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Authors

Humphrey, John S.

Avery, Michael L.

McGrane, Arlene P.

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EVALUATING RELOCATION AS A VULTURE MANAGEMENT TOOL IN NORTH FLORIDA

JOHN S. HUMPHREY, MICHAEL L. AVERY, and ARLENE P. MCGRANE, USDA National Wildlife Research Center—Florida Field Station, 2820 East University Avenue, Gainesville, Florida 32641.

ABSTRACT: As distributional patterns of black vultures (*Coragyps atratus*) and turkey vultures (*Cathartes aura*) change, and as woodland habitat declines, vultures increasingly come in contact with human activity. Relocation of problem birds is one potential management approach for resolving conflicts. Relocation involves trapping and moving the vultures some distance away where their subsequent behavior is not expected to conflict with human activity. To evaluate vulture responses to relocation, we trapped and patagial-tagged 114 vultures at two roosting areas over a period of ten months and equipped ten of them with satellite transmitters. Of 9,101 locations, 18.6% had a measure of accuracy of 1000 m to <150 m. The remainder had an accuracy of >1000 m of accuracy (n=3149), no estimate of location accuracy (n=2024), or invalid location (n=1117). Two transmitters were recovered due to removal or illness of the bird, were reset, and deployed on different vultures. Sixteen tagged birds were sighted after their release. Half of the sighted birds were observed at their unmodified trap site, and four of eight birds with transmitters were tracked to within 16 km of their trap site. No birds had been tracked to or seen at the modified trap site. One bird was tracked to within 32 km of its modified trap site. Birds took an average of eight months to return to the trap site. Relocation appears to be effective in the short term, but habitat modification and harassment to render the location unattractive is necessary for successful long-term removal of problem vultures.

KEY WORDS: *Coragyps atratus*, *Cathartes aura*, roosts, relocation, trapping, tagging, movements, satellite, telemetry

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INTRODUCTION

The ranges of black (*Coragyps atratus*) and turkey vultures (*Cathartes aura*) are expanding in the eastern U.S. (Rabenold and Decker 1989). As vulture distributional patterns change and as woodland habitat declines, vultures increasingly cause nuisance and safety problems, property damage, and livestock depredations (Coleman and Fraser 1989; Lowney 1999).

Efforts to reduce vulture numbers locally consist mainly of frightening birds with exploding and whistling pyrotechnics, augmented with limited shooting. Such roost dispersal methods are not compatible with visitor-oriented activities at parks and urban locations. Furthermore, vultures can rapidly habituate to pyrotechnics and other traditional scare devices so that the effectiveness of such methods is short-lived.

An alternative non-lethal approach is to trap vultures where they are causing a problem and release them some distance away where their subsequent behavior will not conflict with human activity. The effectiveness of relocation programs for managing vulture problems will be partially determined by whether relocated vultures return to the original site. If they do not return, it would be important to know if transported vultures subsequently become involved in other nuisance or predation activity at a new site.

Satellite telemetry provides cost-effective, long-term monitoring of animals that have large home ranges and/or migrate long distances. It has been used extensively for monitoring terrestrial mammals (Harris et al. 1990), but has more recently been used to monitor the movements of birds (D. Arrington, USAF/BASH Team, pers. comm. 1997; Griesinger 1992; Hendricks 1997; Howey 1997). Reduction in size of the components used to build the platform transmitter terminal (PTT), allows for

transmitter packages as small as 20 g (Microwave Telemetry, Inc.). Satellite telemetry is most cost-effective when the study is long, air charter costs are high, the area to be searched is large, and labor costs for obtaining quality locations are prohibitive (Harris et al. 1990). The satellite telemetry system consists of a PTT, receiving equipment on polar-orbiting satellites, and a network of satellite tracking stations and communication links that transfer satellite data to a Service Argos (referred to hereafter as Argos) processing center which distributes results to users, usually via E-mail (Harris et al. 1990). This approach to telemetry can account for substantial cost savings over the life of a study and provide continuous location data regardless of the geographic locations of researcher and test subject.

The objectives of this study were to trap vultures at roosts in central Florida, transport them to distant sites, and follow their movements subsequent to release. We also evaluated trapping methodology and evaluated suitability of satellite telemetry for documenting vulture movements. The information will help determine if relocation is an effective, useful management tool.

METHODS

Trap and Site Selection, Maintenance

We chose a trap design for this study based on those used by other vulture researchers (Stolen 1996; E. Davis, USDA/WS-TX, pers. comm.) and personal experience trapping other birds. Prior attempts at luring vultures into a modified Australian crow trap with a recessed entrance proved unsuccessful. Our version of the funnel trap used by other researchers was conceived through simplicity and the availability of preconstructed panels. Fish was used as bait as it provided the greatest attraction to vultures.

We trapped vultures from roosting populations at Florida Fish and Wildlife Conservation Commission's (FFWCC) Richloam Fish Hatchery near Dade City, Florida and at Sea World of Florida in Orlando, Florida. Birds were trapped near the target roost sites using a large (9.1 x 3.0 x 1.8 m) trap with a funnel entrance baited with dead fish. The trap was constructed out of 3.0 m x 1.8 m chicken wire panels. We constructed one panel with a door and placed it at one end of the trap. The funnel entrance was made using two panels placed inside the trap at the end opposite the door, leaving a 0.3 m x 1.8 m opening. We used a 1.2 m x 1.8 m panel to close the funnel entrance. Five panels were used to cover the trap. A solar powered electric fence was placed around the outside of the trap to prevent mammals from entering the trap and eating the bait.

Vultures were removed from the trap and placed in shaded carrying cages (100 x 60 x 40 cm), with a maximum 6 birds/cage, and transported in the back of a pickup truck from the trapping site to the USDA National Wildlife Research Center's (NWRC-FL) facility in Gainesville. At the field station, vultures were measured (beak, wing chord, and tarsus length) and weighed, examined for ectoparasites, and had blood smear samples taken for parasitology.

Marking the birds was essential for information retrieval and identification, so each bird received a colored, alpha-numeric coded cattle ear tag (Maxi large female and large male or male button; Allflex USA, Inc., Dallas-Fort Worth, TX) placed on the patagium of the right wing (Wallace et al. 1980; Sweeney et al. 1985). Cattle ear tags are inexpensive, readily obtained, and are authorized by the Bird Banding Laboratory (BBL) for vultures. A sighting record was recorded whenever a report of a tagged bird was made to the BBL or the NWRC Florida Field Station. Records kept were location, date, species, color and location of the tag, tag number, trap site and date, release site and date, person seeing the tagged bird, and any other pertinent information as to its behavior or characteristics of the site. These sightings were plotted and analyzed in Arc View GIS and updated as resightings were reported.

Eight vultures were equipped with back-mounted satellite transmitter PTTs (four solar with indefinite life spans, two with 2.5 yr life span, two with 1.5 yr life span; Microwave Telemetry, Columbia, MD). Two of the transmitters had altimeter sensors and all had mortality sensors. The satellite transmitters used did not exceed 4% of the bird's body weight, as authorized by the BBL. The PTTs were also equipped with a VHF radio transmitter (ATS Inc., Insanti, MN), which allowed tracking via conventional hand-held or truck-mounted receivers and facilitated recovery of the expensive satellite transmitters at the end of the study or in the event of bird mortality.

Transmitters were mounted using a Teflon tape harness used by other researchers (D. Arrington, USAF/BASH Team, pers. comm.; T. King, USDA/NWRC-MS, pers. comm.). This is the most secure yet least intrusive method for attaching transmitters on this type of bird. Three sizes of ribbon (7, 9, and 14 mm; Bally Ribbon Mills, Bally, PA) were tested, and the 7 mm worked the best for our application. The ribbon

was formed into a harness, sewed, and glued (Loctite 380 Black Max/712 instant adhesive/accelerator) to prevent fraying and removal by the bird. To evaluate transmitter attachment prior to release, we maintained birds in 9 x 3 x 2 m holding pens for two days to two weeks in groups up to nine birds. Vultures were given a diet of fish and Nebraska Brand Bird of Prey Diet (North Platte, NE). Sea World personnel modified that site by removing the trees used for roosting. Pyrotechnics were also used in the morning to discourage new birds from roosting at the site. No habitat modifications or harassment activities were conducted at the Richloam Fish Hatchery.

Release and Monitoring

We coordinated with the National Forest Service to provide temporary release sites in the Osceola National Forest (ONF) and the Apalachicola National Forest (ANF). Birds with transmitters were tracked via VHF telemetry until they dispersed from the release site or for two hours, whichever came first. Birds were tracked with VHF for two days to confirm dispersal from the release site. The VHF transmitters deployed in ONF were programmed to last 1.5 years to coincide with the life expectancy of the PTT so that the transmitter package could be located and retrieved. Transmitters deployed in ANF were solar powered with an indefinite life span. All VHF transmitters had a 24 h mortality signal.

The PTTs were programmed to provide locations of birds every second day during the first month of operation and weekly thereafter via E-mail from Argos. In the event that a mortality signal was received from the PTT, ground tracking by VHF was conducted in the area of the latest satellite location until the PTT was located. Locations from the PTTs were entered into a database and divided into groups based on the information received from the satellite and analyzed using Arc View GIS. These groups include date, time, latitude, longitude, location class, and number of messages sent (by the PTT to the satellite during each transmission). The accuracy of locations received, among other factors, is dependent upon the number of messages the satellite receives during each pass over the transmitter. A minimum number of messages received by the satellite and transferred to Argos are required for a location fix to be calculated. Location classes are identified by the number of messages received and are used to determine the location's accuracy with location class (LC) three being the most accurate (<150 m, four or more messages received) and LC 0 being the least accurate (>1000 m, <4 messages received). Location class 2 has an accuracy of 150 m to 350 m, while LC 1 has an accuracy of 350 m to 1000 m.

RESULTS

Bird Measurements and Processing

Of the 114 birds trapped, 60 were trapped at Richloam fish hatchery and 54 at Sea World. Body mass of black vultures ranged from 1.79 kg to 2.64 kg (mean = 2.10 kg, SE = 0.01, n = 107). Turkey vulture body mass ranged from 1.53 kg to 2.13 kg (mean = 1.82 kg, SE = 0.09, n = 7).

Nine black vultures were tagged on 21 August with orange tags numbered 1-5, 92-95. Eighteen black vultures were tagged on 12 September with orange alpha-

numeric tags numbered A7, A8, A10-A25. Between 5 December 1997 and 24 April 1998, 80 black and 7 turkey vultures were tagged with yellow alpha-numeric tags numbered F00-F86. Yellow tags used on the birds utilized a small male tag instead of a male button so that the test birds could be distinguished in flight. The smaller male tag was visible to 61 m with the naked eye, although the number could only be seen with binoculars.

Location Accuracy and Sightings

Eight transmitters were placed on nine black vultures and one turkey vulture between 20 August 1997 and 1 May 1998. Two transmitters were recovered after deployment, reset, and placed on other birds. One transmitter was removed by the bird within 15 days after release after pulling at the ends of the Teflon ribbon and fraying them until separating from the transmitter. A second transmitter was recovered from the bird after it was determined that the bird had not left the release site due to health problems. The bird was returned to the Florida Field Station where it was rehabilitated and released.

Between 19 August 1997 and 1 March 2000, 9,101 locations were received from Argos. Of these, only 53% (n=4844) were within location classes that provide accuracy. Eighty-one locations were LC 3 (2%), 286 LC 2 (6%), 1,328 LC 1 (27%), and 3,149 (65%) were LC 0. The remaining 47% (n=4257) of the locations had no estimate of accuracy. Twenty-six percent (n=1116) were LC Z (invalid locations). The minimum number of messages received from a transmitter was one (n=81) and the maximum number was 14 (n=1), with the majority of transmissions ranging from 2 (n=1809) to 5 (n=1392) messages.

A public awareness campaign was initiated at the onset of the study, whereby we sent out information to various wildlife and conservation groups to be put in their newsletters. We requested information regarding vultures seen with wing tags and provided various means to contact us. Of 16 tagged birds seen since their release, 8 were seen at their trap site, Richloam Fish Hatchery. With one exception, the other 8 birds were trapped at Sea World and sighted elsewhere. The time period between release and sighting ranged from 1 to 23 months with an average sighting of 10 months from release. Sightings were received by phone calls, email, and reports from the Bird Banding Lab. Most sighting reports came from initial contacts with the state wildlife agency or the bird banding lab. A few reports came from information posted at various places on the internet such as newsgroups, web pages, and Listserv.

Movements of Birds with Transmitters

Of eight birds released with transmitters, only two did not make post-release movements in the direction of the trap site. These two, PTT 1210 and PTT 2120, traveled an average distance of 113 km from the release site with 2120 traveling the farthest at 185 km in 27 months, and 1210 traveling the shortest distance of 97 km in 15 months where it spent the majority of its time. A large roost is located at the locks on Lake Seminole, in the vicinity of 1210's locations, and we speculate that the bird has joined up with others at this roost. In most cases, the

birds stayed within a 80 km radius of the release site for an average of eight months before eventually moving to other locations.

Five of the remaining six birds eventually returned to or near the trap site. All birds that returned, returned to a site that had not been modified and remained conducive for their return. Movements toward the trap site appeared to be in two distinct patterns. The first pattern consisted of a continuous, wandering southward pattern until reaching their trap site (Figure 1). For example, PTT 2119 was released in December 1997 and almost immediately began to move south, taking five months to come within 32 km of the trap site. It stayed until July 1998, when it began a series of north and south movements that covered over 160 km in 20 months, with occasional stops at the trap site.

The second pattern illustrated a seasonal movement pattern. From the April release date until December or January, the birds remained within 80 to 130 km of the release site. The birds then moved south toward the trap site. Two of the three birds stayed within roughly 80 km of the site after reaching it. The third bird went to within 16 km of the trap site in 25 days, but then continued south to the Lake Okeechobee area where it stayed (Figure 2). This bird had the greatest post-release movement. It initially moved about 97 km to the east where it stayed for a couple of months. It then headed 483 km west (185 km west of the release site) before flying nearly 805 km to the southeast near Belle Glade.

No sightings or locations were received from the Sea World treatment site for the 54 birds trapped and relocated from there. However, PTT 16974 was tracked to within 32 km of the site. This bird, released February 13, 1998, stayed within 24 km of the release site for five days before it headed east to an area where it stayed until April. On April 2, the bird started to make a series of large movements north and west, covering 250 to 290 km, before making a turn toward the trap site on May 13, 1998. The bird reached to within 97 km of the trap site on February 11, 1999, but was never tracked to the site. In the final month of transmissions, the bird moved 160 km northwest of the trap site and then returned to 32 km east of the trap when transmissions ceased on March 5, 1999.

DISCUSSION

Monitoring of relocated vultures was facilitated through the use of satellite telemetry. Although the cost of a PTT is much higher than that of a conventional VHF transmitter, the ability to track a bird over large distances and long periods of time via E-mail saves labor and airplane rental which offset the higher initial cost. Locations from satellites may not be as precise as would be desirable, however, for our studies they were adequate. As with any attachment, PTT weight can be of concern when used on birds. The 90 g PTT with altimeter required us to screen birds to find those meeting our approved 4% body mass requirement. The altimeter did not prove useful to us in that it relied on local weather conditions at the time of transmission, which were often difficult to obtain for a specific location and provided too wide a range of altitude to be useful. The addition of a VHF transmitter to the PTT is important as

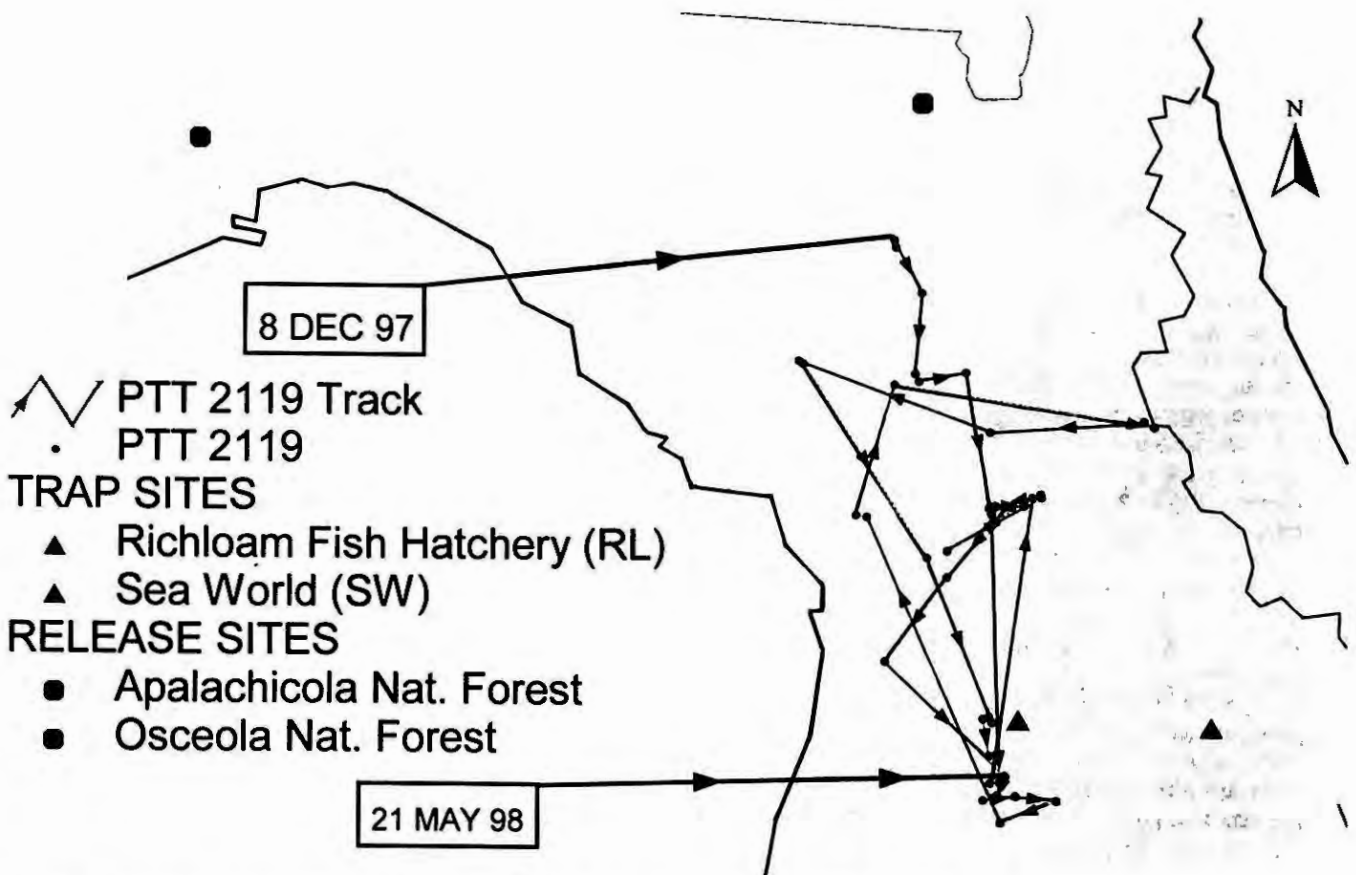


Figure 1. Post-release movements of black vulture PTT 2119. Release date 8 December 1997.

it provides not only for the retrieval of a lost or shed transmitter package, but also aids in more closely defining the location of the bird. The solar powered PTTs provided the most locations as well as locations with a higher location accuracy, yet were the most costly to operate due to their frequent transmissions. The addition of a duty cycle to these transmitters would reduce the operation cost significantly while still providing higher accuracy and a nearly limitless life-span.

The use of cattle ear tags as patagial markers worked well with the exception that the male buttons commonly used appeared to cause some abrasion due to the stiffness of the edges. By switching from the buttons to the large male tag, we eliminated or reduced any abrasion to the patagium and increased the visibility of the tag on soaring birds. This is because the large male tag has a smaller surface area at the point of connection to the female tag. Proper placement in the patagium is required to prevent the tag from binding in the wing when folded or from flipping over the edge of the patagium when placed too near the edge.

There was no difference between release sites for birds returning to the unmodified Richloam trap site. Similarly, one bird in each relocated group stayed in the general vicinity of its release site. We concluded that the release of birds at a site with an over-water return route

did not influence the birds return to their trap site and, therefore, did not differ from those released at a site with an over-land return route. It took all birds an average of eight months to return to their trap site, independent of release date or site.

Although removal and relocation of vultures can be an important aspect of a management program, we do not anticipate that removing vultures from existing roost locations will by itself solve problems that currently exist. Following removal and relocation of resident vultures, it will be necessary to institute and maintain an active program of harassment and habitat modification to render the original locations unattractive to new vultures and to discourage recolonization of the sites.

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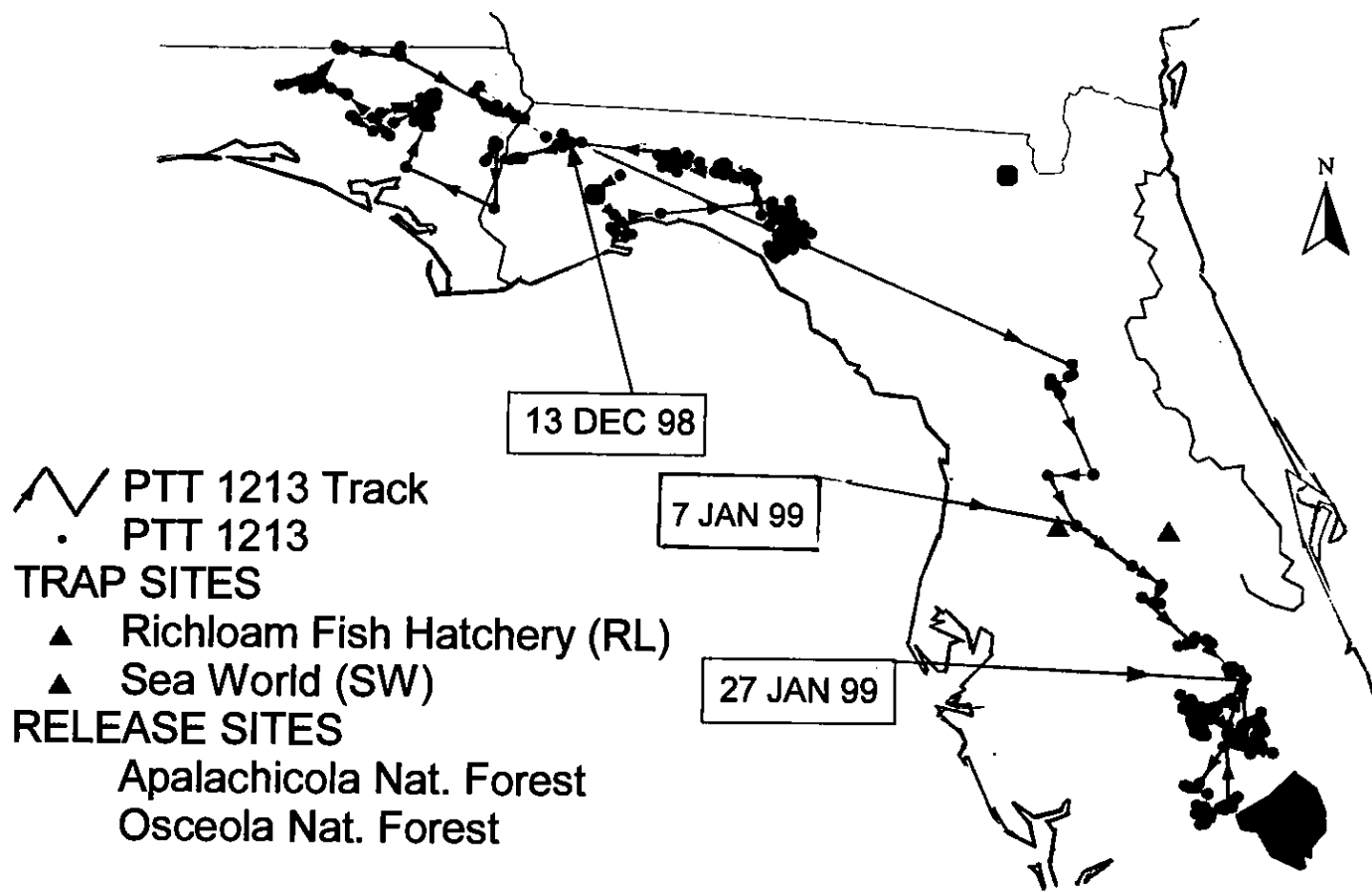


Figure 2. Post-release movements of black vulture PTT 1213. Release date 27 April 1998.

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