep	6:49	5		MI		5		MI		6:49	10		MI	
15-Sep	6:40	5		MI, P		0			X	6:40	5		P	
16-Sep	6:29	5		MI		5		MI		6:29	10	120		X
17-Sep	6:34	10	180		X	0			X	6:34	5	120		X
18-Sep	6:41	5	153		X	5	170		X	6:41	5	156		X
19-Sep	6:48	5				5				6:48	10			
20-Sep	6:58	10				ND				6:58	10			
21-Sep	6:51	5				ND				6:51	5			
22-Sep	6:54	5				ND				6:54			P	
23-Sep	6:59	5	165	P	X	ND				6:59			P	
24-Sep	6:35	5	183	P	X	5	198		X	6:35			P	
25-Sep	6:41	ND				5	225		X	6:41	15		P, ST	

Table C-13 continued

26-Sep	6:49	5		MI		5	235		X	4:22	5		ST, MI	
27-Sep	6:46	5		MI		5	220		X	6:46			P	
28-Sep	6:41	5		MI		5		MI		6:41	20		P, MI	
29-Sep	6:26	5		MI		0			X	6:26	20		P, MI	
30-Sep	ND													
1-Oct	6:34	5		MI		5	172	P	X	6:34	5	120		X
2-Oct	6:41	ND				5	230		X	6:41	10	140	P	X
3-Oct	6:33	ND				5	217		X	6:33	15		P	
4-Oct	6:25	ND				5		MI		6:25	10		MI, P	
5-Oct	6:19	ND				5		MI		6:19	10		P, MI	
6-Oct	6:09	ND				5		P, MI		6:09	10		P	
7-Oct	6:14	5	155	P	X	5		MI		6:14	10		P	
8-Oct	ND													
9-Oct	6:13	5		P, MI		5		MI		6:13			P	
10-Oct	6:11	5		P, MI		5		MI		6:11	15		P	
11-Oct	5:53	10	5	MI		0			X	5:53			P	
12-Oct	6:19	ND				5	180		X	6:19	10		MI,P	
13-Oct	5:43	5	195		X	0			X	5:43			P	
14-Oct	6:05	5		MI		0			X	6:05	10		P, MI	
15-Oct	6:03	5		MI		0			X	6:03	15		P, MI	
16-Oct	5:54	5		MI		5		MI		5:54	5		P, ST	
17-Oct	6:00	5		MI		0			X	6:00	5		P, ST	
18-Oct	5:54	5		MI		0			X	5:54	15		P, MI	
19-Oct	6:03	5		MI		0			X	6:03	5		P	
20-Oct	5:25	5		P		5	216		X	5:25	5		MI	
21-Oct	5:30	10		P		0			X	5:30	5		P, MI	
22-Oct	5:52	5		MI		0			X	5:52			P	
23-Oct	5:45			P		5		MI		5:45	5		P	
24-Oct	6:07	5	180		X	0			X	6:07	5	175		X
25-Oct	5:43	ND				0			X	5:43			P	
26-Oct		ND				0			X	6:13	5	170		X
27-Oct	6:11	5		MI		0			X	6:11	5	130		X
28-Oct	5:10	5		P, MI		5	130		X	5:10			P	
29-Oct	5:35			P				P		5:35	5		P, MI	
30-Oct	5:45	0			X			P		5:45			P	
31-Oct	5:14	0			X			P		5:14	5		MI	
1-Nov	5:33	0			X	0			X	5:33	5	135		X
2-Nov	5:23			P				P		5:23	5		MI, P	
3-Nov	5:26			P		0			X	5:26	0			X
4-Nov	5:12	0			X			P		5:12	5	130		X
5-Nov	5:28	0			X	0			X	5:28	5		P	
6-Nov	5:02	0			X	0			X	5:02			P	
7-Nov	5:02	0			X	0			X	5:02			P	
8-Nov	4:53			P				P		4:53	5		P	
9-Nov	5:08			P		0			X	5:08	10		P, MI	
10-Nov	4:54			P		5		MI		4:54			P	
11-Nov	4:59	0			X	0			X	4:59			P	

Table C-13 continued														
12-Nov	5:15			P		0		P	X	5:15			P	
13-Nov	5:17	0			X	0			X	5:17	5		MI	
14-Nov	5:04	0			X			P		5:04	5		MI	
15-Nov	5:07			P				P		5:07			P	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-14. Data[1] for fall season (15 August-15 November) of 2003 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Fall 2003													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Aug	6:59	5	148	P	X	5	P	5			P	5	
16-Aug	6:55	5	146		X	5		15		5	P	5	P
17-Aug	7:07	10	148		X	5		5	P	ND		5	
18-Aug	6:57	10	141		X	ND		5		5		5	
19-Aug	7:14	5	145		X	10		0		10		0	
20-Aug	7:02	15		P		0	P	0	P	5		0	
21-Aug	ND												
22-Aug	ND												
23-Aug	ND												
24-Aug	6:21	10	132		X	10		15		15	P	15	
25-Aug	7:10			P			P		P		P		P
26-Aug	7:00	10	146		X	5			P		P	5	P
27-Aug	7:18	10	143		X	5		5			P	5	P
28-Aug	7:08	10	146		X	5		15	P	15	P	5	
29-Aug	7:29	10	144	P	X	5		10			P	5	
30-Aug	6:53	10	151		X	5		10		15		5	
31-Aug	6:45	5	140		X	5		10			P	5	
1-Sep	7:05	ND				10		10		15	P	5	
2-Sep	6:13			P		0		15	P	15		5	
3-Sep	6:36	10	135		X		P		P	10	P	5	
4-Sep	7:10	10	145		X	15	P	0		10		5	
5-Sep	7:13	10	146		X	10		0		10	ST	5	
6-Sep	6:20	5	140		X	5		5		10		5	
7-Sep	6:42	10	146		X	5		10		10		5	
8-Sep	6:40	15	145		X	5		10		10		5	
9-Sep	7:08	5	148		X	5		0		5		10	
10-Sep	6:38	15		P, MI			P	15		5		ND	
11-Sep	7:09	5	140		X	5		10		10		10	
12-Sep	7:17	5	135		X	5		10		10		5	
13-Sep	7:11	5	155		X	5		10		10		5	
14-Sep	6:49	10	149		X	5		5		15		5	
15-Sep	6:40	5	142		X	5		10	P	15		5	
16-Sep	6:29	5	143		X	5		10		5		5	
17-Sep	6:34	10	137		X	5		10		5	P	5	
18-Sep	6:41	5		MI		0		5		10			P
19-Sep	6:48	15				5		10		15		5	
20-Sep	6:58	10				0		10		10		5	
21-Sep	6:51	10				5	MI	10		15		5	
22-Sep	6:54	10				5		10			P		P
23-Sep	6:59	10	140		X	10		10	P		P	15	P

Table C-14 continued

24-Sep	6:35	10	150		X	5		15	ST		P	10	P
25-Sep	6:41	5	135		X	5		10		10		10	
26-Sep	6:49	5	142		X	5		10			P	5	
27-Sep	6:46	10		MI		5		10	P	15	P	5	
28-Sep	6:41	10	135		X	5		5		15		15	P
29-Sep	6:26	10	155		X	5		10		15		ND	
30-Sep	ND												
1-Oct	6:34	10	143		X	5		10		15		10	
2-Oct	6:41	5	160		X	5		10		5		10	
3-Oct	6:33	5	166		X	10		10		10		10	
4-Oct	6:25	10	150		X	5		5		10		5	
5-Oct	6:19	10	160		X	5		10		10		5	
6-Oct	6:09	10	155		X	15		10		5	P	10	
7-Oct	6:14	5		MI		5		5		5		5	
8-Oct	ND												
9-Oct	6:13	10	164		X		P	10		5		5	
10-Oct	6:11	10	178		X	5		5		5		5	
11-Oct	5:53	10		MI		5		5		5		5	
12-Oct	6:19	5	145		X	5		5		5		5	
13-Oct	5:43	5		MI		5		5		5		5	
14-Oct	6:05	5		MI		5		5		5		5	
15-Oct	6:03	5	150		X	0		5		10	P	5	
16-Oct	5:54	5		MI		5		5		5		5	P
17-Oct	6:00	5		MI		5		5	MI	5		5	
18-Oct	5:54	5	149		X	0		0		5		0	
19-Oct	6:03	5	145		X	5	MI	5	MI	5		0	
20-Oct	5:25	5		MI		5		5		5		5	
21-Oct	5:30	10		MI			P	5			P	5	
22-Oct	5:52	5	145		X	0		10			P		P
23-Oct	5:45	10		MI		0		10		0		5	MI
24-Oct	6:07	10		MI		5		5		5		5	
25-Oct	5:43	5		MI		0		5			P		P
26-Oct	6:13	5		MI		0		5		5		5	
27-Oct	6:11	5		MI		5		10	MI	5		5	
28-Oct	5:10	5		MI		0		5		5		5	
29-Oct	5:35	5	150	P	X		P		P	5		5	
30-Oct	5:45	5	148		X	0		0		0		0	
31-Oct	5:14			P			P		P		P		P
1-Nov	5:33	5	148		X	0		5		0		5	MI
2-Nov	5:23	5		P, MI		0	P		P	0		0	
3-Nov	5:26	5	154		X	0		5		5		0	
4-Nov	5:12	5	140		X	0		0		5		5	
5-Nov	5:28	5		MI		0		0			P	5	
6-Nov	5:02	10		P, MI		0			P	ND		5	
7-Nov	5:02	10		P, MI		0		0		0		5	
8-Nov	4:53			P			P		P		P		P
9-Nov	5:08	5		P, MI			P	5	MI, P		P		P

Table C-14 continued													
10-Nov	4:54	10	139		X	0		15		5		5	
11-Nov	4:59	5	150		X		P	10			P		P
12-Nov	5:15			P			P	5	P		P	0	
13-Nov	5:17	5		MI		0		0		5		5	
14-Nov	5:04			P		0			P		P	0	
15-Nov	5:07			P			P		P		P		P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-15. Data[1] for fall season (15 August-15 November) of 2003 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Fall 2003														
		MAX				BHX			DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code		dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:59	0			X	5			10		BT, MI		10	
16-Aug	6:55	0			X		P		10		BT, MI		ND	
17-Aug	7:07	5		MI		15	P		10		BT, MI		5	
18-Aug	6:57	5		P, MI		15			5	130		X	5	BT
19-Aug	7:14	0			X	10	P		10		BT, MI		5	
20-Aug	7:02	0			X	5			5	139	BT, P	X	10	
21-Aug	ND													
22-Aug	ND													
23-Aug	ND													
24-Aug	6:21	0			X	10			5	130		X	10	
25-Aug	7:10	0			X	10	P				P		10	P
26-Aug	7:00	0			X		P		10		MI		5	
27-Aug	7:18	0			X		P		5		MI		5	BT
28-Aug	7:08	5		P		10	P		5	131	BT	X	10	
29-Aug	7:29	5	227		X	10	P		10	154	BT	X	15	P
30-Aug	6:53	5		MI	X	10			15		BT, MI		10	
31-Aug	6:45	5		MI		15					BT		10	
1-Sep	7:05	5		MI		5			5	154	BT	X	10	
2-Sep	6:13	10		MI		15					BT, P		10	
3-Sep	6:36			P		15	P				BT, P		15	P
4-Sep	7:10	10		P		20			ND				15	
5-Sep	7:13	5		MI		15			10		BT, MI		10	
6-Sep	6:20	0		P	X	10	ST		5	120	ST	X	10	
7-Sep	6:42	0			X	10			5	145		X	15	P
8-Sep	6:40			P		10	P		10	138		X	15	
9-Sep	7:08	0			X	10			10		P		10	
10-Sep	6:38	5	180	P	X	10			15	146		X	20	
11-Sep	7:09	5	180		X	10	P		10	145		X	10	
12-Sep	7:46	10	210		X	15			10	150		X	20	
13-Sep	7:11	5	175		X	10			5	142		X	20	
14-Sep	6:49	10		P, MI		15			15		BT, MI		15	
15-Sep	6:40			P		15			5	123		X	10	
16-Sep	6:29	0			X	5			10	143		X	15	
17-Sep	6:34	5	186		X	10			10	155	BT	X	15	
18-Sep	6:41	5		MI		15			5	176		X	15	

Table C-15 continued

19-Sep	6:48	5				10	ST	10				15	
20-Sep	6:58	15				15		10				15	
21-Sep	6:51	5				10		10				15	
22-Sep	6:54	5				15		10				10	
23-Sep	6:59	5		MI		20		15		BT, MI		10	
24-Sep	6:35	5	167		X	10		10	167		X	15	
25-Sep	6:41	5	200		X	10		10	168		X	10	
26-Sep	6:49	5	247		X	10	P	10	144		X	15	
27-Sep	6:46	5		MI		10	ST	10	140		X	15	P
28-Sep	6:41	10		P, MI		10		5		BT, MI		10	
29-Sep	6:26	10		P, MI		15		10	147		X	15	
30-Sep	ND												
1-Oct	6:34	5	170		X	10		5	155		X	10	P
2-Oct	6:41	10	220		X	15		10	158		X	15	
3-Oct	6:33	10		MI		10		5	163		X	10	
4-Oct	6:25	5	193		X	10		5		MI		10	
5-Oct	6:19	10		MI		15		10	165		X	15	
6-Oct	6:09	0			X	5		ND				15	
7-Oct	6:14	5		P, MI		10		5		MI		5	
8-Oct	ND												
9-Oct	6:13	0			X	5		15	152		X	15	
10-Oct	6:11	5		MI		10		5	159		X	10	
11-Oct	5:53	0			X	5		5	152		X	10	
12-Oct	6:19	5	171		X	10		10	165		X	15	
13-Oct	5:43	0			X	5		5		MI		10	
14-Oct	6:05	5	150		X	5		5		MI		10	
15-Oct	6:03	0			X	5		5		MI		10	
16-Oct	5:54	0			X	5		5	164		X	10	
17-Oct	6:00	0		P	X	5	P, MI	5		MI		15	
18-Oct	5:54	0			X	0	P, MI	5		MI		5	MI
19-Oct	6:03	0			X	5		10	166		X	10	P
20-Oct	5:25	5		MI		10		5	175		X	15	
21-Oct	5:30	0		P	X	5	P, MI	5		MI		5	P
22-Oct	5:52	0			X	5	MI	5	164	ST	X	10	
23-Oct	5:45	10	190	P	X	10		10	165		X	15	
24-Oct	6:07	5	216		X	5		5	185		X	10	
25-Oct	5:43	5	205		X	5		5	180		X	10	
26-Oct	6:13	5	170		X	10		5	157		X	10	
27-Oct	6:11	5	198		X	5		5	168		X	10	ST
28-Oct	5:10	5		MI		5	P, MI	5		MI		10	
29-Oct	5:35			P			P, MI	5	147		X	10	P
30-Oct	5:45	5		P		10	P	10		BT, P			P
31-Oct	5:14	5		RM		15	P			P			P
1-Nov	5:33			P		5		10		BT, P		10	P
2-Nov	5:23			P			P			P			P
3-Nov	5:26	5	170		X	10		5	166		X	5	

Table C-15 continued													
4-Nov	5:12			P			P		5		P			P
5-Nov	5:28	5		MI		5			10	172		X	10	P
6-Nov	5:02			P			P				P			P
7-Nov	5:02			P			P		10		P, MI			P
8-Nov	4:53			P			P				P			P
9-Nov	5:08	5		MI. P			P		10		P		5	P
10-Nov	4:54	5		MI		15			15	155		X	20	
11-Nov	4:59	10	220		X	15			10	176		X	15	
12-Nov	5:15	5		MI		5			10		MI		20	
13-Nov	5:17	0			X	0			5		MI		10	BT
14-Nov	5:04			P			P				P			P
15-Nov	5:07			P			P				P			P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-16. Data[1] for fall season (15 August-15 November) of 2003 for San Diego, CA (KNKX) and Santa Ana, CA (KSOX) WSR-88D stations.

Fall 2003							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:59	0			X	5	
16-Aug	6:55			P		10	
17-Aug	7:07			P		5	
18-Aug	6:57	5		MI		5	
19-Aug	7:14	5	160		X	5	
20-Aug	7:02	10		P		10	
21-Aug	ND						
22-Aug	ND						
23-Aug	ND						
24-Aug	6:21	10		P		10	
25-Aug	7:10			P			P
26-Aug	7:00			P		10	P
27-Aug	7:18	10	145	P	X	10	P
28-Aug	7:08	5	145	P	X	5	
29-Aug	7:29	5	142	P	X	5	
30-Aug	6:53	10	143	P	X	5	
31-Aug	6:45	5	137		X	5	
1-Sep	7:05	5	141	ST,P	X	10	
2-Sep	6:13	10	150		X	5	
3-Sep	6:36			P		10	P
4-Sep	7:10	10		P		15	
5-Sep	7:13	5	141		X	10	
6-Sep	6:20	5	142		X	10	
7-Sep	6:42	5	148	ST, P	X	5	
8-Sep	6:40	5	144		X	5	
9-Sep	7:08	5	139		X	5	
10-Sep	6:38	10	148		X	5	
11-Sep	7:09	10	150		X	5	
12-Sep	7:17	5	145		X	5	
13-Sep	7:11	5	135		X	5	
14-Sep	6:49	5	140		X	5	
15-Sep	6:40	10	130		X	5	
16-Sep	6:29	5	135		X	5	
17-Sep	6:34	5	129		X	5	
18-Sep	6:41	10	139	ST	X	10	
19-Sep	6:48	10		ST		5	
20-Sep	6:58	10		ST		15	
21-Sep	6:51	10		ST		10	
22-Sep	6:54			P		5	
23-Sep	6:59	10	133	ST, P	X	10	
24-Sep	6:35			P		10	P

Table C-16 continued							
25-Sep	6:41	10	137		X	10	
26-Sep	6:49	10	147		X	10	
27-Sep	6:46	5		MI		5	
28-Sep	6:41	5	135		X	5	
29-Sep	6:26	10	152		X	5	
30-Sep	ND						
1-Oct	6:34	5	135		X	5	
2-Oct	6:41	5	149		X	10	
3-Oct	6:33	5	145		X	15	
4-Oct	6:25	5	141		X	5	
5-Oct	6:19	5	146		X	5	
6-Oct	6:09	10	130	ST	X	10	
7-Oct	6:14	5	143		X	5	
8-Oct	ND						
9-Oct	6:13	5		MI		5	P
10-Oct	6:11	5		MI		5	
11-Oct	5:53	10	165		X	5	
12-Oct	6:19	5	150		X	5	
13-Oct	5:43	10		ST, MI		10	
14-Oct	6:05	5		MI		5	
15-Oct	6:03	5		MI		5	
16-Oct	5:54	10		ST, MI		5	
17-Oct	6:00	5		MI		5	
18-Oct	5:54	5		MI		5	
19-Oct	6:03	5	150		X	5	
20-Oct	5:25	5	158		X	5	
21-Oct	5:30	5	140		X	5	
22-Oct	5:52			P		5	P
23-Oct	5:45			P		0	P
24-Oct	6:07	5		RM		5	
25-Oct	5:43	5		P, RM			P
26-Oct	6:13	ND				5	
27-Oct	6:11	ND				5	
28-Oct	5:10	ND				5	
29-Oct	5:35	ND					P
30-Oct	5:45	ND				0	
31-Oct	5:14	ND					P
1-Nov	5:33	ND				5	
2-Nov	5:23			P		0	
3-Nov	5:26			P		0	
4-Nov	5:12	5		MI		5	
5-Nov	5:28	5		P, MI		5	
6-Nov	5:02			P		5	
7-Nov	5:02	0			X	5	
8-Nov	4:53			P			P

Table C-16 continued							
9-Nov	5:08	ND					P
10-Nov	4:54			P		5	
11-Nov	4:59			P			P
12-Nov	5:15			P			P
13-Nov	5:17	5	153		X	ND	
14-Nov	5:04	0			X	0	
15-Nov	5:07			P			P

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-17. Data[1] for fall season (15 August-15 November) of 2004 for Las Vegas, NV (KESX), Nixon, NV (KRGX), and Yuma, AZ (KYUX) WSR-88D stations.

Fall 2004													
		ESX				RGX				YUX			
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used	dBZ	Dir	Code	Used
15-Aug	6:52	5		P				P		5		MI, P	
16-Aug	6:51	5		P		10	139		X	5		MI, P	
17-Aug	6:54	5		P		10		MI, P		ND			
18-Aug	6:58			P		5		MI		10		P, MI	
19-Aug	7:04	5		P		10		P		5		MI	
20-Aug	7:09			P		5	144		X	5		MI	
21-Aug	7:17	5		MI, P				P		5		P	
22-Aug	6:57	5		MI		0			X	5	106	P	X
23-Aug	6:50	5		MI				P		5	127	P	X
24-Aug	6:56	ND				5		MI		ND			
25-Aug	7:01	5		P, MI				P		ND			
26-Aug	7:02			P		5		MI		5	138		X
27-Aug	7:05	5	168	P	X	5		MI		5		ST, P, MI	
28-Aug	7:13	5	134		X	5	147		X	5		P, ST	
29-Aug	7:19	5		MI		5		MI				MI, P	
30-Aug	7:08	5	122	P	X	5		MI		5		MI, P	
31-Aug	7:26	5		P		0		P	X	10		P, MI	
1-Sep	7:18	5		P,MI				P				P, ST	
2-Sep	6:53	5		P		0			X	5	116	P	X
3-Sep	7:32	5	157	P	X	0			X	10	129		X
4-Sep	6:42	5	150		X	5	148		X	5		MI	
5-Sep	6:49	5	147		X	5	141		X	5	120		X
6-Sep	7:12	5	134	P	X	5		MI		10	139	P	X
7-Sep	6:34	5		MI		ND				5		MI	
8-Sep	6:39	5		P		5		MI				P	
9-Sep	6:44			P		5		MI		5	119	P	X
10-Sep	6:38	5	129	P	X	5		MI		15		P	
11-Sep	6:48			P				P		5	115	P	X
12-Sep	6:30	5	120		X	5		MI		10	115		X
13-Sep	6:36	5	135		X	5	154		X			P	
14-Sep	6:38	10	154	P	X	5		MI		ND			
15-Sep	6:23	5		MI		5	142		X	5		MI, P	
16-Sep	ND												
17-Sep	6:41			P		0			X			P	
18-Sep	6:40			P				P				P	
19-Sep	6:37			P				P		5	140	P	X
20-Sep	7:18			P		5	220		X	10	144	P	X
21-Sep	7:39	5	168		X	5	216		X	10	168	P	X
22-Sep	6:59	5	197		X	5	129		X	5	149	P	X
23-Sep	ND												
24-Sep	ND												

Table C-17 continued

25-Sep	7:00	5		MI				P		10	127	P	X
26-Sep	6:43	5		MI		5	163		X			P	
27-Sep	7:05	5		MI		5	212		X			P	
28-Sep	6:55			P		5	200	P	X	10	141	P	X
29-Sep	6:32			P		10	170		X	10	131	P	X
30-Sep	6:38	10		P		5		MI, P		10		MI	
1-Oct	6:45	5	178	P	X	5	204	P	X			P	
2-Oct	6:23	5	159		X	5	220		X	5	122		X
3-Oct	6:20	5	170		X	5		P, MI		10		P	
4-Oct	6:42	5	155	P	X	5	201		X	10	124	P	X
5-Oct	ND												
6-Oct	6:56	5	158	P	X	5		MI		10		P, MI	
7-Oct	6:17	5	163		X	5		MI		5		P, MI	
8-Oct	6:24	5		MI		0			X	5	132		X
9-Oct	6:18	0			X	5		P		5	133		X
10-Oct	6:28	5	182		X	0			X	10	135		X
11-Oct	6:46	5		MI		0			X	10		P, MI	
12-Oct	6:32	5	212		X	0			X	10		P, MI	
13-Oct	6:49	5	188		X	0			X	10	143	P	X
14-Oct	6:53	5	140		X	5	193		X	5	147	P	X
15-Oct	6:43	5		MI		5	140		X	10		ST, MI	
16-Oct	6:20			P				P		10	140	P	X
17-Oct	ND												
18-Oct	6:36			P				P		0		P	X
19-Oct	6:35			P				P				P	
20-Oct	5:50			P				P				P	
21-Oct	6:32			P		5	182		X	5	154	P	X
22-Oct	6:08	10	172	P	X			P		5	172		X
23-Oct	5:33			P				P		5		MI	
24-Oct	5:40			P				P		5		MI	
25-Oct	5:42			P				P		5		MI	
26-Oct	5:28			P				P		5		MI	
27-Oct	5:31			P				P				P	
28-Oct	5:35	5		MI, P		0			X			MI	
29-Oct	5:10	5	199		X	5	192		X	5	179		X
30-Oct	5:03	5	160		X	0			X	5	148		X
31-Oct	5:27			MI		0			X	5		MI	
1-Nov	5:36			P		0			X	5		MI	
2-Nov	5:20			P		0			X	5		MI	
3-Nov	5:05	0		P	X			P		5		MI	
4-Nov	5:21			P		0			X	5		P	
5-Nov	5:24	0		P	X	0			X	5		P	
6-Nov	5:31			P		0			X	5		MI, P	
7-Nov	5:10			P		0			X	0		P, MI	X
8-Nov	5:26			P				P		5		P	
9-Nov	5:39			P				P				P	
10-Nov	5:25			P				P		5		MI	

Table C-17 continued													
11-Nov	5:17	0			X			P		5		P	
12-Nov	5:32	0			X	0		P	X	5		MI	
13-Nov	5:30			P		ND						P	
14-Nov	5:25	0			X	0			X	5		MI	
15-Nov	5:21			P		0			X	0			X

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-18. Data[1] for fall season (15 August-15 November) of 2004 for Hanford, CA (KHNX), Edwards AFB, CA (KEYX), Los Gatos, CA (KMUX), Vandenberg AFB, CA (KVBX), and Los Angeles, CA (KVTX) WSR-88D stations.

Fall 2004													
		HNX				EYX		MUX		VBX		VTX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Code	dBZ	Code	dBZ	Code
15-Aug	6:52	5	150	P	X	5		5		ND		10	
16-Aug	6:51	10	148		X	10		5		15		5	
17-Aug	6:54	5	142	P	X	10		5		5		5	
18-Aug	6:58	ND				5	P	0		5		5	
19-Aug	7:04	10	144		X	5		0		5		5	
20-Aug	7:09	10	130		X	5		0		5		5	
21-Aug	7:17	10	147		X	10			P	5		5	
22-Aug	6:57	5	140		X	5		0		5		5	
23-Aug	6:50	5	143		X	5		10		10	P	5	P
24-Aug	6:56	10	145		X	5		5		10		5	
25-Aug	7:01	5	140		X	5		5		5		5	
26-Aug	7:02	10	140		X	5	P	15		5		5	
27-Aug	7:05	5		ST, MI		20	P	5			BT, P	5	P
28-Aug	7:13	5	142		X	5	ST	5			P	5	
29-Aug	7:19	ND				5		5			SBT	5	
30-Aug	7:08	5	153		X	5		0		5	P, ST		P
31-Aug	7:26	10	135	P	X	10	ST	0			P		P
1-Sep	7:18	5	135	P	X	5			P		P	5	
2-Sep	6:53	10	135	P	X	5		5			P	5	
3-Sep	7:32	5	140	P	X	15		0		5	P	5	
4-Sep	6:42	5		MI		5	MI	10		10		0	
5-Sep	6:49	5	145	ST	X	5		5		10		5	
6-Sep	7:12	10	136		X	15		5		15		5	
7-Sep	6:34	5	141		X	10		5		10		5	
8-Sep	6:39			P		15	P		P	4	P		P
9-Sep	6:44	10	142	BT, P	X	10		5			P	10	
10-Sep	6:38	5	150	P	X	5	P	5			P	10	
11-Sep	6:48	10	140		X	15		15			P	10	
12-Sep	6:30	10	144		X	5		ND		15	P	5	
13-Sep	6:36	15	144	P	X	5		ND		10		5	
14-Sep	6:38	5	144		X	5	P	ND		5		5	
15-Sep	6:23	5	136	P	X	10		15			P	5	
16-Sep	ND												
17-Sep	6:41	10	147	P	X	5	MI	0		5		5	
18-Sep	6:40	5	140		X	0		0		5		ND	
19-Sep	6:37	5	141	P	X	5			P	5		5	
20-Sep	7:18	15	137		X		P	15		5		5	
21-Sep	7:39	5	146		X	5		10		5		5	
22-Sep	6:59	5	141		X	5		10		10		5	
23-Sep	ND												

Table C-18 continued													
24-Sep	ND												
25-Sep	7:00			P		5		10			P	5	
26-Sep	6:43	5	143	P	X	5		5			P		P
27-Sep	7:05	15	160	P	X	10	P		P		P		P
28-Sep	6:55	10	156		X	5		10	P	10	P	5	
29-Sep	6:32	10	150		X	5		15		5		5	
30-Sep	6:38	10	149		X	10	P	15		10		5	
1-Oct	6:45	5	149		X	5		10	P	10		5	
2-Oct	6:23	10	150		X	15	P	10		10		5	
3-Oct	6:20	15	142		X	5		10		10		5	P
4-Oct	6:42	10	152		X	10		15		15		5	
5-Oct	ND												
6-Oct	6:56	5	147		X	10		5		5	P	5	
7-Oct	6:17	10	155		X	5		10		5		5	P
8-Oct	6:24	5	146		X	5		0		5		5	P
9-Oct	6:18	10	149		X	5		15		5		5	
10-Oct	6:28	5	151		X	ND		15		5		10	
11-Oct	6:46	5		MI		ND		10		5		0	
12-Oct	6:32	5	154		X	ND		10		5		ND	
13-Oct	6:49	5	149		X	ND		5		10		5	
14-Oct	6:53	5	146		X	ND		5		5		5	
15-Oct	6:43	5		MI		ND		5		5		5	
16-Oct	6:20			P		ND			P		P		P
17-Oct	ND												
18-Oct	6:36			P		ND			P	15	P		P
19-Oct	6:35			P		ND			P		P		P
20-Oct	5:50	10	151		X	ND		15		15		10	
21-Oct	6:32	10	154		X	ND		15		15		10	
22-Oct	6:08	5	165		X	ND		5		10		10	
23-Oct	5:33			P		ND			P	5		5	P
24-Oct	5:40	10	158		X	ND		15		5		5	
25-Oct	5:42	10		MI		ND			P	ND		5	
26-Oct	5:28			P		ND		10			P		P
27-Oct	5:31	10	153		X	0		15		10	P		P
28-Oct	5:35	5	145		X	5	MI	5		10		5	
29-Oct	5:10	5	156		X	5		5		10		5	
30-Oct	5:03	10		MI		5	MI	5		10		5	
31-Oct	5:27	5				5	MI	5		5			MI
1-Nov	5:36	5					P	5		5		0	
2-Nov	5:20	5					P	5		5		5	P
3-Nov	5:05			P		0	MI		P		P	0	
4-Nov	5:21	5		P, MI		0			P		P	0	P
5-Nov	5:24	5	150		X		P	5			P	0	P
6-Nov	5:31	5		P, MI			P	5			P	5	P
7-Nov	5:10			P			P		P	0	P		P
8-Nov	5:26	ND				0	P	0		0		0	
9-Nov	5:39	5		MI		0			P	5		5	

Table C-18 continued													
10-Nov	5:25	5		P, MI		0			P	5	MI	5	MI
11-Nov	5:17			P		0		0		0		0	
12-Nov	5:32	5		MI		0			P	5		ND	
13-Nov	5:30	5	162		X	0		5	P	5		ND	
14-Nov	5:25	5		MI		0		0		5		ND	
15-Nov	5:21	5		MI			P	0			P	0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-19. Data[1] for fall season (15 August-15 November) of 2004 for Medford, OR (KMAX), Eureka, CA (KBHX), Sacramento, CA (KDAX), and, Beale AFB, CA (KBBX) WSR-88D stations.

Fall 2004													
		MAX				BHX		DAX				BBX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:52	5		MI, P		10		10		P, MI			P
16-Aug	6:51	0			X	5		10		P, MI			P
17-Aug	6:54	5		MI, P		10		5	158	P	X	5	
18-Aug	6:58	0			X	5		5		ST, MI		10	
19-Aug	7:04	0			X	5		5		MI		5	
20-Aug	7:09	0			X	ND		5	125		X	5	
21-Aug	7:17	0			X	5		5	121		X	5	
22-Aug	6:57	0			X	0		5	136		X	5	
23-Aug	6:50	0			X	0		5		P, MI		10	
24-Aug	6:56	0			X	5	P	5		MI		5	
25-Aug	7:01			P		0				P		10	P
26-Aug	7:02	0			X	ND		10	164	P, BT	X	15	
27-Aug	7:05	0			X	ND		5	146		X	10	
28-Aug	7:13	5		MI		ND		ND				15	ST
29-Aug	7:19	5		MI, P		ND				P		10	
30-Aug	7:08	5		MI, P		ND				P		5	P
31-Aug	7:26	0			X		P	5	141		X	5	P
1-Sep	7:18	0		P	X		P	10	154	P	X		P
2-Sep	6:53	0			X	5		10	150	P	X		P
3-Sep	7:32	5	196		X	5				P			P
4-Sep	6:42	5	172	MI, P	X	5		5	156		X	10	P
5-Sep	6:49	5		MI		5		5		MI		15	P
6-Sep	7:12	5	152		X		P	5	143		X	10	P
7-Sep	6:34	5		MI		10		5	144		X	ND	
8-Sep	6:39	0			X	5		5	140		X	ND	
9-Sep	6:44	0			X	10		5		MI			P
10-Sep	6:38	0			X	5				P			P
11-Sep	6:48	0			X		P			P			P
12-Sep	6:30	5		MI		10		5	135		X	5	P
13-Sep	6:36	5		MI		15		10	155		X	10	P
14-Sep	6:38	ND				ND		5	162		X	5	P
15-Sep	6:23	ND				0		5	155		X	5	P
16-Sep	ND												
17-Sep	6:41			P			P	5	140		X	5	P
18-Sep	6:40			P			P	5	148		X	10	BT
19-Sep	6:37			P		20	P			P			P
20-Sep	7:47	10	195		X	15		15	159		X	20	
21-Sep	7:39	5	170		X	10		10	158		X	15	P
22-Sep	6:59	5		MI		15		5		MI		10	
23-Sep	ND												

Table C-19 continued

24-Sep	ND													
25-Sep	7:00	5		MI, P		5					P			P
26-Sep	6:43	5		MI		15	P				P		5	
27-Sep	7:05	10		MI			P		5		ST, MI			P
28-Sep	6:55	10	187		X	5	ST		5	150		X		P
29-Sep	6:32	10	190		X	10			5	155		X	15	
30-Sep	6:38	5		MI		10			10	164		X	5	
1-Oct	6:45	5		MI		5			10	154		X	10	
2-Oct	6:23	5	180		X	10			10	155		X	10	
3-Oct	6:20	5	217	P	X	10					P			P
4-Oct	6:42	10		P, MI		5			10	147		X	10	
5-Oct	ND													
6-Oct	6:56	0			X	5			5	149	P	X	5	
7-Oct	6:17	5		MI		5			5		BT, MI		5	
8-Oct	6:24			P		0	P		5		MI			P
9-Oct	6:18	10	208		X	10			15	150		X	10	
10-Oct	7:41	10	196		X	15			5	182		X	0	MI
11-Oct	6:46	5	225		X	0			ND				0	
12-Oct	6:32	5	232		X	5			10	154		X	15	
13-Oct	6:49	5	174		X	5			5	155		X	10	
14-Oct	6:53	5	168		X	10			5		ST, MI		15	
15-Oct	6:43	5	166		X	5			5		MI		10	
16-Oct	6:20			P			P		5		MI		5	P
17-Oct	ND													
18-Oct	6:36			P			P				P			P
19-Oct	6:35			P			P				P			P
20-Oct	5:50	5	183		X	10			15	153		X	20	
21-Oct	6:32	10	182	ST	X	5			10	170		X	10	
22-Oct	6:08			P			P		5		MI			P
23-Oct	7:30	5	170		X	10					P		10	P
24-Oct	5:40	5	204		X	5			10	147		X	15	
25-Oct	5:42			P			P				P			P
26-Oct	5:28			P		5	MI		5		P			P
27-Oct	6:29	10		P		5			10	157		X	20	
28-Oct	5:35			P			P		5		MI			MI
29-Oct	5:10	5	168		X	5			10	160		X	10	
30-Oct	5:03	5		MI		5			5		MI		10	
31-Oct	5:27	10				5			5				5	
1-Nov	5:36	5				5			5				5	
2-Nov	5:20			P			P		5		MI			P
3-Nov	5:05	0			X		P				P			P
4-Nov	5:21	0		P	X	5			10	183		X	10	P
5-Nov	5:24	0			X	5			5	164		X	5	
6-Nov	5:31	0			X	5	P		5		MI		5	
7-Nov	5:10	0			X	5	MI		5		MI		5	MI, P

Table C-19 continued													
8-Nov	5:26	0			X	0		0			X	5	BT
9-Nov	5:39			P			P	5		P			P
10-Nov	5:25			P			P			P			P
11-Nov	5:17	0			X	5		ND				10	P
12-Nov	5:32			P			P			P			P
13-Nov	5:30	0			X	5	MI	5	154		X	5	BT, ST
14-Nov	5:25	0			X	0		5		MI			BT
15-Nov	5:21			P			P	5		BT, MI			BT

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.

Table C-20. Data[1] for fall season (15 August-15 November) of 2004 for San Diego, CA (KNKX) and Santa Ana, CA (KSOX) WSR-88D stations.

Fall 2004							
		NKX				SOX	
Date	Time (UTC)	dBZ	Dir	Code	Used	dBZ	Code
15-Aug	6:52	5	142		X	5	
16-Aug	6:51	5	146		X	5	
17-Aug	6:54	10	136	ST	X	15	P
18-Aug	6:58			ST			P
19-Aug	7:04	5	145		X	5	
20-Aug	7:09	5	144		X	5	
21-Aug	7:17	5	135		X		P
22-Aug	6:57	10	126		X	5	
23-Aug	6:50	5	144		X	5	
24-Aug	6:56	5	133		X	5	
25-Aug	7:01	5	142		X	5	
26-Aug	7:02	5	138		X	5	
27-Aug	7:05	10	144	P	X		P
28-Aug	7:13	10		MI			P
29-Aug	7:19	10		ST, MI		5	P, BT
30-Aug	7:08			P			P
31-Aug	7:26			ST		ND	
1-Sep	7:18	5	143	ST	X	5	
2-Sep	6:53	5	128	P	X	10	
3-Sep	7:32	5	140		X	5	
4-Sep	6:42	5	153		X	5	
5-Sep	6:49	5	140		X	5	
6-Sep	7:12	ND				5	
7-Sep	6:34	10	143		X	10	
8-Sep	6:39			P			P
9-Sep	6:44			P		10	
10-Sep	6:38			ST, P		10	
11-Sep	6:48			P			P
12-Sep	6:30	5	140	P	X	5	
13-Sep	6:36	5	145		X	5	
14-Sep	6:38	5	139		X	5	
15-Sep	6:23	5	139	P	X	10	
16-Sep	ND						
17-Sep	6:41	10		P, MI		5	
18-Sep	6:40			P		5	
19-Sep	6:37			P		5	
20-Sep	7:18	5	157		X	5	
21-Sep	7:39	5	158	P	X	5	
22-Sep	6:59	5	147		X	5	
23-Sep	ND						
24-Sep	ND						

Table C-20 continued							
25-Sep	7:00			P		5	
26-Sep	6:43			P			P
27-Sep	7:05			P			P
28-Sep	6:55	5	150		X	5	
29-Sep	6:32	5	131		X	ND	
30-Sep	6:38	5	139		X	5	
1-Oct	6:45	10	135		X	5	
2-Oct	6:23	10	156		X	5	
3-Oct	6:20	5	145	ST	X	10	
4-Oct	6:42	15	144		X	10	
5-Oct	ND						
6-Oct	6:56	10	146		X	5	
7-Oct	6:17	5	139		X	5	
8-Oct	6:24	5	153	P, ST	X	5	
9-Oct	6:18			MI		5	
10-Oct	6:28	5	142	HM	X	10	
11-Oct	6:46	10		P, MI		0	
12-Oct	6:32	10		P		0	
13-Oct	6:49	5	144	P	X	5	
14-Oct	6:53	5	132		X	5	
15-Oct	6:43	5		MI		5	
16-Oct	6:20			P			P
17-Oct	ND						
18-Oct	6:36			P			P
19-Oct	6:35			P			P
20-Oct	5:50			P			P
21-Oct	6:32	10	129		X	10	
22-Oct	6:08	10	121		X	10	
23-Oct	5:33	5		MI		5	
24-Oct	5:40	5		MI		5	
25-Oct	5:42	0			X	5	
26-Oct	5:28			P			P
27-Oct	5:31			P			P
28-Oct	5:35	5	148		X	5	
29-Oct	5:10	5	128		X	5	
30-Oct	5:03	5	130		X	5	
31-Oct	5:27	5				0	
1-Nov	5:36	5		P			P
2-Nov	5:20			P		5	P
3-Nov	5:05	0			X	0	
4-Nov	5:21	5		MI		0	
5-Nov	5:24			P			P
6-Nov	5:31	5		P			P
7-Nov	5:10			P			P
8-Nov	5:26	0			X	0	
9-Nov	5:39	5	152		X	5	
10-Nov	5:25	0		MI	X	5	MI

Table C-20 continued							
11-Nov	5:17	0			X	0	
12-Nov	5:32	5		RMF		0	
13-Nov	5:30	5		MI		0	P
14-Nov	5:25	0			X	0	
15-Nov	5:21	0			X	0	

[1] **MI**=Mostly insects,**P**=Precipitation, **BT**=Breakthrough (ground clutter), **ST**=Strobing, **HM**=High migration, **RMF**=Radar malfunction, **ND in Time Column**=No national mosaic, **ND in dBZ column**=No data for individual station in a national mosaic.