flyers. These birds could easily have been forced down at sea by a sudden squall or become exhausted fighting less severe but constant spring and fall winds. Once on the sea surface they were probably picked up at night by the tiger shark, which tends to be a crepuscular feeder and normally does not approach the surface by day (Springer, ibid.). The presence in the tiger shark of a Mourning Dove, a nonmigrant found adjacent to the beaches in this region, may be the result of this bird having been swept seaward by a strong offshore wind, or already dead, possibly swept out to sea from the adjacent estuary.

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Foraging Success in Three Age Classes of Glaucous-winged Gulls

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A small proportion of bird species delay the onset of breeding past the age of 1 yr. Lack (1954, 1966) explained delayed maturation as a means of maximizing lifetime reproductive output, contending that breeding subjects individuals to increased risk of mortality and that younger individuals, being less experienced, are both more susceptible to the strain of breeding and less likely to produce surviving young, if there is competition for resources during the breeding season. Therefore, in species in which some aspect of breeding, such as gathering food for young, is particularly difficult, lifetime reproductive output may be maximized by delaying the onset of breeding until necessary skills have been developed.

One type of evidence for Lack's hypothesis is that foraging efficiency is lower in younger, nonbreeding age classes than in adults in species with delayed maturation. Juveniles have been shown to be less successful at catching fish in Little Blue Herons (*Florida caerulea*) by Recher and Recher (1969), in Brown Pelicans (*Pelecanus occidentalis*) by Orians (1969), and in Sandwich Terns (*Sterna sandvicensis*) by Dunn (1972). On the other hand, Buckley and Buckley (1974) found that juvenile Royal Terns (*Sterna maxima*) are just as successful in fishing as adults in terms of fish caught per attempt. In this paper, I examine fishing skill in three age classes of another species with delayed maturation, the Glaucous-winged Gull (*Larus glaucescens*).

The study was conducted at the Crittenden Locks in Seattle, Washington during July and August of 1975 and 1977. Ten or more Glaucous-winged Gulls are usually present at the locks, feeding on small fish brought to the surface by an upwelling of water caused by filling and emptying the locks. These gulls use two foraging methods, similar to those used by Black-legged Kittiwakes (*Rissa tridactyla*) (Burtt 1974): (1) "dive foraging" in which a bird dives through the air and enters the water head first, and (2) "surface foraging" in which a bird feeds while swimming on the water surface. Only data on dive foraging will be considered here.

Three age classes were distinguished by plumage and bill color according to the following criteria (see Dwight 1925): (1) yearlings have light brown heads, gray-brown backs, and dark bills; (2) two-year-olds have white heads streaked with brown, gray backs, and bills dark at the tip and drab at the base; and (3) adults have white heads, gray backs, and yellow bills. Three-year-olds have been included with adults though breeding does not start until four (Vermeer 1963).

Data were taken by two observers, who attempted to record every foraging attempt within view. A foraging attempt was recorded whenever a gull dove through the air and entered the water so as to totally submerge its bill. A success was recorded if a fish was seen to be swallowed. If no fish was seen in the bill after an attempt, or if a fish escaped before being swallowed, a failure was recorded. Observations on the three age classes were made simultaneously so that conditions of wind velocity, fish abundance, and cloud cover would be identical for each age class.

In 1975, adults were successful on a greater proportion of attempts than were yearlings on all 5 days of observation (see Table 1), but none of the differences was significant. Adults were more successful than two-year-olds on the 3 days that more than one attempt by two-year-olds was observed, but again none of the differences was significant. Combining the data for the different days, adults were successful in 66.7% of their attempts, which was not significantly better than the 56.8% success rate of yearlings

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TABLE 1. Percentage of fishing attempts that were successful for three age classes of Glaucous-winged Gulls

	Yearlings		Two-year-olds		Adults	
	Attempts	% Successful	Attempts	% Successful	Attempts	% Successful
1975						
27 July	14	57.1	1	100.0	21	71.4
3 August	32	53.1	15	33.3	67	64.2
13 August	14	42.9	1	0.0	7	71.4
15 August	15	53.3	4	50.0	14	71.4
16 August	64	62.5	14	50.0	32	65.6
1975 total	*139*	*56.8*	*35*	*42.9*	*141*	*66.7*
1977						
3 July	43	39.5	12	33.3	20	65.0
10 July	122	39.3	16	37.5	40	52.5
17 July	137	59.9	19	57.9	64	85.9
24 July	52	40.4	13	53.8	20	75.0
31 July	30	46.7	7	28.6	6	50.0
1977 total	*384*	*47.4*	*67*	*44.8*	*150*	*71.3*
Grand total	523	49.9	102	44.1	291	69.1

(χ^2 = 2.88, .10 > P > .05) but was significantly better than the 42.9% success rate of two-year-olds (χ^2 = 6.80, P < .01). The success rates of the yearlings and two-year-olds were not significantly different (χ^2 = 2.19, P > .10).

In 1977, adults had a greater proportion of successes on all 5 days of observation, and on 2 days the differences were significant (July 17, χ^2 = 13.72, P < .001; July 24, χ^2 = 6.92, P < .01). Adults also had a greater proportion of success than two-year-olds on all 5 days, and on one day the difference was significant (July 17, χ^2 = 7.03, P < .01). Combining the 1977 data, the 71.3% success rate of adults was significantly higher than the 47.4% success rate of yearlings (χ^2 = 24.86, P < .001) and significantly higher than the 44.8% success rate of two-year-olds (χ^2 = 14.05, P < .001). The success rates of yearlings and two-year-olds were not significantly different (χ^2 = .16, P > .5).

Combining the data from both years, the 69.1% success rate of adults was significantly higher than the 49.9% success rate of yearlings (χ^2 = 27.94, P < .001) and significantly higher than the 44.1% success rate of two-year-olds (χ^2 = 19.98, P < .001). The success rates of yearlings and two-year-olds were not significantly different (χ^2 = 1.13, P > .3).

These data confirm for Glaucous-winged Gulls the prediction that in species with delayed maturity, nonbreeding age classes will be less skillful at some behavior necessary for breeding. Yearling and two-year-olds were consistently less successful than adults at catching fish. A puzzling aspect of the results is that two-year-olds were no more successful than yearlings. One possible explanation for this is that success of two-year-olds is depressed because adults are more aggressive towards them than towards yearlings, and this aggression interferes with foraging. Moyle (1966) found that Glaucous-winged Gulls feeding on dead salmon defended groups of carcasses and that adults were more successful at defending against second and third year birds than against first year birds. However, this explanation seems unlikely in the present case because most dive foraging attempts begin with the gull circling in the air, where it is unlikely to be affected by aggressive interactions.

Another possible explanation of why two-year-olds had no better success than yearlings is that developing fishing skill is such a slow process in this species that little improvement is seen in 1 yr. The large gap between the success rates of adults and two-year-olds could still be accounted for by the large difference that must exist in the average ages of the two groups. According to Vermeer (1963), mortality in adult Glaucous-winged Gulls is about 10% a year. Assuming that mortality is the same for three-year-olds as adults and remains constant throughout adulthood, then the size of a year class declines at the rate $dN/dt = -0.1(N)$. Letting N_0 be the size of the population reaching the age of three, then the average age of individuals in the adult age class would be $3 + x$, where $\int_0^x N_0 e^{-.1t} = \int_x^\infty N_0 e^{-.1t}$. Solving, we find that $x = 6.9$, so the average age of the adults would be approximately 10 yr. Thus the average adult would have about 8 yr in which to improve its foraging skill relative to the two-year-olds, certainly a long enough learning period to account for the observed difference in success.

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Sexual Chase in Purple Martins

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Several behavioral studies of Purple Martins (*Progne subis*) have failed to comment on sexual chase (Olmstead 1955, Gaunt 1959, Johnston and Hardy 1962), although Allen and Nice (1952) make brief mention of "sexual flights." Here I describe and interpret sexual chase in martins. My studies were conducted at two martin colonies of 72 and 42 rooms, respectively, in Sherman, Grayson County, Texas. Individual martins in the colonies were identified by painted bands, plumage differences, and behavioral peculiarities. I spent approximately 5,445 h observing Purple Martins during 1972–77.

Others have described pair formation in Purple Martins (Allen and Nice 1952, Gaunt 1959, Johnston and Hardy 1962). In Texas two distinct types of sexual chase develop shortly after pairs become firmly established. I refer to them as *Pair Chase* and *Rape Chase*. Pair Chase commonly occurs in Sherman as early as late February, soon after pair formation, and I have noted it as late as mid-June. The peak seems to occur in March, April, and May before each pair lays its eggs. Pair Chase occurs only on partly cloudy to clear, rather mild days when martins are quite active. Cool weather restricts overall martin activity (Brown 1976, Finlay 1976).

Pair Chase involves only the members of a pair. The male vigorously chases his mate for 15–40 s. When chased, females make many complicated twisting and turning maneuvers, the male staying 10–15 cm behind the female. When the male terminates the chase, the pair resumes normal flight. During Pair Chase, the male often utters his song—a warbled set of "chur" and "sweet" notes followed by a guttural trill. Pair Chase invariably begins while a pair is foraging away from the nesting site. I have never recorded Pair Chase originating lower than about 12 m above the ground nor around the martin houses, although females sometimes fly near the ground in their maneuvers while being chased. Most Pair Chases occur when pairs are apart from foraging flocks. Pair Chase ceases when the female begins laying eggs. It seems to be largely a behavior of adult martins, and I have very few records of first-year birds engaging in these pursuits. In Pair Chase I have never recorded an instance of a female being chased by a male other than her mate.

Rape Chase differs greatly from Pair Chase. I have never noted Rape Chase in Sherman prior to the inception of nest building in mid-March. It has occurred as late as mid-June, although most Rape Chases