Aircraft Monitoring Methods at Grand Canyon National Park: An Evaluation

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Abstract. Grand Canyon has the most regulated airspace in the National Park system. With an air traffic volume of about 8,000 flights per month in the summer season, it became necessary to develop a monitoring program to provide National Park Service managers with data on the use in different sections over the park. Seven locations throughout the park were selected where flight corridor traffic near flight-free zones could be tabulated. The number of sampling hours per location was determined using a running mean. Three observation sessions show that air traffic numbers are high (up to 32 aircraft per hour) in some locations, but compliance with the regulation exceeded 98%. Survey results and results of acoustic and sociological research will be used to determine when changes to the regulations are needed to protect natural quiet.

Key words: Aircraft, airspace, air tours, monitoring, natural quiet, overflights.

A monitoring program was initiated at the Grand Canyon to gather baseline information on tour aircraft use. The issue of natural quiet has been in the forefront at the park since the increase in air tour traffic began with the opening of the Grand Canyon National Park Airport in 1967. Legislation has been enacted and regulations implemented. The most recent legislation, the National Parks Overflights Act of 1987 (PL 100–91, 101 Stat. 674), required the National Park Service (NPS) to determine if natural quiet is being affected. This same act required the Federal Aviation Administration (FAA) to create a regulation to manage Grand Canyon airspace based on recommendations made by the NPS. That regulation, Special Federal Aviation Regulation (SFAR) 50–2 (14 CFR Parts 91, and 135, Final Rule—22 March 1989) has been in place since November 1988.

Grand Canyon now has one of the most regulated airspaces in the country. The structure of the SFAR 50-2 is complex (Fig. 1). Four flight-free zones have been designated. Air traffic is funneled between these zones in narrow flight corridors, or planes must fly a minimum of 14,500 feet (4,419 m) above the flight-free zones. An elaborate set of 29 routes has been established by the FAA for tour aircraft to follow. Routes crisscross over parts of the park

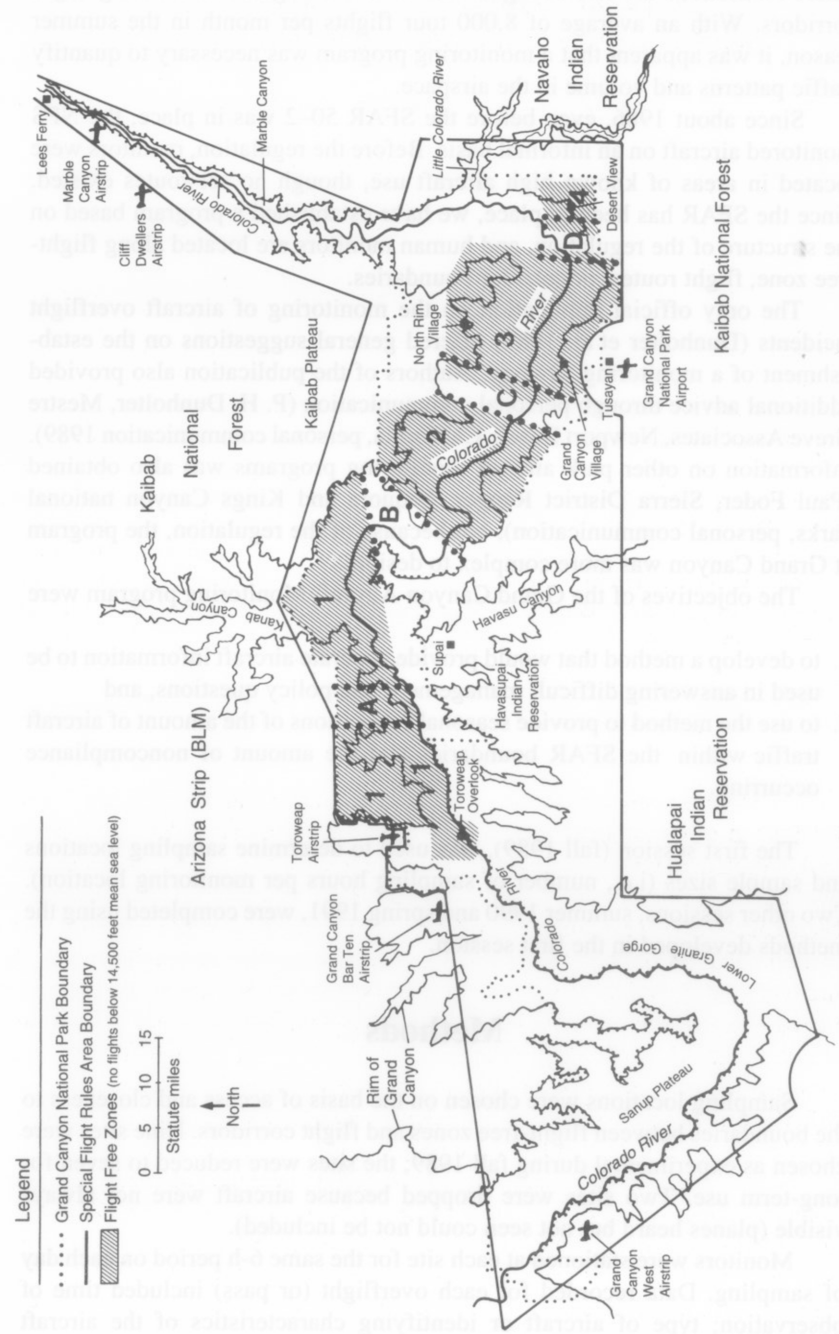

Fig. 1. Map of the Grand Canyon and the area affected by Special Federal Aviation Regulation 50–2, showing four flight-free zones (*1*: Toroweap/Thunder River; *2*: Shinumo; *3*: Bright Angel; *4*: Desert View) and intervening flight corridors (*A*: Tuckup; *B*: Fossil Canyon; *C*: Dragon; *D*: Zuni Point).

where restrictions are less stringent and then converge when entering flight corridors. With an average of 8,000 tour flights per month in the summer season, it was apparent that a monitoring program was necessary to quantify traffic patterns and volume in the airspace.

Since about 1986, even before the SFAR 50–2 was in place, the NPS monitored aircraft on an informal basis. Before the regulation, monitors were located in areas of known high aircraft use, though no set routes existed. Since the SFAR has been in place, we have established a program based on the structure of the regulation, and human monitors are located along flight-free zone, flight routes, or corridor boundaries.

The only official publication on the monitoring of aircraft overflight incidents (Dunholter et al. 1989) offered general suggestions on the establishment of a monitoring strategy. Authors of the publication also provided additional advice through personal communication (P. H. Dunholter, Mestre Greve Associates, Newport Beach, California, personal communication 1989). Information on other park aircraft monitoring programs was also obtained (Paul Foder, Sierra District Ranger, Sequoia and Kings Canyon national parks, personal communication), but because of the regulation, the program at Grand Canyon was more complex to design.

The objectives of the Grand Canyon Aircraft Monitoring program were

1. to develop a method that would provide accurate aircraft information to be used in answering difficult management and policy questions, and
2. to use the method to provide seasonal estimations of the amount of aircraft traffic within the SFAR boundaries and the amount of noncompliance occurring.

The first session (fall 1989), was used to determine sampling locations and sample sizes (i.e., number of sampling hours per monitoring location). Two other sessions, summer 1990 and spring 1991, were completed using the methods developed in the first session.

Methods

Sampling locations were chosen on the basis of access and closeness to the boundaries between flight-free zones and flight corridors. Nine sites were chosen as experimental during fall 1989; the sites were reduced to seven for long-term use. Two sites were dropped because aircraft were not always visible (planes heard but not seen could not be included).

Monitors were stationed at each site for the same 6-h period on each day of sampling. Data recorded for each overflight (or pass) included time of observation; type of aircraft or identifying characteristics of the aircraft (i.e., number of engines, wing location, color, markings); the audibility of the aircraft; direction of travel; and description of any violation observed.

A simple ecological technique was implemented to determine the number of hours necessary to adequately sample a site. The running mean (Mueller-Dombois and Ellenberg 1974) method of plotting was used. I made an assumption that aircraft traffic per hour would be reasonably consistent in each corridor—the more hours sampled, the less variation in aircraft per hour. By plotting the running mean (of aircraft passes per hour) against the total hours of sampling, the resulting curve would fluctuate initially, then flatten at a point where more sampling hours would not significantly change aircraft per hour (the point of diminishing returns).

The method worked well at locations where traffic was consistently busy. Figure 2 shows an example from Pima Point, the location used to sample the busy Dragon corridor traffic. In this example, aircraft per hour values decreased in the first 19 h of sampling from Pima Point. Aircraft per hour then increased to a leveling off point around 25 h of sampling time. At sites where aircraft were not so consistently frequent, it took more sampling hours before the running mean leveled out. The range of hours needed for adequate sample size over all seven locations was from 25 to 50 h. I designed the sampling program to offer the highest amount of hours possible within that range to ensure that adequate samples would be collected at all locations.

I selected 8 sample days over a 2-month period for monitoring based on the sample size calculations from the fall session. After the first 8 days, if plotting the running mean showed the need for more hours, another random day was added to the sample period.

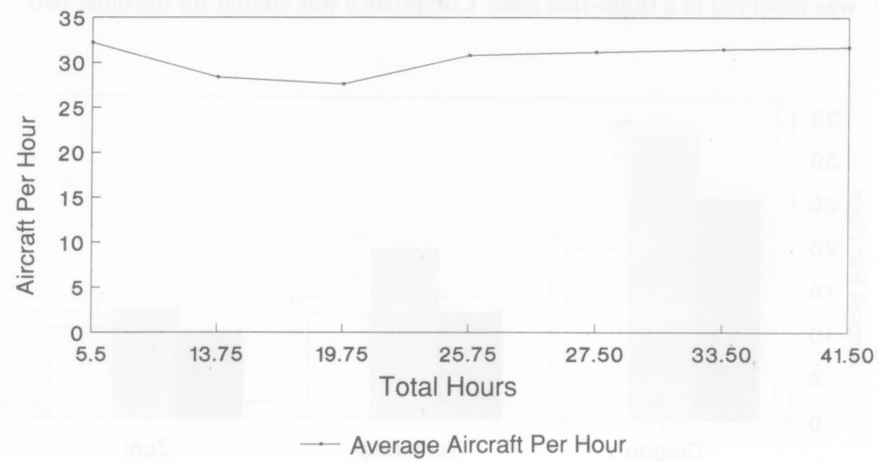

Fig. 2. Running mean of aircraft passes per hour at Pima Point in summer 1990.

Results

Results, in aircraft per hour, for all three monitoring sessions in each flight corridor are shown in Fig. 3. The bars labeled Toroweap do not represent a corridor but represent an overlook toward the western end of the canyon surrounded by a 1.5-mile (2.4-km) flight-free area. The bars represent tour and general aviation aircraft only.

The Dragon corridor is by far the busiest, with an average of 32 aircraft/h or roughly one aircraft every 2 min over this portion of the canyon. Unfortunately, the area under this heavy air traffic corridor is also a popular back-country use area. In the western end of the park, the Toroweap site observer reported about 19 aircraft/h or an aircraft every 3 min—an indication of the amount of traffic a river user or a visitor to the remote Toroweap area experiences. An average of 12 aircraft/h in the Zuni corridor was concentrated over the popular Little Colorado River mouth and the Tanner trail. The Fossil Canyon corridor (not shown) is the least used at about 4/h.

Seasonal fluctuations of aircraft volume are apparent (Fig. 3). Other information that this method can provide includes aircraft per hour by morning, afternoon, or per day; type of aircraft per hour; and, in some instances, data on specific route usage.

Compliance was high even though numbers of aircraft per period were high (32 aircraft/h) in some areas. In the summer 1990 session, 2,827 tour or general aviation aircraft were observed, and only 2% were in violation of the SFAR. Compliance is achieved primarily by the honor system where pilots watch over each other to make sure rules are being followed. Most of the limited violations (71%) were flight-free zone violations where an aircraft was observed in a flight-free zone. Compliance was similar for the other two

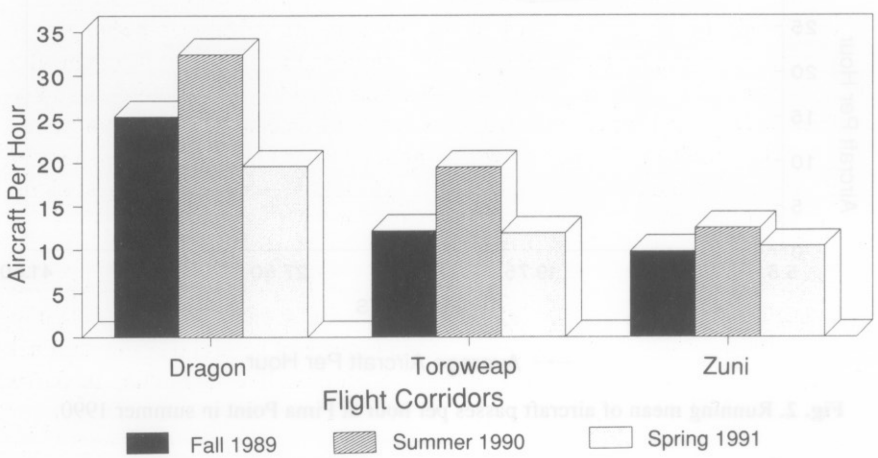

Fig. 3. Comparison of the numbers of aircraft per hour in three flight corridors during three seasons.

sessions. The remainder of the violations involved altitude. Some aircraft were observed in violation while flying below the level of a topographic feature of known elevation. Known elevations of topographic features allow altitude to be determined accurately by observers.

Conclusions

The most valuable data provided by application of the method are of aircraft use per hour. The NPS managers rely on that information to determine if changes in the regulation will be necessary and to present the data in justification. The information gathered on violations is used by the NPS to inform the FAA of problem areas where more training of tour pilots may be in order. Major violations processed by the FAA may result in prosecution of offenders.

The data obtained during monitoring will also be used, along with other research, to determine if natural quiet has been restored to the Grand Canyon. Congress specifically requested in PL 100–91 that a report be submitted to them on the subject.

Acoustic research, currently being done under contract, will result in development of a sound contour map. Contour lines, much like those on a topographic map, will depict the duration that aircraft sound levels surpass a scientifically determined threshold level of noticeability.

The success of monitoring for aircraft use at Grand Canyon National Park also comes from the amount of information collected on each observation. Data from the monitoring sheets can be analyzed by morning, afternoon, day, and type of aircraft. These data can be used in support of any management decisions concerning time of day or quieter types of aircraft.

The sound contour map, information gathered in this monitoring program, and the data from a sociological survey will be used by managers to determine the effectiveness of SFAR 50–2 and to recommend changes, if necessary, to improve natural quiet conditions in the park. The recommendations could include limiting aircraft numbers per corridor, moving corridors away from heavily used back-country areas, or requiring quiet aircraft technology.

The monitoring program will continue seasonally. We hope to extend monitoring to those areas of the park where flight-free zones and corridors do not exist in order to evaluate the amount of air traffic occurring.

Congress made it clear in PL 100–91 that air tours have a place in national parks, and the visiting public seems to have made its feelings clear by its use of the services provided by air tours. But Congress was also clear in its intent to emphasize identifying the importance of natural quiet in national parks. We must try to protect natural quiet just like any other resource protected in the National Park system.

Literature Cited

Dunholter, P. H., V. E. Mestre, R. A. Harris, and L. F. Cohn. 1989. Methodology for the measurement and analysis of aircraft sound levels within national parks. NPS Contract CX 8000–7–0028. Mestre Greve Associates, Newport Beach, Calif. 128 pp.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, New York. 547 pp.