

## **Mother – offspring vocal communication: A Review**

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### **Abstract**

Parental care is one of the most important behaviour found in animals which ensures the safety of the new born offspring and also increases the chances of survival. Contact calls between mother and offspring are of various types and depend on the conditions they are in. Mother always takes care of its child even when the animals live in a huge group. A mother animal can never forget the vocalization of its offspring and can distinguish the acoustic signals of its own offspring from others. The young ones can also recognize the acoustic signals produced by their mother. Significant researches in the field of mother-offspring sound communication of different animal species published between 2000- 2023 have been cited in this paper. Studies related to the mother-offspring communication may help in understanding the maternal behaviour of different animals and how bioacoustics aid animals to take care of their young ones.

**Key words :** Acoustic signals, behaviour, communication, mother-offspring, vocalization.

Acoustic signals are produced by every organism from small insects to largest mammals and these acoustic signals play important role in everyone's life. We can recognize the vocalization of our parents, relatives, friends and other persons that we know because all individuals have different voices. The difference in the vocalization of a person or any other animal is due to the variation in their vocal apparatus<sup>39</sup> Some studies proved that the changes in the structural calls are also linked to the growth and development of the animal and it also depends

on the age and sex of the animal<sup>[6,14]</sup>. All the animals communicate with each other by means of different signals and these signals can be visual, chemical or acoustic signals. Acoustic signals produced by organisms are extremely important and convey different information in different situations. Animals produce alarming calls when they find any predator near their group to inform them, mating calls to attract opposite sex, or threatening calls to scare other animals and also normal contact calls to communicate with their group members. All animals recognize the acoustic

signals produced by their conspecifics and these acoustic signals are unique in every organism. Vocalization or acoustic signals provide sign to an individual identity and due to vocalization, we can differentiate every individual. Even in animals, we can differentiate individual identity by analyzing their acoustic features. All the animals recognize the acoustic signals produced by their own species<sup>7</sup> and these acoustic signals have different acoustic features in different conditions. Animals can produce acoustic signals from birth and these acoustic signals contain various information related to the conditions in which they are living. The changes in acoustic signals are also related to the behaviour and the environment where the animals live.

In many animals, acoustic signals play an important role in forming a bond between mother and its offspring and consequently, it also helps new born animals for their better survival<sup>37</sup>. This article features the significance of mother-offspring communication, vocalization after separation and how it affects their survival success. Playback experiments have been taken into consideration for indicating mother-offspring vocal connection.

*Mother-offspring vocal communication :*

Vocal communication in mammals is significant at longer distances as opposed to olfactory communication, which is effective at short range. Many animals live in groups or colonies and when the young offspring is born it spends a lot of time with the mother because it needs more care and protection as compared to the other members of the group. Many studies reported that mothers are very sensitive to the infant distress calls<sup>29,42</sup> and infants are

also mostly dependent on their mothers and they need their assistance to regulate their emotions and behaviour. An acoustic feature like fundamental frequency is unique in every individual that makes it possible to distinguish the voice of different members of the same species. The acoustic signals produced by the young ones are also related with caring and nursing behaviour<sup>46</sup>. In large group of animals with many group members, mother can recognize and differentiate the vocalization of its own offspring. In animals, mothers can distinguish the acoustic signals of their offspring and it is also confirms that the acoustic parameters of offspring vocalization are different in every individual of the same animal group<sup>47</sup>. Parental care is behavioural strategy present in many animals which increases the survival chances of the young ones and provide safer environment. But parental care is not only present before the young ones are born but also present after the birth of young ones. Acoustic signals also aid in parental care through communication between parent and the offspring. The mother-offspring communication is important to avoid the confusion and for better survival of the animals. In many bird species when young ones are born they need more care and nourishment to develop well. Some evidences also strongly indicate that bioacoustic communication between both parents and young ones plays important role in cooperation and negotiation in their family which decreases the conflicts between the members<sup>32</sup>.

Both the parents take care of their young ones and in some freshwater species of turtles the acoustic communication or signals between parents and new born are used to assemble or gather hatchlings so that they

cannot get separated from the mother<sup>15</sup>. Many animals migrate from one place to another in large group and contact calls facilitate to gather all the group members in one place so they cannot get separated from main group<sup>38</sup>.

Solo singing of parents of singing lemur, indri (*Indri indri*), appears to trigger vocalization in offsprings, and mothers and fathers clarify song elaboration in part, when singing together with offspring<sup>11</sup>. Thus, co-singing with offsprings would influence the rhythm and song elaboration in adult indris. Mother Gibbons have a stereotyped singing pattern while co-singing with daughters than singing alone<sup>26</sup>.

The structure of adult female and fawn calls in fallow deer, an ungulate hider species, was analyzed to test the mother-offspring recognition and the distinctive individuality of their vocalization<sup>52</sup>. Fawn contact calls became longer and deeper as they grow and their vocal folds strengthen. Fawns were found to distinguish the calls of their mothers but the mothers were unable to distinguish their own and alien fawn calls. The changing call structure is related to individuality which makes the recognition difficult.

Early establishment of mother-offspring vocal recognition is essential for the survival of a young. Many researchers reported the fastest establishment of mother–young vocal recognition for any mammalian species, including humans, in Cape fur seal females and their pups voice 2–4 h after parturition and that pups develop this aptitude 4–6 h after birth<sup>34,36</sup>. Such early vocal identification in pups suggests vocal imprinting. These findings

highlight the synergistic role of environmental constraints and biological traits in optimizing the timing of individual vocal recognition. The development of maternal recognition of infant calls in rhesus macaques (*Macaca mulatta*) was studied by<sup>23</sup>. Mothers of infants older than 1 week of age responded longer to the playback of their own infant's distress calls than did mothers of younger infants implying that offspring recognition in macaques develops between the first and second week of the infant's life. These findings support the view that mothers need to be exposed to their infants' calls in order to learn their acoustic characteristics.

Vocalizations in non-human animals including cattle may also signal the physiological and emotional state of the calling animal<sup>4,56</sup>. Individuality in mother-offspring contact calls in cattle, in addition to full mother-offspring bidirectional recognition, might suggest that specific acoustic parameters produced in different contexts are indeed likely to convey expressions of emotion in mother-offspring contact calls<sup>39</sup>.

*Playback experiments on mother-calf communication :*

Playback experiments also demonstrate that animals always recognize the acoustic signals produced by their mother and can discriminate the acoustic signals of other members. All the animals react strongly towards the distress calls of the conspecifics as compared to the control noises<sup>1,27</sup> which corroborate that the animals can differentiate different types of calls produced by their conspecifics. Playback experiments conducted

by many researchers prove that mother never forgets the acoustic signals produced by their offspring. As animals become mature the acoustic signals produced by them become different as compared to the acoustic signals produced when they are new born. Results of many researches reveal that mothers pay more attention towards the lower part of the signal spectrum, the fundamental frequency accompanied by its first two harmonics to recognize their offspring<sup>10</sup>. Mothers never forget the acoustic signals produced by their offspring when they were new born and even when they become months old mothers can still respond towards the acoustic signals of their offspring recorded when they were new born<sup>5</sup>. Mothers always recognize the calls produced by their offspring and even if their offspring were near them, they react to the distress calls played by the researcher. In some bat species, when playback experiments were done they found that the female bats are able to discriminate the isolation calls of their own pups<sup>3,24</sup>. Mothers shows behavioural response against recorded distress calls or other acoustic signals of their own child and do not respond to the recorded distress calls of other child<sup>9</sup> which proves that that they can recognize and respond towards the acoustic signals produced by their child even if there are many young ones in the group. Some playback experiments also proved that in some animals when the new born started producing alarming calls the mother signals them to reduce the false alarming calls<sup>16</sup>. New born animals also spend their time with their mothers and they can also distinguish the acoustic signals of their own mother and other mothers<sup>18,21,31,50</sup>. Some studies also revealed that mother response more towards the acoustic signals of younger offspring as

compared to the older offspring because younger offspring needs more care for better survival<sup>8</sup>.

*Ecological and environmental restraints in mother-offspring vocal recognition :*

Vocalization is also one of the necessary behaviour which is greatly affected by the size and type of the habitat where the animals live. Many animals which live in large groups and explore large area for food and shelter require a habitat in which their vocalization can be heard clearly so that they can find their group members easily through acoustic signals. Different types of habitat controls the acoustic signals produced by the animals because different habitats have different background noises, wind, absorption and other factors which affects the acoustic signals<sup>30</sup>. Same animal species living in different nesting patterns have differences in their acoustic signals which is due to the difference in the obstruction present in different environment<sup>35</sup>. The environmental conditions where large numbers of animals were kept for rearing greatly affect the behaviour of the animals which also affects the acoustic signals. Behavioural and physiological parameters are related to anxiety and in many fish and avian species due to anxiety mothers can also affect the behavioural development of their offspring<sup>12</sup>. Commercial farms are the best place to understand the behavioural and acoustic changes due to overstocking.

Many animals live in large numbers of groups with many individuals of different age group and dense colonies create more noisy and confusing environment in the population<sup>33</sup>. But even in the noisy environment a mother

can differentiate the acoustic signals of its own offspring among many voices even when the other signals have acoustic similarities with its offspring voice<sup>34</sup>. In many animal species parents need to leave the child so that they can fetch food to feed their child, but when they have to reunite in the colony they produce distinctive acoustic signals and recognize each other<sup>43</sup>. Many animals first depends on the visual cues like feeding sites and nesting sites to get near to their destined area then with the help of display calls they can recognize their offspring<sup>2</sup>. Fur seal pups display female attraction calls to attract their mother and the fundamental frequency of the pup voices helps mother to recognize their pups<sup>5</sup>.

Difference in habitat is also responsible for the difference in acoustic characteristics because all habitats are different and the obstruction present in different habitat is also different<sup>53</sup>.

*Acoustic communication and behaviour after separation :*

Both mother and its offspring have special emotional bond between them and therefore when they get separated, they both become distressed and uncomfortable and this separation can cause disorders related to the physiological and psychological stress<sup>51</sup>. According to some studies maternal separation can induce autism spectrum disorder (ASD) in infants which directly affects their further development<sup>44</sup>. After birth, mothers body also changes a lot and mothers also get depressed and agitated when they get separated from their offspring<sup>19</sup>. The acoustic signals are also related to the separation behaviour of the

animals. Studies suggested that the mother responded stronger towards the separated offspring vocalization, begging calls or any other acoustic signals which represent discomfort in the young ones<sup>13,28</sup>. The response of the mother is also influenced with the number of offspring. All mothers not always respond in similar manner when they get separated from their offspring. In guinea pigs, mothers with large number of offspring show greater response to the separation calls as compared to the mother with smaller number of offspring. This type of maternal behaviour is due to the adaptive strategy in resource distribution during reproduction<sup>25</sup>. The acoustic signals contain information related to different behavioural context. Different situations or changes in lifestyle affect the vocalization of animals. The behavioural responses to separation by cows and calves can be alleviated by providing a supplemental milk source during and after the nursing period. Calves that are less nutritionally dependent upon the dam show reduced responses to maternal separation<sup>22</sup>.

In commercial dairy farms and many cowsheds, it is a very common practice to separate the new born offspring from the mother. When mother and offspring get separated, they show both behavioural and acoustic response changes. The cow produces different types of acoustic signals based on the distance from the offspring. Low frequency calls were produced by cows with their mouth moderately opened or closed. High frequency calls (HFC) were produced when the cows got separated with the calves with large distance<sup>41</sup>. New born offspring also produce acoustic signals and become more active after separation from their mother. Young calves

separated just after birth produce less number of acoustic signals as compared to the older calves which were separated with the mother after spending some time<sup>57</sup>. This indicates that the more time the young ones spend with their mother, the bond between them becomes stronger. Some observations also showed that cows show more care to the offspring who display more distress or pain related behaviour<sup>54</sup>. With time when the calf grows and becomes more independent, the bond between mother-offspring also weakens and the older calf communicates less as compared to the young calf<sup>40</sup>. When young calves are separated from their mothers, they produce different types of vocalizations like humming vocalization (HV) and semi-humming vocalization (SHV). Such acoustic signals are related to weaning behaviour and separation stress<sup>20</sup>. Some studies also concluded that in complete separation, the vocalization of animal decreases with time<sup>45</sup>.

In many mammals the mother offspring communicate each other by different types of calls like oral and nasal calls. The acoustic features of both oral and nasal calls are different<sup>48,49,55</sup>. Both mother and offspring can recognize the acoustic signals produced by each other in early age and until weaning<sup>7,52</sup>.

Acoustic signals produced by young animals become different as compared to the acoustic signals produced when they are newly born. Mothers never forget the acoustic signals produced by their offspring when they were new born and even when they become months old, mothers can still respond towards the acoustic signals of their offspring recorded when they were new born<sup>4</sup>. Even when their offspring were near them, mothers reacted to

the distress calls played by the researcher. Playback experiments done in some bat species suggested that the female bats are able to discriminate the isolation calls of their own pups<sup>3,24</sup>. Mothers show behavioural response against recorded distress calls or other acoustic signals of their own child and do not respond to the recorded distress calls of other child<sup>91</sup> which proves that that they can recognize and respond towards the acoustic signals produced by their child even if there are many young ones in the group. Some playback experiments also proved that in some animals when the new born started producing alarming calls, the mother signals them to reduce the false alarming calls<sup>16</sup>. New born animals also spend their time with their mothers and they can also distinguish the acoustic signals of their own mother and other mothers<sup>18,21,31,50</sup>. Some studies also revealed that mother responds more towards the acoustic signals of younger offspring as compared to the older offspring because younger offspring needs more care for better survival<sup>8</sup>.

To increase the chances of survival of the organism it is really important to recognize and understand the different types of vocal signals produced by the conspecific. Mother and offspring both are able to recognize acoustic signals of each other and can differentiate the acoustic signals produced by other group members. Many animals who live in large number of colonies or large number of group members track down their offspring with the help of both visual cues and acoustic features of its offspring which proves that all the organisms are capable to differentiate sounds produced by other individuals. The ecological habitat where the animals dwell also

plays an important role in determining their acoustic features because different habitat needs different intensity or loudness of the sound. All the individuals have different acoustic features and vocal parameters plays important role in differentiating every individual and show variation during different behaviours of the animals. The parents and their offspring are more attached to each other and show distress when they get separated or when they hear distress calls. These studies also provide information that the separation can cause physiological and psychological damage to the animals. Therefore, by studying acoustic signals or distress calls of animals we can explore more about the relation between the acoustic signals and animals health and can reduce the damage caused by separation.

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