



How does a parent respond when its mate emphasizes the wrong role? A test using a monogamous fish

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The convict cichlid fish, *Archocentrus nigrofasciatus*, is biparental: the male spends the majority of his time defending the territory and the female spends much of her time close to the offspring. Under natural conditions, this separation into sex-typical roles is somewhat blurred as males do spend some time with the offspring and females do attack intruders. Here we tested whether an individual selects a parental role based on the location (i.e. parental role) of its mate. For example, do females emphasize offspring care because the male is away from the offspring? Will males be more likely to care for the offspring when the female is away from the offspring? We manipulated the location of one parent by placing it in a transparent plastic box, either near the offspring or at the far end of the tank near a clear plastic compartment that held a conspecific male intruder. We tested both male and female parent under the following four conditions: boxed mate near offspring with no intruder present, boxed mate near offspring with intruder present, boxed mate near intruder compartment with no intruder present, and boxed mate near intruder compartment with intruder present. We found that both parents spent more time with the offspring and less time attacking the intruder when the mate was positioned near the offspring and more time away from the offspring and more time attacking the intruder when the mate was near the intruder. Males were more affected by the location of their mates than were females and we concluded that males were attracted both to their mates' location and their offspring while females were mostly attracted to their offspring. Overall, the location of the mate had little effect on the types of aggressive activities used against the intruder. We did find that males increased their aggression towards boxed females when they were positioned far from the offspring, whereas the aggressive behaviour of females towards boxed males when they were positioned near the offspring was ambiguous. We suggest that males in particular enforce the separation of sex-specific parental roles via this aggression.

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Although most studies that examine biparental care consider the importance of both parents in the rearing of the offspring (reviewed in Clutton-Brock 1991), little research has attempted to examine how the male and female of the pair organize their respective parental activities (see Gowaty 1996). For example, when both parents are present, they may both perform the same activities, such as feeding the offspring and defending the offspring (e.g. Clutton-Brock 1991). However, even when parents perform the same activities, they may perform them at different times. In one of the few studies that carefully monitored both parents, Wynne-Edwards (1995) found, under field conditions, that both sexes of Djungarian hamsters, *Phodopus sungorus*, brought food to the nest, although usually only one parent foraged at a time (for other rodent species see also Gubernick et al.

1993; Solomon 1993; Wang & Novak 1994). Thus, presence of one mate at the nest appeared to free the other mate to leave the nest to forage. Similarly, Keenleyside et al. (1990), using the biparental convict cichlid fish, *Archocentrus nigrofasciatus*, suggested that role switching allows the female the opportunity leave the offspring and forage.

Here we examine how the role performed by one parent influences the role selection and the behaviour of the other parent in the convict cichlid fish. Biparental cichlid fish are well known for their division of labour where males emphasize territorial defence and females emphasize more direct care to the offspring (Smith-Grayton & Keenleyside 1978; Itzkowitz 1984; Wisenden 1994). Itzkowitz et al. (2001), using convict cichlids, observed that widowed males and females with offspring behaved alike, and sex-typical differences emerged with either the presence of the mate and/or the presence of a conspecific intruder. However, even when the mate and intruder

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were present, male and female convict cichlid parents often performed all parental roles, albeit at different frequencies. Thus, the female sometimes joined the male in attacking an intruder and the male sometimes joined the female with the offspring. The coordination of parental roles is further complicated because these parents do sometimes swap parental activities; that is, for short periods, the male may care for the offspring while the female attacks intruders. Thus, although these species do have sex-typical parental roles, they also have considerable flexibility in the roles that they are able to perform, making it unclear how the two parents coordinate their activities.

Itzkowitz et al. (2001, 2002) found evidence that intact pairs of convict cichlid parents coordinate their roles depending on the presence or absence of an intruder fish. That is, in the absence of an intruder, it was unusual for the male and female parents to be away from the offspring at the same time; if the male was away, the female tended to remain with the offspring, and if the female was away, the male tended to remain with the offspring. Thus, cichlid parents seemed to behave in a similar way to Djungarian hamsters in that only one parent at a time tends to leave the nest. However, the presence of an intruder reversed this pattern of role coordination, such that a parent often joined its mate at the offspring or near the intruder. However, it was unclear from this study of free-swimming pairs whether both parents were responding to situational factors or whether one or both parents were responding to the actions or locations of their mate. In the present study we independently manipulated the location of one of the parents and observed the location and behavioural activities of the other parent.

In the present study we independently manipulated the location of one of the parents and observed the location and behavioural activities of the other parent. We manipulated the location of one of the parents by confining it in a clear plastic box and positioning the box near the offspring or near the intruder area at the opposite end of the tank. We predicted that, in the absence of an intruder, the free-swimming parent would tend to remain with the offspring when its mate was artificially positioned away from the offspring and would tend to leave the offspring when its mate was positioned near the offspring. We predicted the opposite effect of the location of the artificially positioned mate when an intruder was present. That is, in the presence of an intruder, when the mate was positioned near the intruder, the free-swimming parent would be most likely to leave the offspring, but when the mate was positioned near the offspring, the free-swimming parent would be least likely to leave the offspring.

We also examined the aggressive behaviour used by the free-swimming parent against the intruder. When both parents are free swimming, there is no difference in the rates at which either parent performs aggressive activities (Itzkowitz et al. 2001). Given that the presence of the mate provides an advantage to either parent in defending against intruders (Itzkowitz et al. 1998), we hypothesized that placing the boxed mate near the intruder would make the free-swimming parent less intimidated by the

intruder. Thus, the free-swimming parent should be more likely to escalate to biting at the intruder and less likely to threaten (i.e. frontal and lateral displays). It is also possible that both parents being near the intruder would cause the free-swimming parent to escalate quickly to biting in order to defeat the intruder and then return to the offspring. Conversely, when the boxed mate was positioned near the offspring, we hypothesized that the free-swimming parent would be less likely to bite and more likely to threaten the intruder.

Our preliminary observations revealed that parents not only attack intruders, but also sometimes gently bite or butt their mates. If this aggression is designed to simply separate the two parents, we predicted that the amount of aggression by one or both sexes would be closely related to the amount of time that they spent in the same area. In effect, the aggression may lead to a separation of the parents but would not influence their separation into sex-specific roles. Alternatively, this aggression may function to cause both mates to return to their sex-typical locations and roles. In this case we predicted that the male would increase his aggression towards the female when she was away from the offspring and that the female would increase her aggression towards the male when he was near the offspring.

METHODS

Subjects

Convict cichlids occur naturally in Central America, and field studies have been done mainly in Costa Rica (Wisenden 1995). Our field observations indicate that pairs form first and then establish territories that they defend against all other species of fish. They are serially monogamous. They display the typical substrate-brooding behaviour described for many other species of cichlids in which parents lay eggs within a small cave with the walls scraped clean. After approximately 3 days, the eggs hatch into nonmotile individuals called wrigglers. The parents transfer the wrigglers to pre-dug pits (in our experiments, the parents keep the wrigglers inside a flower pot). At the end of the 6-day wriggler stage, the offspring absorb their yolk sacs and become free-swimming fry. The fry remain with the parents a variable period of days and then disperse.

The subjects used in this experiment were obtained either from several commercial suppliers or were bred from our own stock. Our breeding stock was a combination of adults from both commercial suppliers and from wild-caught individuals (from Costa Rica). Unisex groups of adults were housed in 473-litre stock tanks.

The Experimental Tank

We tested pairs in a 284-litre glass aquarium (Fig. 1). The experimental tank had a clear plastic partition that extended across the width of the tank at one end, forming the intruder compartment, and a flower-pot at the opposite end, where pairs typically deposited their eggs (offspring area). During testing, we temporarily confined one

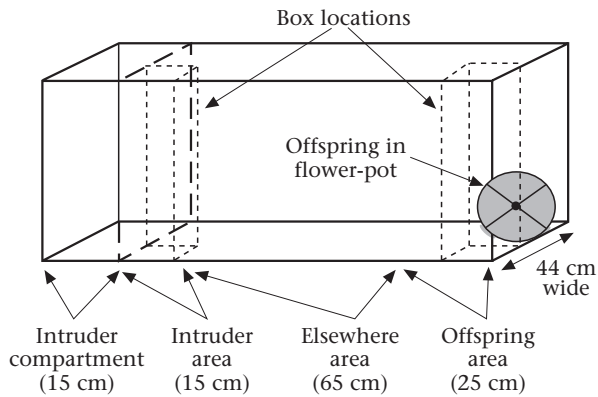


Figure 1. Sketch of the experimental tank. The plastic box housing one parent was placed either near the offspring or near the intruder.

mate inside a transparent plastic box (15 × 15 cm, L × W) at one of two locations: (1) near the offspring; (2) near the intruder (Fig. 1). Although the plastic box used to house a parent was completely transparent (e.g. transmitted UV light), we drilled numerous 1.0-cm holes in the box to minimize distortion of visual, auditory and chemical communication signals between the two parents.

Experimental Design Using a Boxed Mate

We placed three males and three females were placed in an experimental tank and allowed one pair to form. We immediately removed the nonpaired fish and added a juvenile to the intruder compartment, because the presence of an intruder increases the likelihood that a pair will produce eggs (Itzkowitz & Draud 1992). We used juveniles as intruders instead of adults because adult intruders may present an alternative mate to one of the members of the pair and disrupt the pair bond (see Triefenbach & Itzkowitz 1998). Once eggs are deposited, mate switching does not occur. After several days, eggs were typically laid on the upper inside surface of the flower-pot. At this time, we removed the juvenile intruder. Irrespective of where the eggs were initially laid, the parents always placed the newly hatched wrigglers into the flower-pot, where they remained for the 6 days. On the second day of the wriggler stage, we began the manipulations. A manipulation began with the netting of a parent and placing it in the box. The boxed mate was placed either near the intruder or near the offspring. After placing the parent in the box, the entire tank was videotaped for 25 min. At the end of videotaping, we added a male intruder to the intruder compartment and again videotaped the tank for 25 min. Although preliminary studies revealed that both parents respond aggressively to male and female intruders, in the present experiment we used only male intruders as in Itzkowitz et al (2001).

At the end of the second videotaping, we released the boxed parent into the tank. The boxed parent always resumed its normal parental activities. At the end of 4 consecutive days (with one replicate performed each day), each parent had been placed in the box two times (once within the intruder area and once within the

offspring area) and each time it was first videotaped without and then with the intruder. We randomized the four presentations for each pair.

Validity of Experimental Design

The artificial manipulation of mate location has the potential for disrupting natural reactions in the free-swimming mate. Nevertheless, we anticipated the possibility that confining a mate to a section of the aquarium in this way may produce aberrant behaviour in the free-swimming parent. For example, a free-swimming parent may not recognize its confined mate and treat it as an unfamiliar intruder. To account for this possibility, we conducted a preliminary series of tests that replaced the confined mate with a confined individual that was not the mate (i.e. an unfamiliar individual temporarily replaced one of the mates in the box). This preliminary experiment ($N=10$) produced dramatically different results in that the single parent treated these unfamiliar individuals as potentially dangerous intruders (M. Itzkowitz & N. Santangelo, unpublished data). Another possibility was that the free-swimming individual would recognize its confined mate but show behaviour that was inconsistent with that observed under natural conditions (e.g. the female might abandon her offspring or never attack the intruder). Thus, to evaluate further the validity of our experimental design, we review quantitative data previously obtained on free-swimming single and paired parents using the same basic tank design as that used in the present experiment (Itzkowitz et al. 2001; see Discussion).

Behavioural Activities

The behavioural activities were transcribed using the BEAST event-recording program (1998, v.1.01A, University of Hawaii, Windward Technologies). The activities included: the total amount of time that a parent remained within 25 cm of the offspring (offspring area), the total amount of time that a parent remained within the intruder area (within 15 cm of the intruder partition), the amount of time that the parent remained in the 'elsewhere area' (65 cm between the offspring and intruder areas), the total number of frontal and lateral displays, the total number of bites directed against the intruder partition, and the total number of bites directed against the walls of the boxed parent. Frontal and lateral displays are considered threats in which an individual either faces (frontal) or presents its lateral sides to the opponent, spreads its unpaired fins, and lowers its branchiostegals.

Both male and female convict cichlids do interact directly with the offspring (e.g. fanning, moving them). We were unable to accurately observe and quantify these activities, and thus, relied on the location of the parent as an indicator of a parent's role. Itzkowitz et al. (2001, 2002) observed that the coordination of parental roles are largely based on the location of the parents, because in convict cichlids, location seems to be a good indicator of the kind of role a parent performs.

RESULTS

Each parental pair ($N=15$) was presented with eight conditions (e.g. four conditions in which the female was placed in the box and the male was free-swimming, and four conditions in which the male was placed in the box and the female was free-swimming). Each parental behaviour was subjected to a repeated measures factorial analysis of variance (ANOVA) using the program Statistica (Statsoft 1998).

Time within the Offspring and Intruder Areas

The ANOVAs for times were analysed as two (sex) by two (location of the boxed parent) by two (intruder absent or present) factorials. Given the constant session time of 25 min per day, times spent in the offspring area and in the intruder area were closely and negatively correlated (cell means in Fig. 2). All main effects and both two-way interactions involving sex of parent were significant for both measures. Females spent substantially more time with the offspring than did males (92.4% of session time for females versus 57.2% for males; ANOVA: $F_{1,14}=73.51$, $P<0.05$) and substantially less time in the intruder area (4.5% for females versus 30.7% for males; $F_{1,14}=89.28$, $P<0.05$). (Note that the percentage of time spent in the offspring and in the intruder area do not equal 100% because some of the session time was spent in the middle of the tank in the 'elsewhere' location.) The main effect for location of the boxed parent indicated that the boxed mate attracted its mate to that location (time in offspring area: $F_{1,14}=34.29$, $P<0.05$; time in intruder area: $F_{1,14}=18.79$, $P<0.05$). The main effect for the presence of the intruder indicated that when the intruder was present, the free-swimming parent spent less time with the offspring ($F_{1,14}=107.22$, $P<0.05$) and more time in the intruder area ($F_{1,14}=81.75$, $P<0.05$).

However, the strong sex*location-of-boxed-mate interaction ($F_{1,14}=13.41$, $P<0.05$) indicated that the location of the boxed mate affected the time that males spent with the offspring (66.5% when the boxed female was near the offspring versus 48.0% when the boxed female was near the intruder) far more than it did females, who were essentially unaffected (92.8% when the boxed male was near the offspring versus 92.0% when the boxed male was near the intruder). Similarly, the sex*location-of-boxed-mate interaction for intruder area time ($F_{1,14}=10.22$, $P<0.05$) showed that males spent more time in the intruder area when the boxed female was also there (38.7%) than when the boxed female was near the offspring (22.7%), whereas females were seldom in the intruder area when the boxed male was also there (3.9%) or when the boxed male was near the offspring (5.1%). The sex*presence-of-intruder interaction indicated that the absence or presence of a conspecific intruder fish also affected where males placed themselves in the tank far more than it did females (time in the offspring area: $F_{1,14}=52.36$, $P<0.05$; time in the intruder area: $F_{1,14}=79.98$, $P<0.05$). Males spent more time with the offspring when there was no intruder present than when an intruder was present (80.8% versus 33.7%). Females

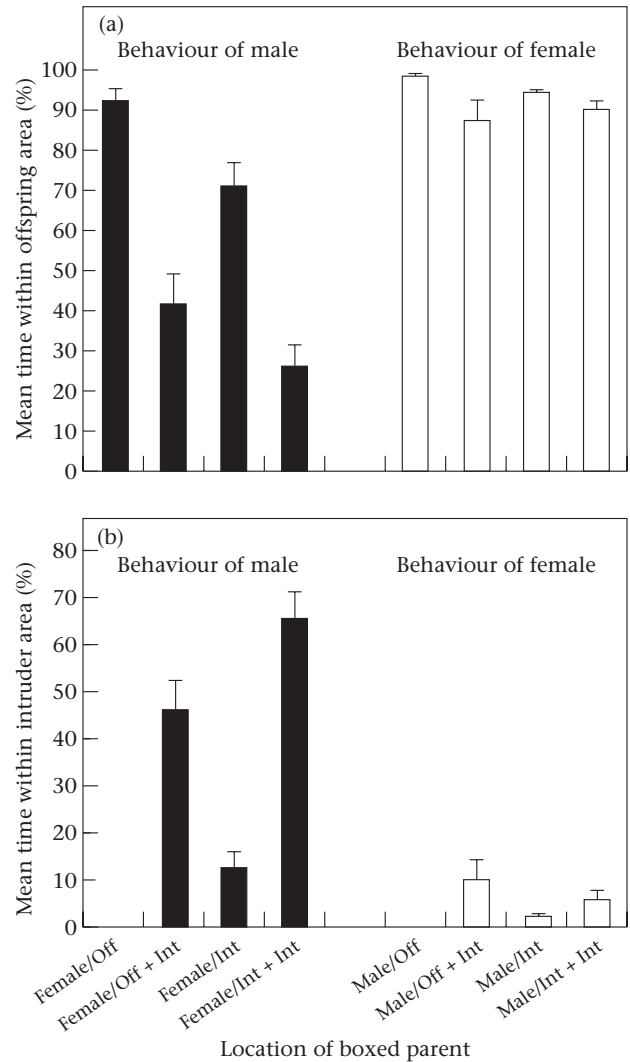


Figure 2. Mean \pm SE percentage of time that the free-swimming parent remained in (a) the offspring area and (b) the intruder area. ■: free-swimming male; □: free-swimming female. Fem/Off: boxed female positioned near the offspring with no intruder; Fem/Off+Int: boxed female positioned near the offspring with intruder; Fem/Int: boxed female positioned near the intruder compartment with no intruder; Fem/Int+Int: boxed female positioned near the intruder compartment with intruder; Male/Off: boxed male positioned near offspring and with no intruder; Male/Off+Int: boxed male positioned near offspring with intruder; Male/Int: boxed male positioned near intruder with no intruder; Male/Int+Int: boxed male positioned near intruder with intruder.

showed a similar but less dramatic tendency (96.4% versus 88.4%). Conversely, males spent more time in the intruder area when an intruder was present than when an intruder was not present (55.4% versus 6.1%). Females showed a similar tendency but the effect was smaller (7.9% versus 1.1%). There was no significant sex*presence-of-intruder or significant triple interaction for either time measure.

Aggression Towards Intruder

Measures of aggression (bites, threats; cell means in Fig. 3) towards the intruder fish were analysed as two

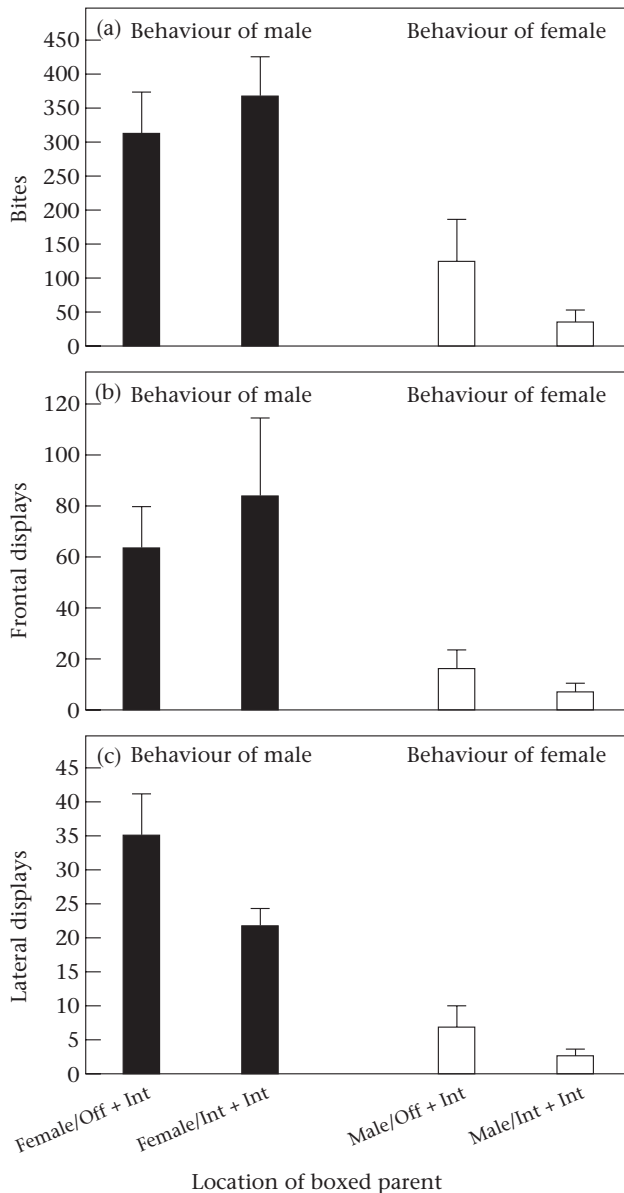


Figure 3. The mean \pm SE total number of (a) bites, (b) frontal displays and (c) lateral displays directed at the intruder. ■: free-swimming male; □: free-swimming female. Abbreviations as in Fig. 2.

(sex) by two (location of boxed mate) factorials because all measures required the intruder fish to be present. All three measures of aggression showed a significant sex effect. Compared with females, males directed more bites (338.3 versus 75.3; $F_{1,14}=35.13$, $P<0.05$), more frontal displays (73.2 versus 11.0; $F_{1,14}=11.04$, $P<0.05$) and more lateral displays (28.3 versus 4.7; $F_{1,14}=29.91$, $P<0.05$). More lateral displays were directed towards the intruder when the boxed mate was near the offspring than when the boxed mate was near the intruder (20.9 versus 12.1 displays, respectively; $F_{1,14}=10.30$, $P<0.05$). Boxed mate location did not affect either the number of bites or the number of lateral displays directed towards the intruder, and the sex*boxed-mate-location interaction was not

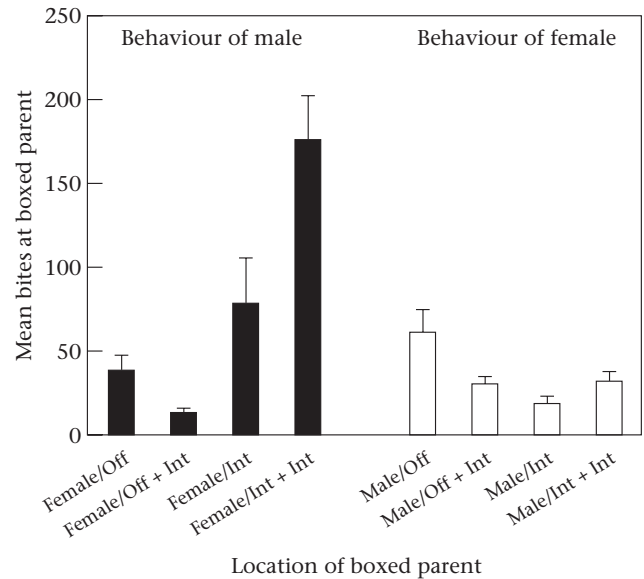


Figure 4. Mean \pm SE number of bites directed at the boxed parent. ■: free-swimming male; □: free-swimming female. Abbreviations as in Fig. 2.

significant for any measure of aggression towards the intruder.

Bites Towards Boxed Mates

We also measured aggression directed towards the mate using a two (sex) by two (location of boxed mate) by two (presence of intruder) factorial ANOVA. Both parents showed some aggression towards their mates, but males directed more bites towards their boxed mate than did females (75.0 versus 34.3, respectively; $F_{1,14}=9.18$, $P<0.05$). More bites were directed towards the boxed mate when the boxed mate was in the intruder area than when the boxed mate was in the offspring area (74.5 versus 34.8, respectively; $F_{1,14}=11.12$, $P<0.05$). However, these main effects must be qualified by the significant sex*box-location interaction ($F_{1,14}=28.46$, $P<0.05$) and the significant box-location*presence-of-intruder interaction ($F_{1,14}=21.78$, $P<0.05$). Males directed bites towards the boxed female far more when the box was in the intruder area (125.0 versus 25.1), whereas females directed bites towards the boxed male more when the box was in the offspring area (44.6 versus 24.0). Also, when the intruder was absent, bites towards the boxed mate did not differ as a function of box location (49.0 for box near the offspring, 47.0 for box near the intruder). However, when the intruder was present, there were many more bites towards the boxed mate when the box was in the intruder area than when it was near the offspring (102.0 versus 20.7). The main effect of intruder and the double interaction between sex and presence or absence of the intruder were not significant. The significant triple interaction ($F_{1,14}=4.80$, $P<0.05$; Fig. 4) suggests that all significant effects were caused in part by the very high number of bites by the male towards the female when the female was placed in the intruder area in the presence of the intruder.

DISCUSSION

Division of Parental Roles

Convict cichlid fish have two general sex-typical parental roles; the male defends the territory against intruders and the female cares for the offspring. Our previous study (Itzkowitz *et al.* 2001) showed that these sex-typical roles are most manifest in the presence of an intruder or the mate. Here, we controlled the location of one parent by confining it in a small plastic box and tested whether the selection of parental roles by the single free-swimming parent was based on the presence or absence of an intruder and/or the location of the other boxed parent.

The experimental design did preserve the basic pattern seen in free-swimming pairs. That is, males spent more time near the intruder and less time near the offspring than did females. It was clear that both the male and the female did 'recognize' their boxed mate. For example, unlike their response to a nonmate placed within the box, the aggression directed at a boxed mate was much less intense and more closely resembled that seen between members of free-swimming pairs (Itzkowitz *et al.* 2001).

However, some differences did appear. Itzkowitz *et al.* (2001) found that in free-swimming pairs with no intruder present, females spent significantly more time with the offspring than did males and rarely did both parents leave the offspring at the same time. For this reason we predicted that the location of the boxed parent would cause the free-swimming parent to increase its time in the other location. However, our boxed parent experiment revealed that in the absence of an intruder, when the boxed parent was placed near the offspring, both sexes rarely left the offspring (males averaged 91.5% and females averaged over 98.5% of their time near the offspring). When the boxed parent was placed within the intruder area (intruder still not present), females did significantly, albeit slightly, reduce their time with the offspring (i.e. females spent 94% with their offspring), whereas males showed a considerable reduction in their time with the offspring (males spent 70% of their time with their offspring). This increase in the time that the offspring were left unattended may be related to our forcing the boxed parent to spend the entire 25-min session either constrained to the offspring area or constrained to the intruder area. When one parent spends a prolonged period at a particular location, this may function as a distress signal to the other parent that attracts the other parent to that location (e.g. to defeat an intruder). In the present study, because of the free-swimming male's attraction to the location of the boxed female, the offspring were often left unattended when the female was placed in the intruder area in the absence of an intruder, but the offspring were rarely left unattended when the boxed female was placed in the offspring area.

The male's much greater attraction to the female's location than the female's attraction to the male's location corresponds with our observations of free-swimming pairs in nature, where males repeatedly

approach the female when she is with the offspring (M. Itzkowitz & N. Santangelo, personal observations). Unless an intruder is nearby, the female will sometimes switch roles with the male and move freely around the territory. When role exchange does occur, the male always moves away from the offspring when the female returns, suggesting that females always have access to their offspring, whereas the male's access is constrained by the female. This difference in the access to the offspring rarely has been addressed in other biparental animals, but studies on humans frequently report that women often limit their husband's access to the children and in this sense women serve as 'gate keepers' to the offspring (Cowan & Cowan 1988).

With the addition of the intruder, we predicted that both the male and female would spend more time near the intruder, leaving the offspring unattended for longer periods. This prediction was supported. Moreover, because males continued to be attracted to the location of the female, placing the boxed female near the intruder further increased the time that the offspring were left unattended. But another consequence of the male's attraction to the location of the female was that placing the boxed female near the offspring also increased the time the potentially dangerous intruder was left unguarded by the free-swimming male. Again, unlike males, females were relatively unaffected by the location of their mate.

Aggressive Behaviour Towards Intruders

For the most part, the aggressive behaviours displayed by a free-swimming parent when its mate was confined to one location are similar to the behaviours displayed by free-swimming pairs (see Itzkowitz *et al.* 2001). That is, males performed more aggressive behaviour activities than did females. However, with the exception of the lateral display, the location of the boxed parent had no significant effect on the aggressive behaviour of the free-swimming mate. This coincides with our previous study (Itzkowitz *et al.* 2001) showing that a parent's biting, frontal displays and lateral displays towards an intruder are not related to the presence or absence of the other parent. Thus, our results do not support the hypothesis that the location of a confined mate influences the free-swimming parent's aggressive activities.

Aggression Towards the Mate

Unlike spousal aggression in humans, we know of no study that has investigated parent-parent aggression in animals. This is surprising because studies often assume that parents are in competition to reduce their parental investment burden, implying that parents are in conflict (e.g. Trivers 1972). Animals may, however, resolve this type of conflict without overt aggression. We tested whether the parent-parent aggression in convict cichlid parents might serve to influence the separation of the parents, irrespective of parental sex or location. In this case, we predicted that both sexes would show similar levels of mild biting whenever and wherever they were

together. Alternatively, if this behaviour is rooted in a conflict over an individual preference for a particular role, we predicted that the male would be more aggressive towards the female when she was in the intruder area and that the female would be more aggressive towards the male when he was near the offspring.

We found some support for both predictions. In support of the conflict over sex roles hypothesis, the male directed more bites towards the female when she was in the intruder area ('his' location). Similarly, the female directed more bites towards the male when he was near the offspring ('her' location), although this was true only in the absence of an intruder. In effect, this mate-mate aggression could contribute to the separation into sex-preferred roles. For males, in particular, these results are consistent with our observations of free-swimming pairs, where males often bite at a female that approaches an intruder, then subsequently drive or lead the female back to the offspring and return to the intruder area.

However, taking time into account makes this interpretation ambiguous, at least for the female. In the absence of an intruder, the female was with the boxed male near the offspring (providing the opportunity for aggression against him) for almost the entire 25-min session (98.5%), whereas she was with the boxed male in the intruder area for only a small fraction of the time (2.1% or less than 1 min). In fact, both females and males directed more bites toward their boxed mates per unit time they were together when they were in the intruder area than when they were near the offspring, both in the absence and in the presence of an intruder. This higher frequency of biting at the mate in the intruder area suggests that mated pairs show a greater motivation to separate themselves when they are away from the offspring than when they are near the offspring. Alternatively, the pairs' general level of aggression may be inhibited near the offspring and disinhibited away from the offspring. However, because females showed relatively little aggression, their behaviour probably has little effect on the behaviour of free-swimming males.

In conclusion, we provide the first experimental evidence to suggest that the 'glue' holding a monogamous pair together differs for each sex. That is, our evidence suggests that the male is attracted to both the female and the offspring, whereas the female is attracted only to her offspring. This may explain why other investigators have observed that, under natural conditions, widowed females spend more time guarding their offspring than do widowed males (e.g. Wisenden 1995). Widowed males may be more prone to leave their offspring, perhaps in search of a lost mate, and expose their unprotected offspring to predators. Results of previous studies also suggest that the female limits the male's access to the offspring, causing him to perform other roles. In the present study, although both sexes appeared to contribute to this role separation via mild aggression towards each other in all locations, the male showed a dramatic heightening of his aggression when the female was positioned near the intruder. In free-swimming pairs, the males appears to force females back to the offspring.

Acknowledgments

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