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PREVIEW

MECHANISMS INFLUENCING ADOPTION  
IN THE  
COMMON TERN (*STERNA HIRUNDO*)

by

Margaret S. Friar

A Dissertation

Submitted to the University at Albany, State University of New York

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Arts & Sciences

Department of Biological Sciences

2003

UMI Number: 3107598

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PREVIEW

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## ABSTRACT

I investigated mechanisms influencing adoption behavior in the common tern (*Sterna hirundo*). I defined adoption in the Laridae and treated the adoption process as two distinct steps: (1) wandering followed by (2) acceptance into a new nest. I conducted two series of field experiments and evaluated data from an eight-year observational study directed by Dr. Ian C. T. Nisbet. All investigations were conducted on Bird Island or Ram Island in Buzzards Bay, Massachusetts.

My analysis of the observational study data showed that chick wandering is neither rare nor widespread, occurring at a rate of 16% of all nests studied. Twenty-six percent (26%) of wandering chicks survived to fledge, compared to an overall survival rate of 44%, and stay-at-home siblings of wandering chicks realized the highest survival rate (57%). Most adoptions occurred at nests where the oldest chick was four-days or less old.

In the first of my two series of field experiments, I investigated fitness costs and benefits to both parents and chicks through brood manipulations. Transferred chicks generally realized both direct and indirect fitness benefits because they and their stay-at-home siblings both had higher survival rates than control chicks of the same hatch rank. Parents of transferred chicks also gained fitness benefits, while parents at augmented broods suffered fitness losses due to lower survival rates of their own chicks.

In the second of my two series of field experiments, I investigated mechanisms involved in chick wandering by temporarily removing one member of a parent-pair. Removing one parent resulted in higher levels of aggression directed towards experimental broods and significantly higher wandering rates. These results suggest that wandering can be triggered by either deficiencies in parental care or aggression directed towards chicks.

My results support the view that both wandering chicks and their parents stand to realize fitness gains. If parents actively induce wandering, then adoption can be interpreted as a parasitic strategy facilitated by the timing of parent-offspring recognition.

## PREFACE

The field experiments described in this dissertation were conducted under scientific collecting permits issued by the USF&WS (#MB778956-0) and the Massachusetts Division of Fisheries and Wildlife (155.98SCB, 136.99SCB, 094.00SCB, and 035.01SCB) and under University at Albany IACUC Protocols #98-010 and #00-003. The Medical Associates Recombinant DNA Lab at Loras College, Dubuque, IA, performed DNA sex determinations. My research was supported in part by financial grants from the University at Albany Graduate Student Organization and the SUNY Benevolent Association and through the generosity of Dr. Ian C. T. Nisbet.

My committee consisted of Dr. Kenneth P. Able, who was Chairman, Dr. Jerram L. Brown, Dr. Ian C. T. Nisbet, and Dr. George R. Robinson. I am very grateful to each of them for their guidance and encouragement.

I value the interest and encouragement of Dr. Ingrid Peters, Esther Brown, and Alice Jacklet, all of whom visited my research site for first-hand exposure to an active tern colony. Alice also provided useful comments on my manuscript and valuable insight and experience while I was her teaching assistant. Dr. Tram Neil provided useful suggestions on data analysis. Dr. Jeremy Hatch provided insight and encouragement during a total of six field seasons at Bird Island. Dr. Steve Brown and Dr. Jeff Travis have each been mentor, role model, supporter, and friend. I am grateful for the assistance of Ann Boehm and Blanche Feck in the Biology Department Office.



Suzanne Conlon assisted me with my fieldwork in 1999 and Courtney Redmond assisted me during 2000 and 2001. Without their help, I would have been unable to accumulate the volume of data in the experiments. I am grateful to Dr. Jennifer Arnold, a fellow Bird Island researcher, for her assistance and encouragement. I am grateful to the various managers and field assistants working on the Buzzards Bay Tern Project for their help and companionship during my fieldwork. I am enormously grateful to Dr. Ian C. T. Nisbet. In addition to serving on my committee and providing financial support and data from his own adoption studies, he has been both the inspiration for my research and a rare and valued mentor during a total of six field seasons and the ensuing years.

I am grateful to my parents for their support and to my husband, Glenn Friar for his unwavering support, assistance, and encouragement.

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# CHAPTER I

## ADOPTION BEHAVIOR IN THE LARIDAE

### Introduction

Adoption and other forms of alloparental care, in which individuals other than the genetic parents provide care for young, have been documented in over 150 mammalian and 120 avian species (Riedman 1982). Many of the species involved in these cases share similar behavioral or social reproductive characteristics.

Alloparental care behaviors include "babysitting" and "helping", where young receive care from non-parents as well as parents. Adoption, on the other hand, is a form of alloparental care involving the fostering of another individual's young (Riedman 1982). In adoption, only foster parent(s), and not biological parents, care for young. Forms of adoption include "step parenting", where a replacement parent cares for the offspring of its mate (Plissner and Gowaty 1988); adoption by failed breeders (Jouventin et al. 1995); taking over of an entire brood (Larsson et al. 1995; Williams 1994); and assuming full care for a single (or a few) foreign young by breeders that are also caring for their own young (Brown et al. 1995; Bukacinski et al. 2000; Carter and Spear 1986; Gaston

et al. 1995; Graves and Whiten 1980; Holley 1981; Morris et al. 1991; Oro and Genovart 1999; Roberts and Hatch 1994; Saino et al. 1994). The last of these forms of adoption is the focus of this dissertation.

Among birds, differing patterns of adoption require distinct adaptive explanations. Altricial and semi-altricial species show lower rates of adoption than semi-precocial or precocial species (Oro and Genovart 1999). In precocial birds whose chicks feed themselves, costs to adopters seem to be minimal (Williams 1994; but see Codenotti and Alvarez 1998). Semi-precocial young, however, require brooding and feeding, so adoption in this case should involve a fitness cost to foster parents.

The remainder of this dissertation addresses the Laridae (gulls and terns), a family of seabirds with semi-precocial young. Their chicks are mobile almost from hatching, yet require extensive bi-parental care for thermoregulation and feeding (Hamer et al. 2002). Species in this family have life history characteristics that could lead to the evolution of cooperative reproductive traits such as adoption (Brown 1998). The adults are long-lived (Weimerskirch 2002) and show strong natal philopatry and nest site fidelity (Bried and Jouventin 2002). Colonial breeding is also common in gulls and terns. The close proximity of pairs nesting in open habitats with few physical barriers allows chicks to move among nests, providing the opportunity to solicit care and feeding from birds other than their biological parents. Adoption studies of members of this group are particularly interesting because, while adoption behavior can reduce the fitness of foster parents (Carter and Spear 1986; Graves and Whiten 1980;

Holley 1981; Riedman 1982), it is not rare. Adoption has been detailed in numerous gull and tern species.

I have chosen as my model for investigation, the common tern (*Sterna hirundo*), a highly social, ground-nesting, colonially breeding seabird with semi-precocial young. Common tern chicks hatch covered with down, yet require brooding during the first few days of life (Nisbet 2002). Modal clutch size is 3 eggs (Nisbet 2002). Siblings hatch asynchronously (Morris et al. 1991; Nisbet and Cohen 1975) over a period of 2.5 to 3 days or longer as the breeding season progresses (Nisbet and Cohen 1975). Chick survival declines with hatching order (Bollinger 1994), and adults fledge an average of between 1 and 2 chicks per year depending on environmental conditions (Nisbet 2002). Common tern chicks have been observed to wander from their natal nest and solicit care at other nests, usually within two days after hatching (Nisbet pers.comm.). Adoption behavior in common terns has been documented with some regularity.

In general, wandering from the nest is risky for chicks, many of which die before they find a pair that will accept them. Except for the short period before adults learn to recognize their own chicks, most gulls and terns vigorously attack foreign young that enter their territories. This has been interpreted as a defense against the risk of adopting unrelated offspring (Ashmole 1963). Acceptance of a foreign chick is a rare failure of this defense mechanism.

Food is a limiting factor for terns because parents must leave the colony to forage for a single food item which is then carried back to the chicks (Fasola and Saino 1995; Nisbet 2002). Chick provisioning is generally more costly for terns

than for gulls because terns carry food in the bill and each food item requires a separate trip, whereas gulls are able to gather several prey items and then regurgitate to feed the chicks without the risk of losing food items to kleptoparasites. Thus, for terns, accepting a foreign chick into a brood should come at an even greater cost than it does for gulls because of the extensive parental care required to raise each chick.

### Terminology

Alloparenting and adoption in mammals and birds have been the subjects of many studies. The related terminology has been used in slightly different ways throughout the literature. Here, I define some of the terms as I use them in the context of my study. "Adoption" is the exclusive fostering of another individual's offspring by parents that are also caring for their own young. "Wandering" is the departure of a chick from its natal or adoptive brood. Operational definitions for wandering and adoption are provided later in this chapter. Broods from which a chick has departed are called "donor broods" and broods in which an adoption has occurred are called "adopter broods". Parents of these broods are called "donor parents" and "adopter parents", respectively. I use the term "foreign" to refer to non-natal chicks and also distinguish them from adopted chicks (adoptees). I use the term "siblings" to describe biological siblings together or in separate broods and "nest mates" to describe chicks in a brood that are not biological siblings, e.g., an adoptee is a nest mate to chicks