Premating and Mating Behavior of the Dungeness Crab (*Cancer magister* Dana)[1]

By C. Dale Snow and John R. Neilsen

Fish Commission of Oregon
Research Division, Newport, Ore.

ABSTRACT

A male and female Dungeness crab (*Cancer magister* Dana) were kept under continuous observation in an aquarium to observe the premating embrace, female ecdysis, and mating. The male held the female in premating embrace from June 10 until June 18, 1965, when she molted. The male allowed the female to reverse her position from the premating embrace, sternum to sternum, to that of female carapace to male sternum only after she became aggressive. The male never allowed the female to escape from his control while she molted. Copulation occurred 1 hr and 32 min after female ecdysis, when the new exoskeleton had firmed somewhat, and the male carried the female in a postmating embrace for 2 days.

Extensive wear on the chelipeds of male crabs may reflect prolonged periods in the premating embrace and stroking of the female by the male rather than matings with several females. The male crab probably becomes aware of the female's readiness to molt by her aggressive pinching of maxillae and eyestalks.

INTRODUCTION

Little has been written about the premating and mating behavior of the Dungeness crab (*Cancer magister* Dana). Since female molting occurs before mating, considerable speculation has occurred among biologists on how this is accomplished and on whether the male crab releases the female from the premating embrace when she molts. MacKay (1942) stated that mating seemed to be between a soft-shelled female and a hard-shelled male and believed that during molting the male released the female and reclasped her later. Cleaver (1949) stated that mating generally followed quite closely the procedure described by MacKay. Butler (1960) described copulation but was uncertain whether the male continued to hold the female throughout ecdysis.

The objective of the present study was to follow the molting and mating sequence of Dungeness crabs to completion.

MATERIALS AND METHODS

On April 21, 1965, five female crabs were placed in an aquarium with a moderate-sized male. Five days later the latter was replaced by a 178-mm male.[2] On June 7, three additional females, reportedly being clasped by males in a premating embrace when captured, were added to the aquarium. On

[1]Received for publication January 13, 1966.
[2]Straight-line measurement between the bases of opposite 10th anterolateral spines.

J. Fish. Res. Bd. Canada, 23(9), 1966.
Printed in Canada.

the morning of June 10, the male crab was found clasping a 110-mm female in the premating embrace. These two animals were then transferred to a 50-gal aquarium supplied with a continuous flow of filtered sea water. The aquarium was partially covered to reduce the light intensity yet still allow observation of activities within the tank. Water temperature in the aquarium during the period of observation ranged from 12 to 15 C — slightly higher than the ocean during the same period. A 16-mm Bolex movie camera and 35-mm still camera were mounted on tripods and readied for photographing the molting and mating. Observations of behavior were made for a continuous 192 hr. All actions and behavior mannerisms were recorded.

RESULTS

During the period April 21 to June 7, 1965, the male crab in the aquarium ignored the females. On June 7 when the new females were introduced the male became quite active. He approached the new females, body held high, walking on the extreme tips of the walking legs. At this time and for the next 2 days the females resisted his advances. On the morning of June 10 the male was observed holding a female in the premating embrace (Fig. 1). At the time of transfer to the larger aquarium the male released the female, but within 3 min reclasped her. This was accomplished by walking toward her on the tips of his walking legs and grasping her with both chelipeds, then turning her sternum towards him and pulling her firmly to him. Throughout this activity the antennae of each animal vibrated. After clasping the female, the male walked about with her in his grasp seemingly to investigate the new quarters.

The female was observed on many occasions to make movements as if to free herself from the premating embrace. Each such movement resulted in her being pulled roughly back into position with an audible click of sternum upon sternum. Following each of these attempts to free herself, or whenever she became restless, the male would stroke her carapace with his chelipeds in an up and down motion that seemed to pacify her. This reaction was noted periodically during the entire time that she was in the premating embrace. The female repeatedly moved her chelipeds above and around the eyestalks of the male, but these movements did not appear to be aggressive in nature. On occasion the male would rise up on the tips of his walking legs and raise the female up into an elevated position nearly 6 inches off the bottom of the tank. This movement would be accompanied by a continuous flexing of the male's abdominal flap. The female on numerous occasions was noted rocking back and forth in the clasp of the male and on one occasion she flexed all legs simultaneously and nearly escaped from the male's clasp. His reaction to this was to move her roughly back into the premating position. On one occasion the male raised up on the tips of the walking legs and allowed the female to drop down on the bottom of the tank. He then pressed forward with abdominal flap flexing. After about 3 min the female started moving and the male

reclasped her in the premating embrace. The male frequently walked around with the last pair of walking legs extended straight back.

Periodically we removed the aquarium covering to take photographs. At such times the male appeared to become agitated and would start walking about as if looking for an escape route. On one occasion, when the aquarium was covered, both animals rested in one corner of the tank with their eyestalks retracted and appeared to be sleeping. This behavior lasted for about 1 hr.

During the 5th day of observation (June 15, 1965) the male allowed the female to slip back to the vicinity of the 3rd and 4th walking legs. During one such period of positioning, the female attempted to escape and ended up with her carapace against his sternum. The male managed to turn the female again into the premating position after their positioning had been reversed for about 30 min.

During the 7th day of observation the female changed from relatively passive to active behavior. She attempted to push away from the male with the 3rd and 4th walking legs and nervously worked her walking legs and chelipeds. By 5:15 PM on June 17 the female's epimeral line obviously opened and both animals exhibited a new behavior pattern in that the antennae and mouth parts began moving rapidly. The male at this time allowed the female to hold herself 3–4 inches from his sternum but continued to hold her in his clasp. The female's behavior at this time became more aggressive and she started to grasp at the male's eyestalks and mouth parts with both chelae. This caused the male to pull her roughly back to his sternum. By 7:18 PM the female's suture line had opened up past the 10th anterolateral spine. At 7:50 PM the male lowered his grip to the base of the female's carapace and raised up as if to lift off the female's carapace. During this time the female continued her aggressive grasping at the male's maxillae and eyestalks. At 8:45 PM she managed to turn over in the male's clasp and ended up with her carapace to his sternum. At 9:21 PM the male raised up on the tips of the walking legs, grasped the female with his chelae, and again turned her over into the premating embrace. The female again started the aggressive movements and the male vigorously stroked her carapace. This aggressive activity by the female continued for about 2 hr; she then settled down into a passive state for about 2 hr.

At 2:00 AM on the 8th day she began actively trying to escape the male's clasp and grasping at his eyestalks and mouth parts. By this time her epimeral line had opened to the 2nd and 3rd anterolateral spine. At 2:17 AM the male allowed her to turn over so that her carapace was next to his sternum. Shortly after this reversal of position the male adopted a new position forming a "cage" with his walking legs and chelipeds that enclosed the female and kept her confined beneath him. By 3:29 AM the female was observed to be straining and moving her legs and appeared to be starting to withdraw from her old exoskeleton. During this period the male exercised only a moderate restraint over the female and even raised up to where she could move about underneath him. By 4:00 AM the female was definitely withdrawing from the old exoskeleton while completely encircled by the male's chelipeds and walking

legs. The sequence of the female molting is shown in Fig. 2–5. At this time it was again noted that the male's mouth parts and antennae were moving vigorously and whenever the female moved as if to get away, he would gently but firmly return her to the encirclement of his legs. By 5:45 AM the female's new carapace was bulging out to the 8th anterolateral spine and at 5:55 AM the female had nearly freed herself from the old exoskeleton. At this time the male raised up on his walking legs seemingly to facilitate the female's withdrawal. At 5:58 AM the female freed herself from the old exoskeleton and the male shoved it away with his chelipeds (Fig. 6). Following her withdrawal from the old exoskeleton the male hovered over the back of the female but did not attempt to pick her up. Eight minutes after the female finished molting, the male picked the female up in his walking legs, rolled her about and then released her. This action on the part of the male was repeated periodically for 1 hr and 22 min following her molting. At the end of this time he attempted to copulate, however, she slipped sideways from his grasp and he again hovered over her. Ten minutes later the male again turned the female over and she extended her abdominal flap and the male settled into the copulatory position with the gonopods inserted in the spermathecae (Fig. 7–8).

Copulation was the same as described by Butler (1960). However, after 12 min the male released the female when we tried to move the animals into a better photographic position. They were then placed in a darkened aquarium and after 30 min the male again mounted the female and remained in the copulatory position for 2 hr. Following copulation the male carried the female in a postmating embrace for 2 days before releasing her. This, as far as we are aware, is the first time that a postmating embrace has been recorded in Dungeness crab mating.

DISCUSSION

Though the conditions under which these observations were made were not natural and constitute a single observation, certain conjectures can be made. It appears highly improbable that the male crab ever lets the female out of his control once he has picked her up in the premating embrace. This might be particularly true in an environment where competing males could take her from him. At no time during these observations was the female capable of escaping the male's restrictions on her movements, even during ecdysis. During this latter period he allowed her to turn around but kept her in control and appeared to raise up in order to allow her to withdraw from the old exoskeleton. Following the female's molting the male did not attempt to copulate for 1 hr and 32 min; it appeared that he was waiting for a firming of the new carapace. Cleaver (1949) and Butler (1960) report that copulation takes about 30 min. Possibly the extended period of copulation observed here (2 hr) and the 2-day postmating embrace, which had not been reported before, are attributable to the unnatural surroundings and disturbance after the first copulatory attempt.

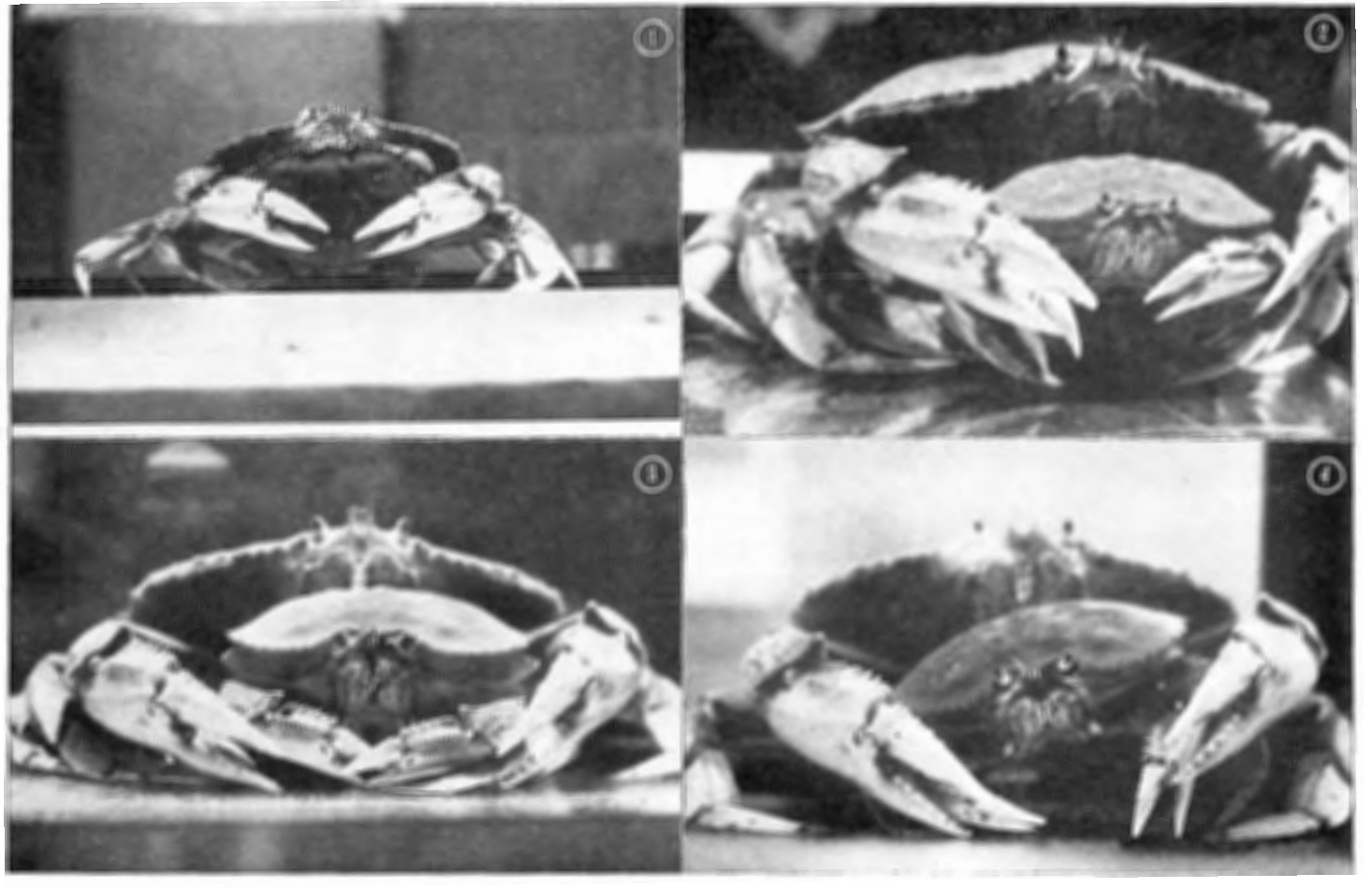
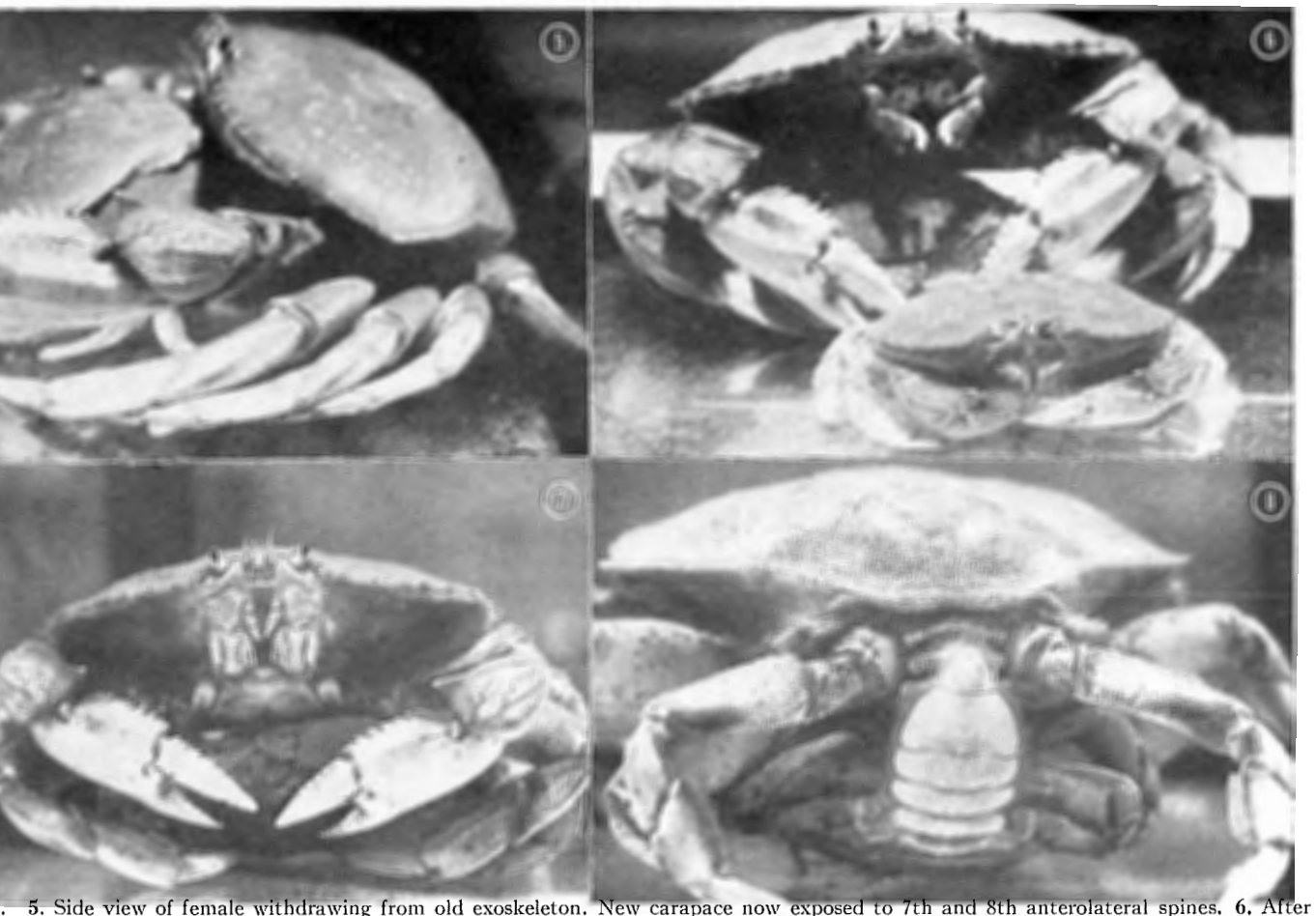


FIG. 1–4. **1.** Female crab in the premating embrace of the male. **2.** Female crab starting ecdysis while in control of male. **3.** Female crab continuing ecdysis while encircled by male's chela and walking legs. **4.** Female raising up and straining to start withdrawal from old exoskeleton.

Snow and Neilsen — J. Fish. Res Bd. Canada



. 5. Side view of female withdrawing from old exoskeleton. New carapace now exposed to 7th and 8th anterolateral spines. 6. After withdrawal from the old exoskeleton, the male has shoved the old exoskeleton away. Female can be seen beneath male. Note the position mouth parts as compared with Fig. 3–5. 7. Frontal view of copulating Dungeness crabs. 8. Posterior view of copulating crabs showing position of the abdominal flaps.

Neilsen — J. Fish. Res. Bd. Canada

Butler (1960) concluded that extreme wear on the chelipeds of mating male crabs indicated prolonged periods in the premating embrace with several females. The male crab observed in this study did not have mating marks prior to picking up the female. At the end of 8 days he had pronounced marks on the wrist or carpus. These were undoubtedly created by the frequent stroking of the female carapace. The location of wear on carpus or propodus is probably dependent upon the size of the two animals involved. It appears that polygamy might cause heavy wear but it may also occur during a single mating if the male carries the female for an extended period of time.

Shellfish biologists have wondered how the male crab sensed that the time was right to release the female from the premating embrace so that she could molt. During our early observations the female remained relatively passive in the male's clasp, but during later stages she became rather aggressive and would pinch the male's maxillae and attempt to pinch the eyestalks. This behavior may cause a reaction in the male which allows the female to reverse her position in the premating embrace and complete ecdysis.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of Kenneth Staffensen and Robert Comstock, commercial fishermen, who furnished the crabs; Waldemar DeBen, who made some of the observations; Wilbur Breese, Oregon State University Department of Fisheries and Wildlife, who made available equipment to conduct the study; and T. H. Butler, Fisheries Research Board of Canada, Nanaimo, B.C., who reviewed the manuscript and made invaluable comments.

REFERENCES

BUTLER, T. H. 1960. Maturity and breeding of the Pacific edible crab *Cancer magister* Dana. J. Fish. Res. Bd. Canada, **17**: 641–646.

CLEAVER, F. C. 1949. Preliminary results of the coastal crab (*Cancer magister*) investigation. Washington State Dept. Fish., Biol. Rep. 49–A, p. 47–82.

MACKAY, D. C. G. 1942. The Pacific edible crab, *Cancer magister*. Bull. Fish. Res. Bd. Canada, No. 62, 32 p.