on high-quality habitats throughout the breeding season (e.g., area Z in Fig. 41b) as a result of increased tolerance by breeders given unusually abundant acorns into the summer months.

During the year, floaters search for and fill available breeding vacancies as shown in Figure 41. Although breeding vacancies arise from breeder death throughout suitable habitat, floaters have the greatest probability of gaining a breeding vacancy either in poor quality habitat where breeder turnover may be greater or in high-quality habitat where breeder density has been reduced by an acorn crop failure. Also as shown in Figure 41, there is movement of breeders from one territory to another, often from lower to higher quality habitat. Not illustrated are the relatively rare regional acorn crop failures that may result in breeder density decline and subsequent low reproductive output over a broad area, providing increased opportunity for dispersing offspring and older floaters to gain a territory and breeding status.

These patterns of habitat quality and acorn production, the varied behaviors floaters employ to acquire breeding space and exploit resources, the behavioral interactions between territorial jays and floaters, and the ability of breeders to move and improve the quality of their territories all promote selection for early dispersal and floating in scrub-jays in central coastal California, and selection against cooperative breeding.

ACKNOWLEDGMENTS

Fanny Hastings Arnold, through her continuous generosity, and the Museum of Vertebrate Zoology, provided the exquisite Hastings Natural History Reservation where this research was done. Financial assistance was provided by the Department of Forestry and Resource Conservation (Oliver Lyman Fund), the American Museum of Natural History (Frank M. Chapman Memorial Fund), Sigma Xi, the American Academy of Sciences (O. C. Marsh Fund), and the Museum of Vertebrate Zoology (Kellogg Fund). I was also supported by University Fellowships, Graduate Minority Fellowships, and a Betty S. Davis Memorial Fellowship.

I am especially grateful to Walt Koenig and Ron Mumme for their companionship at Hastings and their ideas concerning cooperative breeding. Frank Pitelka and Dale McCullough continually sent me back to the field with new ideas and rekindled enthusiasm. Numerous field assistants worked on the study: Greg Ashcroft, Bob Beffy, Clay Clifton, Sharon Dougherty, Lenore Feinburg, and Jim Siegel, all of whom braved long hours and certain exposure to poison oak in search of scrub-jay nests.

Frank Pitelka, Walter Koenig, Ron Mumme, Glen Woolfenden, John Fitzpatrick, Peter Stacey, and Dale McCullough made numerous helpful criticisms of earlier drafts. Joseph Jehl and John Rotenberry provided long-term editorial support. Karen J. Nardi provided love and understanding and both the financial and moral support needed to complete the study. To all of these individuals I give my sincere thanks.

LITERATURE CITED

Altmann, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227–267.

Arcese, P. 1987. Age, intrusion pressure, and defense against floaters by territorial male Song Sparrows. Animal Behaviour 35:773–784.

Arcese, P., and J. N. M. Smith. 1985. Phenotypic correlates and ecological consequences of dominance in Song Sparrows. Journal of Animal Ecology 54:817–830.

Arnold, K. E., and I. P. F. Owens. 1998. Cooperative breeding in birds: a comparative test of the life history hypothesis. Proceedings of the Royal Society of London, Series B 265:739–745.

Arnold, K. E., and I. P. F. Owens. 1999. Cooperative breeding in birds: the role of ecology. Behavioral Ecology 10:465–471.