



2011 PEREGRINE FALCON MIGRATION STUDIES AT ASSATEAGUE ISLAND, MD/VA

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ABSTRACT

As part of a continuing research program, field studies were conducted on the Peregrine Falcon, *Falco peregrinus*. This report focuses on our 42nd annual study, which was conducted on the northern (MD) portion of Assateague Island, MD/VA. Observations and captures by unit effort were the 6th highest and 9th highest respectively for this long-term study. Between 27 September and 17 October the survey team expended 212 man-hours in the field, recording 325 sightings of Peregrines and capturing 77 different individuals. Two of the falcons captured were previously banded. The 325 sightings included 115 observations and seven recaptures of individuals previously captured during the survey. We also obtained 77 blood samples for collaborative studies, and recommend that the survey be continued indefinitely.

INTRODUCTION

The presence of Peregrine Falcons on Assateague Island, Maryland each autumn was confirmed by falconers in 1938. Most of these were tundra Peregrines (*Falco peregrinus tundrius*), a migratory Arctic nesting subspecies. Some few individuals of the subspecies *Falco peregrinus anatum* also occurred on Assateague in the fall. These Peregrines were known to breed on rock faces in the eastern United States.

Catastrophic declines in global Peregrine populations after the mid 1940s were attributed to widespread use of chlorinated hydrocarbons (such as DDT) as agricultural pesticides after World War II (Hickey 1969). Food chain contamination resulted in high levels of DDE (the principal metabolite of DDT) in the tissues of Peregrines, which caused the formation of thin eggshells and increased reproductive failures. *F.p. anatum* was extirpated east of the Mississippi River and only remnant populations survived elsewhere in temperate North America. By the late 1960s *F.p. tundrius* was also in rapid decline and both subspecies received endangered species status in 1970.

Diverse efforts were undertaken to study, monitor and augment Peregrine populations. Enderson (1969) advocated coastal surveys as population indices in migrating Peregrines. Assateague Island, as a major focal point of the autumn tundra Peregrine migration, had been visited for the preceding three decades by falconers, bird banders and scientists. In 1970 the Department of the Army initiated a program to monitor the tundra Peregrine and to develop new technologies to assist in the study of highly migratory threatened, endangered and sensitive species. The Assateague survey was established in 1970 and a similar effort was begun at Padre Island, TX in 1977. At Assateague our data could be related to records kept by previous researchers for over 30 years (Ward et al. 1988). The program rapidly expanded to include research in diverse geographic regions to assess all aspects of the natural history of the tundra Peregrine, and specifically the issues associated with global contaminants affecting their population dynamics. In addition to investigations referenced in the Methods section, we have studied habitat use during migration (Seegar and Ray 1979), prey selection by Peregrine age class (Ward and Laybourne 1985), and distribution of band recoveries (Yates et al. 1988). The principals, now working under the Earthspan banner at Assateague and Padre, have developed new and innovative technologies to examine migration and wintering biology (Seegar et al. 2003). The results dramatically extend our knowledge of this macropredator on migration and during its wintering period in the Neotropics.

North American Peregrine populations rebounded dramatically after the U.S. ban of DDT for agricultural use in 1972. Relying heavily on standardized data from this study, the U.S. Fish and Wildlife Service (USFWS) in 1994 removed *F.p. tundrius* from the List of Endangered Species; *F.p. anatum* followed in 1999.

METHODS

In 2006-2011 we surveyed only the northern (MD) portion of the island. Our 2011 study area on Assateague Island, MD/VA, included Assateague Island National Seashore (National Park Service) and Assateague State Park (State of MD). During the survey period the island was traversed each day from sunup to sundown by one party in a four-wheel-drive vehicle. Only vehicle failure, high wind, flood tide, or other condition that would place Peregrines or personnel in jeopardy would constrain survey operations. All raptors observed were recorded according to species, time, location and activity at time of sighting.

An attempt was made to capture Peregrines encountered that were not identified through color marking as duplicates, and that were found in areas conducive to trapping. Capture methods are described by Ward and Berry (1972). Unbanded Peregrines were fitted with a U.S. Geological Survey (USGS) lock-on band (size 6 for males, 7a for females) and processed according to current research protocols before release at the capture site. Past protocols have included recording weight and body measurements, collecting small feather samples (Parrish et al. 1983), pollen samples from plumage, ~2ml blood samples (as described by Redig 1993), and cloacal and pharyngeal swabs, affixing color-coded alpha-numeric bands (Ward 1975), and attaching conventional (Cochran 1985) and pulse-coded (Howey et al. 1984) transmitters. Since 1993 we have also deployed Platform Transmitter Terminals (PTTs) on a small sample of adult Peregrines, which are tracked and located globally by polar orbiting satellites (Fuller et al. 1995). Before each falcon was released the head and crop were marked with red dye. This identifies the individual as one already sampled during the survey and precludes recapture attempts; it fades quickly over a three-week period.

RESULTS AND DISCUSSION

Between 27 September and 17 October the survey team expended 212 man-hours in the field, recording 325 sightings of Peregrines and capturing 77 different individuals (Table 1). Two of the falcons captured were previously banded. The 325 sightings included 115 observations and seven recaptures of individuals previously captured during the survey. We exclude resident Peregrines (none were seen in 2011) but include these other known duplicates in tables and discussion. This is to allow more direct comparisons among our data and those from earlier Assateague counts (dating from 1939) and other projects where protocols do not allow identification of duplicates.

Sightings per 10 man-hours were 6th highest and captures 9th highest among our 42 survey years (Table 2). Fewer hours were expended than in many of the preceding 40 years since just one party daily surveyed only the Maryland portion of the island. Among individuals identified by age class adults comprised only 11.8% of those identified (Table 3), which is below our 42-year mean of 14.99%. The many sightings in 2011 of previously captured immatures understandably skews this number downward. We are awaiting details from the USGS Bird Banding Laboratory on the two previously banded falcons. One was an individual from the new race of Peregrines established in the East through captive propagation and release.

During the survey 168 merlins (*Falco columbarius*) were observed, the largest number in recent years. The peak of merlin migration normally precedes our Peregrine survey dates. In recent years sightings of Bald Eagles (*Haliaeetus leucocephalus*) have increased dramatically, especially on the McCabe Tract. It is not unusual to observe as many as ten utilizing the McCabe beachfront at a given time, and their presence and that of Peregrines is often mutually exclusive. In 2011 that trend continued, and we began to see many more individuals farther south on the Maryland Beach.

Sightings and captures by sector are detailed in Table 4. Sightings on the Maryland Beach by unit effort equaled those on the McCabe Tract, but captures were much lower. A limiting factor for occurrence, observation and capture here of Peregrines is the very intensive public use of off-road vehicles (ORVs), particularly on weekends.

As usual, we operated only on the beachfront of the McCabe Tract due to the presence of the federally threatened and Maryland endangered plant Sea Beach Amaranth (*Amaranthus pumilus*). This had little or no impact on results, as most resting Peregrines there are on or near the beachfront. The McCabe Tract was more productive in terms of capture success than the Maryland Beach; that is to be expected because of the prohibition on public use by ORVs. As previously noted, the presence of many Bald Eagles on the McCabe Tract at times visibly reduced our productivity.

Because of its very narrow beachfront, development and public use, the Assateague State Park is seldom utilized by migrant Peregrines. Its primary value to the survey is for efficient travel between potentially productive sectors during periods when few people are using the State Park beachfront. Likewise, the Access

Road is utilized only for travel between the McCabe Tract and Maryland Beach, and offers no possibility for anything more than observations.

We collected blood samples from 77 individual Peregrines for collaborative studies, including an effort associated with the Deepwater Horizon (DWH) MC 252 oil spill. In April 2010 a catastrophic explosion ripped through an offshore oil rig; eleven workers were killed and a massive release of crude oil fouled the Gulf of Mexico and associated coastal habitats. Oil spill-related injury to wildlife is of major concern, and our investigation deals directly with the effects of this event on the tundra Peregrine Falcon. The Gulf oil spill poses an especially high risk to the tundra Peregrine population in North America; Earthspan researchers have determined most of the population ($\geq 80\%$) passes through the Gulf States during their annual fall and/or spring migrations. As predators at the top of the food chain, they are particularly susceptible to toxins and contaminants concentrated at lower trophic levels. Polycyclic Aromatic Hydrocarbons (PAHs), components of the DWH oil spill, are known to cause a variety of adverse eco-toxicological impacts. Zuberogoitia et al. (2006) found that a 2002 oil tanker sinking off NW Spain "...clearly resulted in increased rates of (Peregrine) adult mortality and reduced fertility..." The Peregrine Falcon is a recognized environmental sentinel species, and it is established that: 1) Peregrines are susceptible to acute toxicity from PAHs; 2) PAHs are lethal to developing Peregrine embryos; 3) PAHs form DNA adducts in several avian species; and 4) PAHs cause heritable genetic mutations in birds. Furthermore, immediate hazards loom during semiannual migrations through contact contamination and accumulation of oil when large numbers of falcons capture and consume prey in oil contaminated Gulf Coast habitats. Tundra Peregrines migrating southward at Assateague in 2010 could not yet have been exposed to DWH contaminants, and immature Peregrines in subsequent years could only have been exposed through any contaminants borne by their mother or by contaminated migratory prey species they ingested to the north. The samples we collect (along with those previously archived) comprise an invaluable baseline for future samples we will acquire. Earthspan is collaborating with The Peregrine Fund for analyses of blood samples we collect here and during our Padre Island autumn and spring surveys.

In collaboration with Drs. Sandra Talbot (USGS) and David Mindell (California Academy of Sciences) we provide red blood cell samples for continued genetic analyses. Dr. Talbot is completing DNA level analyses of Peregrine samples acquired at Assateague and Padre Islands. Talbot is utilizing samples collected from past surveys and investigating methods that will help us: 1) describe the composition of the migratory population using a molecular probe that will identify birds to population of natal origin; 2) assess the relative contribution of various breeding populations to the migratory populations at Assateague and Padre; 3) examine how changes in weather patterns and migratory patterns influence the size of the migratory populations; and 4) possibly draw conclusions about changes in the size of breeding populations.

No resident Peregrines were observed in 2011, so there was no impact on survey results in. In 1980 captive-bred Peregrines of mixed subspecies were first released from a "hack tower", a tall platform constructed on the Virginia portion of Assateague. In 1981 a pair took up residence, produced young, and remained on territory during the fall migration of tundra Peregrines. Residents were present during the 1981-2004 surveys, and we witnessed aggression towards migrants in varying degrees. Other individuals of the newly established eastern race have at times taken territories on the north and south ends of the island, and have been observed defending these territories. It has been clear that the artificial establishment of this coastal population has resulted in many agonistic encounters for migratory Peregrines in the autumn.

We outfitted no Peregrines in 2011 with PTTs tracked by satellite. In 1993 we first equipped two adult female Peregrines at Assateague with PTTs tracked and globally positioned by the Argos/Tiros system. Developed through our joint project of many years with the U.S. Army, the USFWS, and the Applied Physics Laboratory of Johns Hopkins University, these 27-gram PTTs were equipped with activity, temperature and battery voltage sensors, and transmitted signals at programmed intervals to orbiting satellites. The accuracy of the system in locating those PTTs depended upon several factors, and accuracy of location estimates ranged from several hundred meters to several miles.

One of the 1993 adults wintered in a unique wetland habitat, at 14,000 feet in the central Argentine altiplano. Members of our research team reached this area in February of 1994, where they made detailed observations

on the wintering behavior of the falcon and did a complete habitat analysis and avifauna survey. It was determined that an immature female Peregrine also wintered in this small wetland with the adult we tracked.

Since that time we (with North Star Science and Technology, LLC) have continued to refine, miniaturize and apply these technologies to unlock the remaining mysteries of the tundra Peregrine's ecology. PTTs providing location estimates like the first generation can now weigh <10 grams, and those that provide extremely accurate GPS locations can weigh only 22 grams. This subspecies was removed from the list of endangered species entirely on the basis of population trends evident from breeding ground surveys in the Arctic and migration studies in temperate zone flyways. Although contaminant levels have declined, it still faces toxic threats to the food chains in its Central and South American wintering grounds. These technologies comprise an invaluable tool in identifying critical habitats and in pinpointing and mitigating global sources of contaminants affecting Peregrines and the other Neotropical migrants with which their life histories are so irrevocably intertwined. If sufficient funding of our oil spill investigation allows we will outfit migrants at Assateague and Padre Islands with PTTs. Wintering ground studies will be conducted on subjects and their habitat, prey and wintering range biology will be investigated. Adjunct to these basic monitoring elements will be comprehensive contaminant analyses to determine the presence, extent and impact of PAHs in the population.

We have tracked more than 40 Assateague migrants via PTT. The migration of these individuals is incorporated into Earthspan's, "Eye of the Falcon" (EOF). EOF is an educational system designed for schools, nature centers (including kiosks in Chincoteague National Wildlife Refuge's Herbert H. Bateman Educational and Administrative Center and the South Padre Island Birding and Nature Center), and home use that utilizes satellite-tracking data of migratory animals to teach core concepts in the life sciences and to involve students in cutting-edge scientific research and technology. The system focuses on animal migration as a means of engaging viewers of all ages and reinforcing a conservation ethic: think globally while acting locally. The EOF system includes an interactive web site, educational software, and teacher and student guides, and it includes concepts from a wide range of fields such as ecology, animal behavior, earth sciences, physics, and geography. Users have access to satellite tracking data that have been collected over the past decade for a wide range of species, as well as tracking data from ongoing projects taking place in real time. Our software allows users to generate maps using Geographic Information Systems to examine the relationships between animal movements and a wide range of landscape and environmental variables. The information is modular and layered to allow viewers to learn at their own pace according to their individual interest.

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

2011 totals showed continued good levels of productivity by unit effort, and we conducted important sampling for associated studies. The tundra Peregrine has made a significant recovery and has been removed from the list of endangered species, yet continued monitoring of populations is imperative. Because of this survey's continuity and standard method for data collection it has become an essential tool in that effort. During the past 42 autumn migrations we have expended over 19,000 hours in the field, observing more than 18,000 Peregrines and capturing 5,257 individuals. Our database includes sightings of every other raptor we have observed on the Island since 1970. Standardized survey protocols have been used during the course of the study, and nearly 90% of all observations have been recorded by three experienced individuals.

In 2008 our database allowed us to provide an Expert Declaration on the Draft Environmental Assessment and Management Plan for Take of Migrant Peregrine Falcons in the United States for Use in Falconry. Among other points, we concluded that the standardized average number of migrating Peregrines we observed at Assateague over the preceding 29 years was essentially the same as that seen more than six decades ago (1939-1944), before DDT had serious adverse effects on the reproductive potential of the Peregrine in North America. Our work at Assateague and Padre Islands represents the bulk of tundra Peregrine Falcons banded within the continental United States since the establishment of the Bird Banding Laboratory by the Department of the Interior. Furthermore, our database constitutes the most significant and longest continuous monitoring study on this falcon in the Americas. Long-term studies such as ours are essential to monitoring the stability of wildlife populations, particularly in light of rapid changes that may occur due to contaminants, infectious diseases, habitat loss, climate change and other factors. By the long-term and standardized nature of our

studies, we have established levels of observation in stable populations that will quickly raise future concerns if not achieved over a several year period.

As outlined above, our work with satellite-received telemetry will allow for continued research to elucidate previously undescribed aspects of the tundra Peregrine's wintering biology and continental migration and to identify critical habitats. Given available technologies, Assateague remains the ideal laboratory in which to study and address present and future issues of concern to Peregrines, other Neotropical migrants, and humans. In recent years we have addressed emerging infectious pathogens such as West Nile Virus (Dusek et al. 2005) and Avian Influenza in partnership with U.S. Government entities, and currently address contaminants through our DWH studies. In addition, the new race of eastern Peregrines introduced from captive stocks is encountered routinely on the island. Our continued observations on this race and its interactions with migrating tundra Peregrines should be an invaluable asset when future management decisions are considered.

Accordingly, we recommend that this study continue into the foreseeable future without significant changes in 1970-2011 protocols.

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TABLE 1.

ASSATEAGUE AUTUMN PEREGRINE SURVEY
 2011 TOTALS (EXCLUDING RESIDENTS, INCLUDING RESIGHTS)

	Observed	Captured	Recaptured	resighted
Immature male	37	13	-	2
Immature female	216	47	6	113
Adult male	2	-	-	-
Adult female	32	17	1	-
Unidentified	38	-	-	-
Total	325	77	7	115

TABLE 2.

ASSATEAGUE AUTUMN PEREGRINE SURVEY
1970-2011 TOTALS (EXCLUDING RESIDENTS, INCLUDING RESIGHTS)

	Man-hours expended	Peregrines sighted	Peregrines sighted/10 man-hours	Peregrines captured	Peregrines captured/10 man-hours
1970	310.0	66	2.13	23	.74
1971	222.1	120	5.40	35	1.58
1972	325.7	41	1.26	8	.25
1973	360.7	136	3.77	47	1.30
1974	360.3	59	1.64	22	.61
1975	332.5	186	5.59	40	1.20
1976	336.2	176	5.23	48	1.43
1977	468.2	209	4.46	75	1.60
1978	436.2	259	5.94	64	1.47
1979	427.4	598	13.99	127	2.97
1980	451.1	512	11.35	110	2.44
1981	564.7	347	6.15	89	1.58
1982	632.3	591	9.35	121	1.91
1983	637.2	562	8.82	116	1.82
1984	724.9	547	7.55	150	2.07
1985	683.0	483	7.07	147	2.15
1986	704.1	838	11.90	230	3.27
1987	607.4	327	5.38	112	1.84
1988	671.7	409	6.09	132	1.97
1989	601.2	813	13.52	203	3.38
1990	509.3	659	12.94	248	4.87
1991	630.3	743	11.78	227	3.60
1992	558.8	340	6.08	116	2.08
1993	593.2	595	10.03	192	3.24
1994	557.3	467	8.38	133	2.39
1995	485.4	525	10.82	139	2.86
1996	374.3	568	15.17	192	5.13
1997	516.5	889	17.21	254	4.91
1998	556.3	999	17.96	261	4.69
1999	504.3	560	11.10	179	3.55
2000	536.8	522	9.73	155	2.89
2001	507.3	404	7.96	115	2.27
2002	513.8	350	6.81	116	2.26
2003	518.7	572	11.03	155	2.99
2004	477.3	489	10.25	147	3.08
2005	388.2	439	11.31	126	3.25
2006	238.3	173	7.26	66	2.77
2007	171.5	222	12.94	78	4.55
2008	206.0	380	18.45	123	5.97
2009	196.7	356	18.10	124	6.30
2010	194.6	457	23.49	135	6.93
2011	212.3	325	15.31	77	3.63
Total	19,304	18,313	9.49	5,257	2.72

TABLE 3.

ASSATEAGUE AUTUMN PEREGRINE SURVEY
1970-2011 SIGHTINGS BY AGE CLASS (EXCLUDING RESIDENTS, INCLUDING RESIGHTS)

	Adults sighted	Adults sighted/10 man-hours	Immatures sighted	Immatures sighted/10 man-hours	Percent adults
1970	8	.26	50	1.61	13.79
1971	8	.36	97	4.36	7.62
1972	7	.21	23	.71	23.33
1973	18	.50	110	3.04	14.06
1974	13	.36	40	1.11	24.53
1975	14	.42	153	4.60	8.38
1976	14	.42	121	3.60	10.37
1977	18	.38	167	3.57	9.73
1978	32	.73	199	4.56	13.85
1979	35	.82	501	11.72	6.53
1980	42	.93	408	9.04	9.33
1981	57	1.01	235	4.16	19.52
1982	64	1.01	454	7.18	12.35
1983	48	.75	408	6.40	10.53
1984	77	1.06	406	5.60	15.94
1985	60	.87	353	5.17	14.53
1986	111	1.58	630	8.95	14.97
1987	73	1.20	178	2.93	29.08
1988	90	1.34	249	3.71	26.55
1989	131	2.18	580	9.65	18.42
1990	93	1.83	494	9.70	15.84
1991	70	1.11	553	8.77	11.23
1992	70	1.25	239	4.28	22.65
1993	76	1.28	440	7.42	14.73
1994	56	1.00	340	6.10	14.14
1995	53	1.09	413	8.51	11.37
1996	50	1.34	445	11.89	10.10
1997	120	2.32	650	12.58	15.58
1998	90	1.62	821	14.76	9.88
1999	97	1.92	418	8.29	18.83
2000	90	1.68	352	6.56	20.36
2001	67	1.32	294	5.80	18.56
2002	112	2.18	191	3.72	36.96
2003	65	1.25	415	8.00	13.54
2004	81	1.70	340	7.12	19.24
2005	53	1.37	324	8.35	14.06
2006	39	1.64	119	4.99	24.68
2007	33	1.92	160	9.33	17.10
2008	30	1.46	315	15.29	8.70
2009	62	3.15	264	13.42	19.02
2010	32	1.64	368	18.91	8.00
2011	34	1.60	253	11.92	11.80
Total	2,393	1.24	13,570	7.03	14.99

TABLE 4.

ASSATEAGUE AUTUMN PEREGRINE SURVEY
 2011 PRODUCTIVITY BY SECTOR (EXCLUDING RESIDENTS, INCLUDING RESIGHTS)

	Sighted	Sighted/10 man-hours	Captured	Captured/10 man-hours
McCabe Tract (MD)	216	16.12	58	4.33
State Park (MD)	1	3.75	-	-
Access Road (MD)	-	-	-	-
Maryland Beach	108	16.10	19	2.83
Total	325	15.31	77	3.63