

CONTESTS OF DOUBLE-CRESTED CORMORANTS FOR PERCHING SITES

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Since the pioneer work of Schjelderup-Ebbe (1922) the investigation of the problem of dominance as a factor in the organization of bird flocks has become a clearly defined and productive field of biological research. Experimental investigations, usually done on small groups of captive birds under controlled conditions, have revealed two main types of dominance-subordination relationships which have been reviewed by Allee (1938:175-208) and by Shoemaker (1939). In their simplest form the two types of dominance-subordination relationships are: first, absolute "peck-right," best illustrated by the domestic fowl whose entire flock is organized in a rigid and inflexible hierarchy in which the individual bird pecks with impunity all birds beneath it in the "peck-order" and is pecked by all the birds above it without itself attempting to retaliate; and second, "peck-dominance," illustrated by canaries and domestic pigeons, in which the dominance-hierarchy although present, is not constant or fixed, but varies from time to time depending on many factors such as age, sexual condition of the contestants and the place (territory) in which the contest takes place.

It is obvious that either of these two types of dominance can be fully expressed only when the functional social unit is sufficiently small that frequent and repeated contacts between its members are possible.

It is equally obvious that among birds which habitually form large aggregations, such contacts, because of the large numbers of individuals present, can be neither frequent nor often repeated, except during the breeding season in the nesting area.

During the fall of 1940 incidental to the study (Bartholomew, 1943) of the daily movements of cormorants on San Francisco Bay, opportunity was afforded for the observation of contests among Double-crested Cormorants (*Phalacrocorax auritus*) for perching sites. The following discussion of those contests is presented in the hope that it will cast some additional light on the problem of dominance, particularly as it is expressed in large aggregations of birds. It is entirely possible that in a breeding colony of cormorants the problems of dominance would be quite different from those to be described here, for in such a colony the creation and maintenance of a definite and permanent territory is an important factor.

It is immediately apparent that in a field study where unmarked birds are observed it is impossible for the student to say categorically that two contestants are meeting for the first time. In this paper, however, it is assumed that such is the case. The population of the daytime roost where the observations were made varied from zero to forty and was constantly shifting. The birds were part of a flock which during the period of study numbered in excess of 2000.

Contests to determine the ownership of specific perches on the daytime roosting sites are frequent. Newcomers attempt to chase the occupants away and the occupants in turn try to drive off the newcomers. This competition is especially conspicuous at the more crowded roosts, but contests may occur between a pair of birds when they are the only cormorants on a roost large enough to support fifty or sixty individuals.

The roosts under special observation consist of the pilings west of the Berkeley Yacht Harbor which lies at the foot of University Avenue in Berkeley, California. The pilings are about thirty inches in diameter and approximately eight feet apart. On most of the daytime roosting sites on the Bay the individual perches are not clearly separated so that the cormorants have no sharply defined "roosting territories" which they are stimulated to defend, but these pilings offer a series of definitely delimited

perches, each small enough to be readily defended by a single bird. Such man-made "territories," perhaps through their similarity to the nesting territories which the cormorants maintain in their breeding colonies, call forth vigorous defense behavior. Because of the limited area on the tops of the pilings, the contests here are much more definite than those taking place on a roost where there is plenty of room for the birds to move about. On a spacious roost newcomers can alight on vacant spots and avoid contests; or if a contest does develop, the vanquished bird need not leave the roosting site—it can merely walk two or three feet away and resume its perching. On the pilings the vanquished bird has no alternative but to leave. Another factor which contributes to the frequency of contests on this roost is the small amount of space available on the roost as a whole.

Some of the pilings are broken off close to the water and are submerged at high tide, while others are always three or four feet above the water. Cormorants wishing to roost approach the low pilings by swimming and the high ones by flying.

The competition, although keen, was never seen to result in fights in which the cormorants grappled and attempted to drive each other away by force; it consisted of brief formal contests in which each contestant, by threats, postures, and vocal efforts, tried to force its opponent to depart.

Several types of threats are employed, but all are variations of a single pattern—a vigorous thrust or series of thrusts of the open bill in the direction of the head of the opponent, accompanied by a swelling of the gular pouch and deep hoarse grunting sounds. The contesting birds rarely touch, and when this does occur only the bills establish contact.

A tabular record was kept of sixty-four contests observed during windless early morning hours.

Newcomer driven off by threats of occupant before alighting.....	19
Newcomer driven off by threats of occupant after alighting.....	4
Occupant driven off by threats before newcomer alights.....	15
Occupant driven off by threats after newcomer alights.....	4
Both occupant and newcomer remain.....	22
Number of contests in which occupant threatened.....	45
Number of contests in which newcomer threatened.....	45

The tabulation indicates the following things: (1) the newcomer and occupant are equally aggressive; (2) the occupants are slightly more successful in maintaining their perches than the newcomers are in usurping them; (3) the number of draws is midway between the number of victories of the occupants and the number of victories of the newcomers; (4) after two birds are established on a single piling, occupant and newcomer are equally successful in driving their opponents away.

All in all these figures support the general impression gained that neither newcomer nor occupant has any significant advantage. The result of a contest is determined not by the status of the contesting birds, that is, whether newcomer or occupant, but by the individual birds themselves and the circumstances in which they find themselves.

Since physical force is not employed, the contests are largely psychological. The bird that can establish dominance by its posture and the vigor of its thrusts and calls is able to drive the other bird away. As a result, it is possible for an observer to predict the probable victor at the very onset of a fight by the strength and aggressiveness of its actions and to predict the probable loser by its nervous defensive attitude. When both contestants are equally aggressive, neither bird is able to drive the other away.

Several factors are of course involved in determining which bird will be victorious. There is undoubtedly an innate tendency for some individuals to be aggressive and

for others to be defensive, or one bird may in previous contacts have established its dominance over the other, but there are other more readily analyzable external factors. The most apparent of these external factors is the direction in which the occupant is facing in relation to the approach of the newcomer. This in turn is dependent on the direction and velocity of the wind. Roosting cormorants always face into the wind and flying cormorants always alight heading into the wind. Thus, when the wind is blowing, the newcomer flies in from the leeward and so approaches the occupant from behind. Because their legs are adapted for swimming rather than walking, a perching cormorant has difficulty in turning around quickly enough to threaten the newcomer adequately. The best it can do is to twist its head and neck around over one shoulder and make a few short thrusts in the direction of the approaching bird. At the same time, however, the approaching bird is not in a position to force the occupant to leave, for both birds are facing the same way and neither can adequately threaten the other. Consequently, when the wind has a velocity of more than twelve or fourteen miles per hour, a high percentage of the contests end in draws. In the course of the afternoon of November 18, 1940, when the wind was blowing approximately fifteen miles per hour, ten contests not included in the foregoing table were observed. Of these, seven resulted in draws whereas normally only about three out of ten contests would end with both birds remaining on the piling.

Another factor of importance is the posture of the roosting bird. Cormorants frequently crouch down flat on their bellies, twist their necks over one shoulder, and tuck their bills in among the feathers of one wing, and they also often stand on one leg with the bill tucked under. Obviously when a bird assumes either of these postures, it is in no position to put up a fight and it rarely succeeds in driving its opponent away.

Cormorants are rather awkward when maneuvering on the wing at close quarters. It is not unusual for one to miscalculate and almost miss the piling. Such an occurrence puts the newcomer on the defensive and immediately places it at such a disadvantage that a single strong thrust of the head by the occupant will usually cause it to give up, drop into the water and swim away.

The contests to be described below are indicative of the various types which occur. All were seen on the pilings west of the Berkeley Yacht Harbor during the months of October and November, 1940.

In slightly less than a third of the contests the newcomer is driven off before it has a chance to alight. The following is typical: A cormorant flew in from the north and started to alight on a piling which was occupied. When the newcomer was about fifteen feet away and beginning to back-paddle with its wings, preparatory to landing, the occupant turned about twenty degrees to the left and faced the approaching bird, leaned forward, partly extended its wings, swelled its gular pouch, opened its bill, drew its head back and then thrust it forward to the full extent of its neck, at the same time uttering a deep coughing grunt. The first threat, completed when the newcomer was about six feet away, had no effect, but when the newcomer was about a yard distant and had its legs extended ready to alight, the occupant again thrust forward its head and open bill and this time the newcomer acted as if it had received a physical blow. It abandoned its effort to alight on the piling so rapidly that it awkwardly fell into the water with a splash. As soon as the newcomer hit the water, the occupant stopped threatening and resumed its preening.

When an occupant is driven from its perch by a new arrival, the behavior differs: A bird flying in from the north circled and headed for a piling on which another cormorant was perched. When the new arrival was at least thirty feet away and just beginning to check its speed, its gular pouch was already fully extended, its mandibles

were parted, its neck was stretched forward, and it was uttering a deep snoring "quork." Even before the newcomer began to call, the cormorant on the piling was visibly excited; it shifted its feet "nervously" from side to side, and made several rapid, short, weak silent thrusts in the direction of its attacker. As it shifted its feet about, it crouched down and backed as far away from the newcomer as it was possible to get and still remain on the piling. The newcomer alighted on the far edge of the piling, made one powerful thrust and the occupant all but fell over backward in its haste to get out of the way and into the water. In this instance, since both birds were immature and both were approximately the same size and there was no apparent external environmental reason why the occupant should have been nervous and defensive, the defeat may have been the result of an established dominance-subordinance relationship.

Frequently the result of a contest is not decided until the newcomer has alighted and both birds are perched together on the piling. The following is a typical example: An immature cormorant was crouched down flat on its belly with the head twisted to the right and lying on its shoulders between the wings. Another cormorant flew in from the north and landed on the piling. The occupant apparently was unaware of the newcomer until the latter had actually alighted on the piling, but as soon as the presence of the intruder was discovered, the occupant, while still crouched on its belly, swung its head around and made two half-hearted thrusts. The note accompanying this threat was not the usual low-pitched grunt, but a high gull-like squawk. The newcomer ignored these threats and as soon as it alighted, began to preen unconcernedly. After remaining motionless for about fifteen seconds following its first threats, the occupant stood up, turned around, moved leisurely toward the newcomer, and twice thrust vigorously and silently at its opponent who retreated, hopped into the water and swam away. It seems probable that the newcomer ignored the first threats of the occupant because the latter was neither in a position to threaten adequately nor to substantiate its threats by force.

As indicated previously, in about one third of the fights, neither contestant is able to drive the other away. For example, an immature cormorant flew in from the north and alighted on a piling on which there was already another immature bird. The occupant who was standing on the edge of the piling farthest away from the approaching bird did not threaten until the newcomer had settled itself on the opposite edge and the two birds were facing each other across the width of the piling. Both opened their bills at the same time, but the occupant took the offensive by leaning forward and darting its head and open bill directly at the head of the newcomer, who instead of hopping off from the piling into the water, merely jerked back its head. As the occupant recovered from the thrust by drawing its head back between its shoulders, the newcomer assumed the offensive and thrust its head forward strongly and then as it in turn drew its head back in order to get set for another thrust, the occupant shot its head forward again. Thus the two birds were thrusting alternately. The thrusts and recoveries were so synchronized that it looked as if the birds' heads were fastened together. Each bird was uttering the usual hoarse "quork," but neither could make the other retreat. After seven or eight thrusts both birds, as if by mutual consent, stopped and paid no further attention to each other. Most indecisive contests end in the same manner. When neither bird is successful in forcing the other to leave, the contest stops abruptly and the two birds pay no further attention to each other. If, however, a third bird should attempt to alight on the same piling, either one or both the occupants may attempt to drive it away. If despite the threats of the two occupants the third bird is able to establish itself on the piling, all three birds perch peacefully together and make no further attempts to drive each other away.

When two cormorants are sharing a piling, the arrival of a third may evoke defensive behavior from either one or both of them, but sometimes when the new arrival is aggressive and the two occupants are so crowded that maneuvering is difficult it can overawe both the roosting birds and drive them off.

The difference in the reactions of two cormorants occupying the same piling when a third bird tries to alight on it emphasizes the importance of the attitude of the individual bird in determining which of a pair of contestants will be victorious. The cormorant which assumes a nervous defensive attitude or an attitude that is aggressive, but not sufficiently aggressive to impress the newcomer, is usually dispossessed, whereas the bird which ignores the newcomer is seldom involved in the contest at all.

Opportunities to observe contests between cormorants on the pilings and those approaching by water are less frequent than opportunities to watch contests involving flying birds, because there are few pilings whose tops are close to the water. Nevertheless, such contests are not infrequent. They follow the same general pattern as those described previously.

The status of the attacking bird when it is swimming differs from that when it is flying, for in the water the newcomer has the disadvantage of having to approach at a relatively slow speed. This allows the occupant ample time to prepare to defend its perch. Although the newcomer loses the opportunity of catching its opponent off guard and overawing it by a swift approach, as well as the chance of attacking from above, it gains in one respect, namely, increased flexibility in method and direction of approach. Double-crested Cormorants are not adept at maneuvering on the wing so if a newcomer approaches a roost in the air and is defeated, it drops into the water and then laboriously takes off, circles and flies in to try again. In contrast, a swimming cormorant can approach from any angle, and it need devote no energy to the complicated business of landing. If it is unsuccessful on its first attempt, it can immediately try again.

The technique of threatening is the same whether the cormorant is flying or swimming. The following is typical of the contests in which a newcomer in the water dispossesses the occupant: A single immature cormorant had been perching for twenty-five minutes on a broken piling whose top was about ten inches above the water when another bird began to swim toward it. When the newcomer was about six feet away, the occupant turned and faced it, partly spread its wings, tipped its body forward and downward, opened its bill, thrust its head and neck directly at its opponent and began to grunt. The swimming bird at the same time also stretched its neck in the direction of the roosting bird, opened its bill and grunted, all the while swimming steadily toward the piling. As the birds came closer together, both became more excited and gave louder and more frequent grunts. The newcomer was not to be daunted; it swam straight up to the occupant. Both began to make short thrusts at each other's heads, but just as its opponent began to climb out on the piling, the occupant lost heart, turned and hopped into the water. As soon as the newcomer had clambered up out of the water, it spread its wings to dry and began to preen.

The following incident is one of the most instructive contests that was seen because it includes successful defense, successful offense, and a rapid change from defensive to aggressive behavior: A cormorant was perched on a piling whose top was less than six inches above the water. Two other cormorants swam up and repeatedly tried to climb up on the piling, but each time the occupant drove them away. On their unsuccessful attempts the attackers had approached from the front, but after three or four unproductive assaults from this direction, one of the birds swam around to the opposite side of the piling, approached the occupant from the rear and managed to climb on

to the piling before the occupant could turn around. Although the newcomer threatened only once, the occupant was unprepared and retreated so rapidly that it fell backward into the water. As soon as it was in the water, the dispossessed cormorant, despite the almost panic-stricken nature of its departure a second before, swam back to the piling and without hesitation chased the other bird into the water.

The importance of the direction of approach is further emphasized by a contest in which four birds were concerned. Three immature cormorants, all facing west, were standing on one of the low pilings when a fourth immature bird swam in from the west and in spite of the efforts of the occupants climbed out on the piling, but no sooner was it on the piling than it was forced back into the water. Instead of giving up, the newcomer swam around behind the occupants and, presumably because the cormorants on the piling were crowded so close together that none of them could turn around to do battle, climbed out onto the piling without a contest. This is the only time four birds were seen perched on the same piling.

Blanchard (1936:145) suggests that, "Consciously or unconsciously, we stress the discontinuity of breeding and winter behavior. We emphasize changes and beginnings and look on song, territorialism and mutual attraction of opposite sexes as exclusive manifestations of the reproductive period—strictly limited phases which begin and end abruptly. Actually, perhaps, effective breeding behavior is less something new than a coordination of many elements already present, some permanently, some as far as we can perceive, for short preceding periods."

These statements apply with particular cogency to the Double-crested Cormorants which I studied, for there are several modes of behavior associated with the contests for the determination of the ownership of particular pilings which can hardly be interpreted as anything other than half-differentiated nuptial displays. It is improbable that these displays are intended as threats, for they never cause the departure of either contestant. The nature of the roosting site on these cement pilings seems to present the proper conditions for calling forth "nuptial displays," for such behavior was never seen at any other roost. This roosting site as previously mentioned is broken into a number of discrete areas, each readily defensible by a single bird and each comparable to the territory existing around a nest in a cormorant rookery.

This similarity under certain conditions apparently evokes fragmentary elements of nuptial behavior which would seem to indicate that in this species the pattern of sexual behavior, although latent during the non-breeding season, can appear even in immature birds in response to temporary environmental conditions independent of the physiological state of the bird. This condition in Double-crested Cormorants agrees with that found in laboratory rats. Lashley (1938:459) states that "There seems to be no item of behavior except parturition and the removal of the fetal membranes from the young which is wholly restricted to the mother rat . . . nests are sometimes built and young retrieved in a manner indistinguishable from that of the best mothers by virgin females and even by males."

The cormorants perform this display only infrequently, but sometimes when a contest has ended in a draw, the occupant displays to the newcomer and vice versa. Occasionally after a newcomer has chased one of a pair of cormorants from a piling, the occupant which remains may perform a "nuptial display," apparently directing its efforts toward the victorious newcomer. Displays are by no means forthcoming every time either of the circumstances mentioned above develop, but they seem to appear only when one or the other of these sets of conditions is met.

The nature of the displays can best be pictured by describing actual instances. The following, a typical performance, was seen at 9:04 a.m. on November 18, 1940.

An immature cormorant flew in from the west and prepared to alight on a piling on which another immature bird was already perched. As the newcomer approached, the occupant reacted in the usual manner, although somewhat half-heartedly. It made three short, weak, silent thrusts which had no visible effect on the new arrival who alighted as if the piling were vacant. As soon as the newcomer was perched, the occupant moved over and stood directly in front of it, so close that the breasts of the birds were touching. Both birds opened their bills, thrust their heads high in the air, gave several high-pitched grunts and intertwined their necks. After rubbing neck against neck for a few seconds, they moved apart and the occupant walked to the side of the piling opposite the newcomer and raised its head high in the air. As it directed its bill vertically, its gular pouch became distended and its whole neck swelled to half again its normal size. The cormorant flexed its legs and crouched down until its breast almost touched the ground but kept its neck stretched upward to its full extent and then hopped eight or ten inches into the air, at the same time uttering a single deep hoarse coughing grunt, much louder, deeper, and more resonant than the "quorks" used in threatening. After this "hop-display" had been repeated twice without evoking the slightest response from the newcomer, both birds began to preen.

On October 20, 1940, at 5:34 a.m., the following incident occurred: An immature cormorant flew in from the north and prepared to land on a piling on which another immature was already roosting. As the approaching bird was about to land, the bird on the piling gave one vigorous thrust with its head and neck and uttered the usual grunt, but the newcomer ignored this threat and alighted directly in front of the occupant. The two birds faced each other, breast to breast. The occupant spread its mandibles, grasped the bill of the newcomer and swung its opponent's head firmly, but gently, from side to side three times. Neither bird made any noise and the newcomer seemed to offer no resistance to having its head waved. The occupant, after releasing the bill of the newcomer, moved to the other side of the piling and, standing sideways to the newcomer, crouched down, stretched its neck upward and hopped into the air giving a hoarse coughing grunt and at the same time bending the upper part of its neck sharply downward from a point three or four inches below the head. The newcomer did not respond in any manner and both birds began to preen.

The following incident involving three birds occurred at 8:03 a.m. on November 28, 1940: An immature cormorant flew toward a piling on which two other birds were already standing. As the newcomer approached, one of the occupants became excited and scrambled about, thrusting its head in the direction of the newcomer, but the other occupant ignored the approaching bird. The newcomer, after alighting and thrusting once in the direction of the excited occupant, who immediately hopped into the water, began to preen without paying any attention to the bird which still remained on the piling. About forty-five seconds after the arrival of the intruder, the second occupant, who up until that time had remained aloof, walked over and made a partial thrust at the newcomer who responded in a similar manner. Then the two birds began to fence with their bills, but they did not appear to be trying to drive each other away. Their movements consisted of short quick forward thrusts of the head followed by swift recoveries interspersed with rapid movements of the head from side to side. The bills of the two birds rarely touched, but once or twice a sharp click was audible to me sixty feet away. The mandibles of one bird repeatedly passed between the open mandibles of the other. After about eight seconds the fencing stopped abruptly and the occupant performed the "hop-display" twice, but the other bird did not respond and both settled down and devoted themselves to preening.

When flying in to alight on a roost, a cormorant ignores the presence of gulls and all birds smaller than itself and lands just as if the site were vacant. It neither calls nor threatens, but as it back-paddles and extends its legs to alight, the gulls or ducks depart without a protest. A single immature Double-crested Cormorant was once observed to cause one Red-breasted Merganser (*Mergus serrator*), two Lesser Scaups (*Nyroca affinis*), one Ruddy Duck (*Erismatura jamaicensis*), and one Canvas-back Duck (*Nyroca valisineria*) to hop precipitantly into the water and swim rapidly away. Apparently there is no need for cormorants to threaten; their size, the speed of their approach, and the vigor of their back-paddling is enough to chase smaller birds away.

I have never seen a gull of any species, either mature or immature, offer resistance of any sort to the usurping of its perch by a cormorant, whether the latter approached by flying, swimming, or walking. Although gulls frequently chase each other off roosts, they never attempt to rob a cormorant of its perch. Possible reasons for this situation are, first, that cormorants are somewhat larger than gulls, and second, that gulls are buoyant fliers whereas cormorants are not and it requires less effort for a gull to fly away than for a cormorant to change its direction once it has begun to back-paddle preparatory to landing.

Only once have I seen a bird of another species chase a cormorant from a roosting site. During the winter of 1941, there was a single escaped Mute Swan in the Berkeley Aquatic Park. On one occasion, it swam rapidly in the direction of an immature Double-crested Cormorant which seemed frightened by the approach of the larger bird and hopped into the water and swam away when the swan was about four feet distant. The swan neither threatened nor attempted to chase the cormorant.

A cormorant was seen making an unprovoked threat at a bird of another species only once and this incident can probably be explained by the fact that both birds involved were on a log hardly more than eight inches across so that they had no way of keeping out of each other's way. A Killdeer (*Oxyechus vociferus*) had been perching quietly among seven cormorants on the log boom in the Berkeley Aquatic Park for six or eight minutes when for no apparent reason the nearest cormorant turned and walked in its direction. When the cormorant was about two feet away, it stopped, opened its bill, and thrust its head at the Killdeer which immediately flew away calling loudly. The cormorant then walked slowly along the log and perched about eighteen inches beyond the spot where the shore bird had been.

Double-crested Cormorants tend to remain aloof from the other species of birds associated with them on the daytime roosting sites. They almost always elect to alight on that part of the roost where there are other cormorants and to avoid that part of the roost where there are ducks or gulls, although when the amount of space available is small they do not hesitate to alight among birds of another species.

The only native species of bird on the Bay which was seen going out of its way to annoy cormorants was the Western Gull. On three different occasions these gulls were seen deliberately and for no apparent reason bothering the cormorants. In the first instance, an immature cormorant was standing facing northwest on a log in the Berkeley Aquatic Park, when an immature Western Gull flew in from the south and landed about two and a half feet in back of the cormorant. After eighteen or twenty seconds the gull cocked its head to one side, twisted its neck to the right, sidled up behind the cormorant, deliberately stretched its neck out, grasped the cormorant's outer tail feathers with its bill and gave a sharp tug. The cormorant, which up until it felt the tug had seemed unaware of the gull's presence, instantly whirled about, opened its bill and threatened its assailant by thrusting its head out to the full length

of its neck. The gull immediately backed up rapidly for about fifteen inches and the cormorant, after the single silent thrust, resumed its original position with its back turned to the gull. Twenty seconds after the first tug, the gull again sidled up behind the cormorant and again pulled one of its outer rectrices. Once again the cormorant turned around and threatened the gull who once more backed up about a foot. After an interval of thirty seconds the gull repeated the tug and once again evoked the same threat from the cormorant who this time did not shift its feet and turn around, but merely twisted its head to one side and thrust its open bill over one shoulder at its annoyer. The cormorant made no further attempt to drive the gull away, and after about forty seconds the gull departed of its own accord.

On the second occasion a gull chased a flying cormorant. Nine cormorants and three gulls were perching on the pilings west of the Berkeley Yacht Harbor. About two seconds after one of the cormorants had taken off and flown west, one of the gulls also left the pilings and soon caught up with it. The cormorant at first paid no attention to the gull which then was flying about five feet behind and two feet above it, but after traveling about two hundred yards, it turned sharply to the left and began to gain altitude to cross the Berkeley Pier. The gull followed along close behind and the cormorant became excited and swerved first to the right and then to the left. The gull followed these maneuvers effortlessly and the cormorant made no further attempt to dodge, but continued to fly steadily with the gull following until lost to sight.

The third instance is similar to the second. A gull resting on the water took off and chased a cormorant which passed overhead. After the gull had followed the cormorant for about eighty feet, flying approximately two feet behind and one foot above it, the cormorant swerved sharply three times but was unable to lose its pursuer. It then banked steeply and dropped almost vertically into the water, whereupon it turned and faced the gull, who after hovering about five feet overhead for eight or nine seconds flew away southward. As soon as the gull departed, the cormorant took off and continued its way northward. The cormorant apparently dropped into the water for the express purpose of escaping its annoyer.

It seems that in both of these chases, the gulls pursued the cormorants for no reason other than play, because robbery could not have been the motive.

The relationship between Western Gulls and Double-crested Cormorants depends on the circumstances under which the two species come in contact. On roosts where there is plenty of room, the two remain aloof and pay no attention to each other. When there is a shortage of perches, the cormorants chase the gulls away. When they are fishing, the cormorants ignore the gulls, and the gulls attempt to rob the cormorants only when the latter have caught a fish almost too large for them to handle. In the air, the gull is dominant and easily chases the cormorant who can do nothing but dodge ineffectually. On the ground or in the water the gull moves aside at the approach of a cormorant. Cormorants do not go out of their way to annoy gulls, but the opposite sometimes takes place.

SUMMARY

The analysis of contests by Double-crested Cormorants over roosts on a group of pilings lying west of the Berkeley Yacht Harbor, Berkeley, California, indicates that at least in large flocks of non-breeding birds of this species no absolute "peck-right" exists but instead a condition approximating the more flexible "peck-dominance." The winner of a specific contest is usually determined on the spot and seems to depend primarily on such external factors as wind direction and velocity, posture of the roost-

ing bird, direction and approach of the attacking bird and the crowding of the birds already present on the roost.

So dependent is the outcome of a contest on external conditions that on occasion the occupant of a roosting site may, because of a poor strategic position, be dispossessed and then with the condition reversed, immediately shift from defense to offense and regain its perch from the bird which had just vanquished it.

The contests are purely psychological and consist entirely of threats, postures, and calls which occasionally merge into incomplete nuptial displays despite the fact that immature birds are involved and that the action takes place in the non-breeding period (November).

With the exception of the Western Gull, the cormorants in the area of observation had no friction with the other species with which they associated. On three occasions gulls of this species were seen deliberately annoying Double-crested Cormorants but the converse was never true. In the air the cormorants assumed the defensive, but on the ground or water, the gulls yielded to the cormorants without resistance.

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