Kasetsart J. (Nat. Sci.) 41 : 229 - 238 (2007)

# Comparative Anatomy of Land Snail Genus *Succinea* from Eastern Thailand (Pulmonata : Succineidae)

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## ABSTRACT

Morphology, shell, jaw, radula, and reproductive anatomy of land snails in the genus *Succinea* from the Eastern Thailand have been studied. Snails were collected from Chantaburi, Rayong and Trat Province. They were compared with *Succinea putris* (Linnaeus, 1758) from Zoologisch Museum, Amsterdam, the Netherlands. All of the investigated snails contain the shell, jaw, radula and genitalia characteristics of *Indosuccinea*. This is the first anatomical study of succineidae and new recorded data belongs to this family in Thailand.


**Key words:** Succineidae, *Succinea*, morphology, reproductive anatomy, Thailand

## INTRODUCTON

The malacological fauna of Thailand is poorly studied with more than 300 species currently recorded (Panha, 1996; Panha and Burch, 2005). The family Succineidae is reported to have only one genus and two species, *Succinea tenella* and *S. cochinchinensi* (Panha, 1996). The taxonomic placement of the two species of the Succineidae is based largely on shell characters which are unreliable, because of considerable convergence. Over the past 35 years, taxonomist has used the features of male and female reproductive tracts, radula and jaw, and patterns of pigmentation to distinguish and characterize some genera and species (Patterson, 1971). In this study, we report on the shell, jaw, radula and genitalia morphology of succineid snails collected from several localities of Eastern Thailand.

## MATERIALS AND METHODS

### Field collection

Specimens of Thai succineid snails were collected from limestone mountains at several parts of Eastern Thailand (Table1). At each location, 10 specimens were collected and compared with *Succinea putris* (Linnaeus, 1758) from Province Noord Hollland, Loosdrecht, Kromme Rade, Netherlands. Voucher specimens have been deposited at Zoological Laboratory, Faculty of Science, Burapha University. Localities of the species used in this study are given in Table 1. Snails were identified using taxonomic criteria of Patterson (1971), Burch and Jung (1988), Abbott (1989) and Panha (1996).


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**Table 1** Species and localities of the succineid snails in this study.

| Species | Location |
|---|---|
| *Succinea putris* | Province Noord Hollland, Loosdrecht, Kromme Rade,The Netherlands |
| *Succinea* sp.1 | Khao Saming, Trat Province |
| *Succinea* sp.2 | Queen Rambhai Bharni Rajaphat University, Chantaburi Province |
| *Succinea* sp.3 | Khao Pratoon cave, Rayong Province |
| *Succinea* sp.4 | Khao Sukim, Chantaburi Province |

**Shell, jaw and radula morphology**

Shells, jaws and radulae were dissected and prepared using the citeria of Patterson (1970) and photographed with an Olympus SZH 10 stereo microscope. Radula were examined under light microscope BX 50 and scanning electron microscope LEO 1450 VP with camera lucida CMZ-U ZOOM 1:10. Comparative drawings were made to clearly identify the organs.

## RESULTS

***Succinea putris* (Linnaeus, 1758)**

**Location**: Province Noord Hollland, Loosdrecht, Kromme Rade, The Netherlands

**Shell:** The shell is amber in color, very glossy inside and moderately shiny on the exterior surface, ovate-attenuate in shape with $2\ ^{3}/_{4}$ whorls, heigh spire and aperture is oval (Figure 1A).

**Jaw:** The jaw is amber in color with the cutting piece and the basal accessory plate is nearly uniform in color. The arms of the cutting piece are elongate. The posterior margin is straight and the convex anterior margin of the cutting piece is irregular with 2 folds on each side of a distinct median prominence. The basal accessory plate is nearly square (Figure 1B).

**Radula:** The central tooth of the radula is quadrate and tricuspid, the lateral teeth are also quadrate,but either bicuspid or tricuspid and the marginal teeth are variable in shape. The radula formula of *Succinea putris* population is 21:12:1:12:21 (Figure 1C).

**Genitalia:** The hermaphroditic gland is composed of numerous acini and is pigmented with a scattered amount of black granules. The hermaphroditic duct is covered with a thin connective tissue containing black pigment. There are two white receptacula seminis of unequal length. The fecundation pouch is white and surrounds the base of the receptacula seminis. The creamy white albumen gland is of moderate size. The creamy white prostate gland is irregular in shape and follicular in appearance. The white spermatheca and oviduct are irregular spheroid and irregular in shape, respectively. The vagina is short, creamy beige in color and pigmented with scattered black granules. The white penis is approximately twice the length of the vagina and constricts abruptly at its posterior end where it joins with a short epiphallus. There is a well-developed penial sheath pigmented with black granules and appressed to the penis near the base (Figure 1D, 1E and 1F).

***Succinea* sp. 1**

**Location:** Khao Saming, Trat Province.

**Shell:** The shell is amber in color, very glossy inside and moderately shiny on the exterior surface, ovate-attenuate in shape with $2\ ^{1}/_{2}$ whorls, low spire and collemella fold exists. Aaperture is oval (Figure 2A).

**Jaw:** The jaw is amber in color with the cutting piece and the basal accessory plate is nearly uniform in color and wider than its length. The arms of the cutting piece are short. Both posterior and anterior margins are straight. The basal accessory plate is nearly square (Figure 2B).

**Radula:** The central and lateral tooth are quadrate and either bicuspid or tricuspid with the

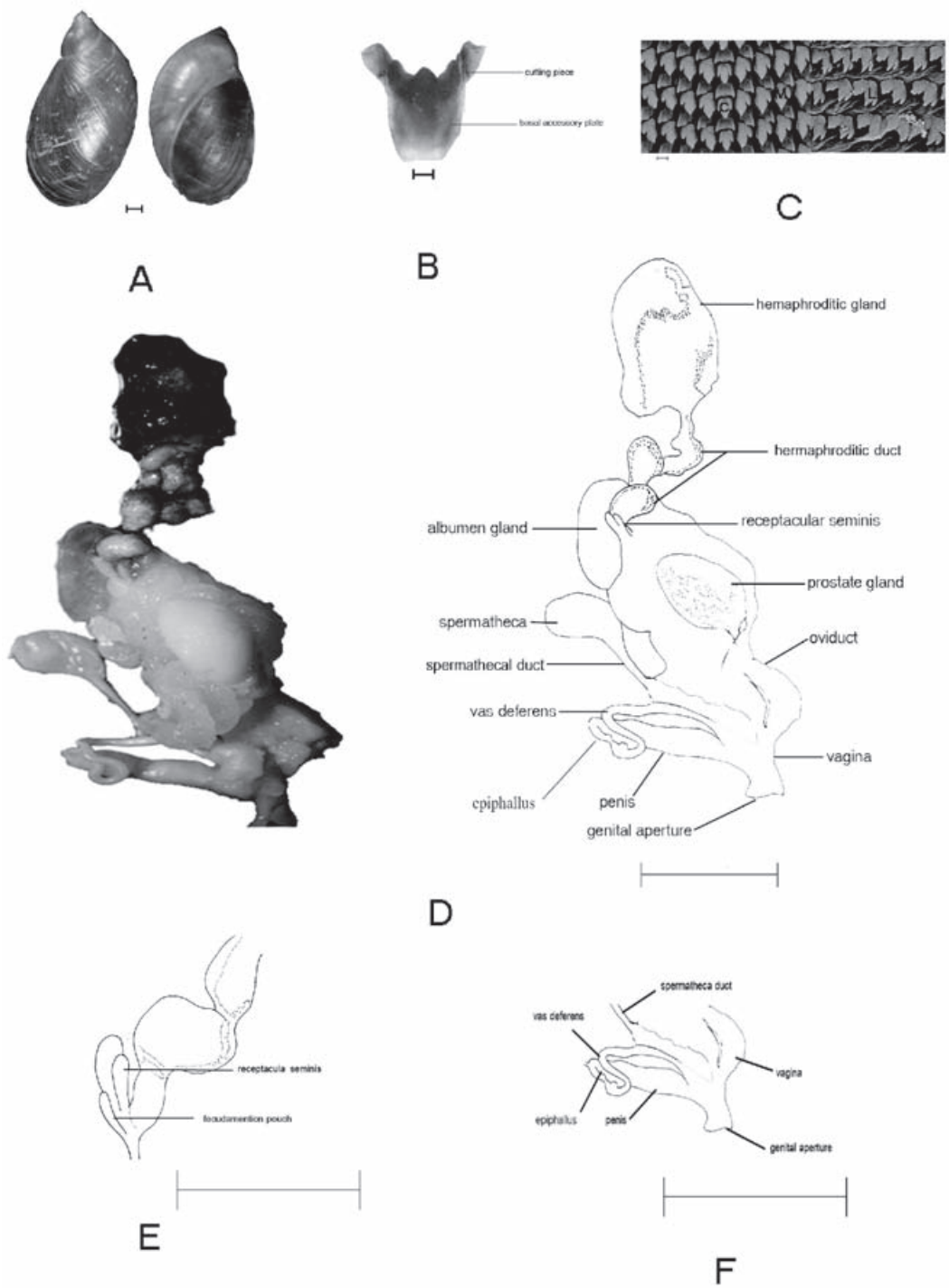



**Figure 1** Photographs and drawings of *Succinea putris* (Linnaeus, 1758) from the Netherlands, A: shell (scale bar = 1 mm), B: jaw (scale bar = 0.5 mm), C: scanning electron micrograph of radula (scale bar = 20 μm), D: reproductive anatomy (scale bar = 1 mm), E: receptacula seminis (scale bar = 1 mm), and F: genital opening (scale bar = 1 mm).

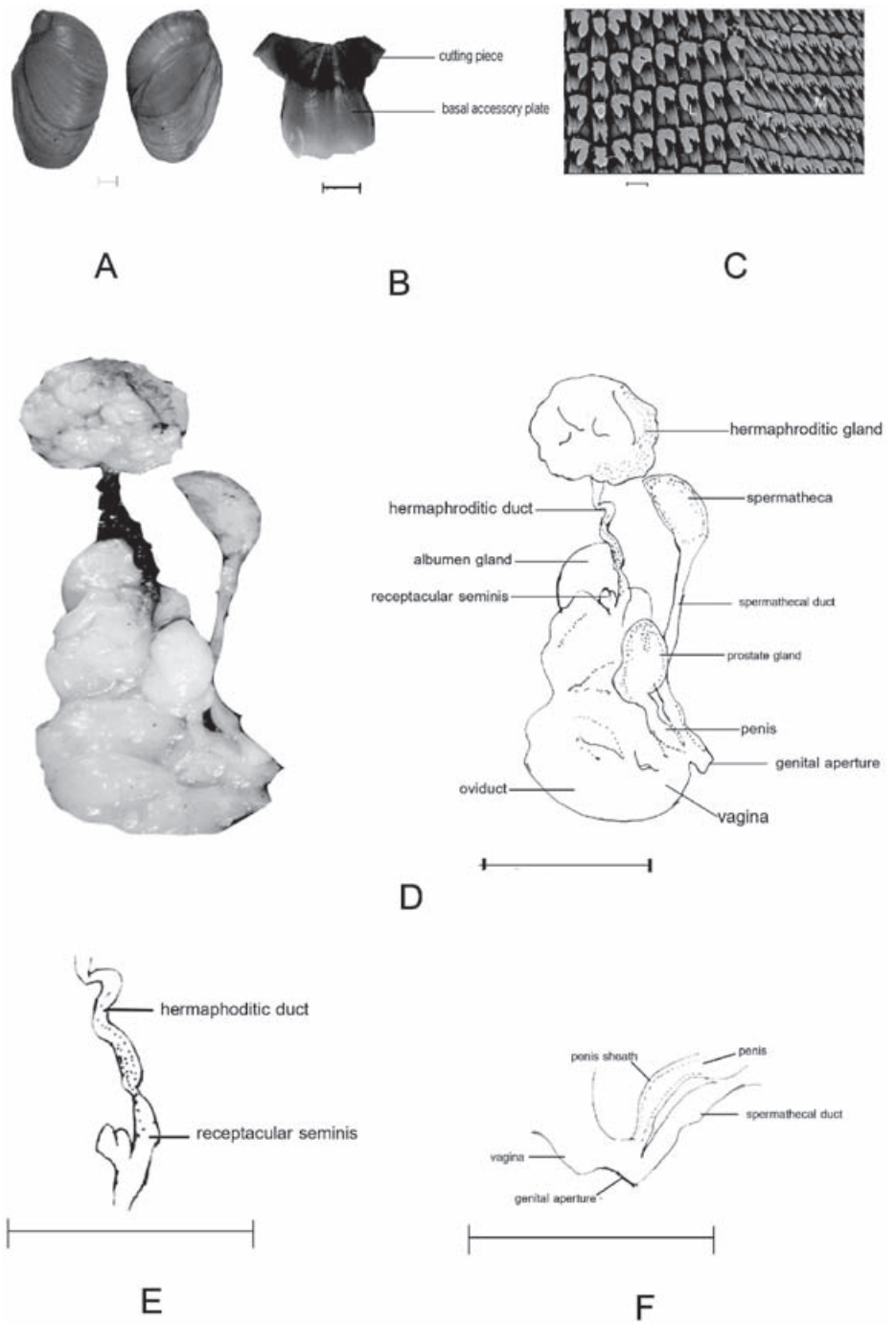



**Figure 2** Photographs and drawings of *Succinea* sp. 1. from Khao Saming, Trat Province, A: shell (scalebar = 1 mm), B: jaw (scale bar = 0.5 mm), C: scanning electron micrograph of radula (scale bar = 20 μm), D: reproductive anatomy (scale bar = 1 mm), E: receptacula seminis (scale bar = 1 mm), and F: genital opening (scale bar = 1 mm).

marginal teeth variable in shape. The radula formula of *Succinea* sp.1 population is ∞:5:1:5:∞ (∞ > 60) (Figure 2C).

**Genitalia:** The hermaphroditic gland is pigmented with scattered black granules. The hermaphroditic duct and two equal receptacula seminis are covered with a thin connective tissue with scattered black pigment. There is a distinct fecundation pouch which resembles the receptacula seminis in shape. The albumen gland is large and creamy yellow in color. The creamy yellow prostate glands are irregular spheroid in shape. The white translucent spermatheca is spherical in shape. The oviduct is gelatinous-like and has several folds. The white vagina is moderately long. The penis sheath is well-developed, large and long (Figure 2D, 2 E and 2F).

***Succinea* sp. 2**

**Location:** Queen Rambhai Bharni Rajaphat University, Chantaburi Province. They were found on the leaf of orchid *(Eulophia sp.)* near the building.

**Shell:** The shell is amber in color, very glossy inside and moderately shiny on the exterior surface. The shell is ovate-attenuate in shape with $2\ ^1/_2$ whorls, low spire and aperture is oval (Figure 3A).

**Jaw:** The jaw, cutting piece and the basal accessory plate are nearly uniform in amber color. The posterior margin of the basal accessory plate and the anterior margin of the cutting piece are straight. There is no median prominence and the posterior margin of the cutting piece is slant slightly (Figure 3B).

**Radula:** The central tooth of radula and the lateral teeth are quadrate, but either bicuspid or tricuspid while the marginal teeth are variable in shape. The radula formula of *Succinea* sp. 2 population is 55:6-7:1:6-7:55 (Figure 3C).

**Genitalia:** The genitalia show the hermaphroditic gland to be composed of several acini and irregularly pigmented with black granules. The hermaphroditic duct and two equal receptacula seminis are covered with a thin connective tissue with irregular black pigment. There is a distinct fecundation pouch which resembles the shape of the receptacula seminis. The creamy yellow albumen gland is large. The creamy yellow prostate glands are irregular spheroid in shape. The white translucency spermatheca has a global shape. The oviduct is gelatinous-like and has several folds. The white vagina is moderately long. The penis is a small tube, white in color and the covering connective tissue is thin with black pigmented areas (Figure 3D, 3E and 3F).

***Succinea* sp. 3**

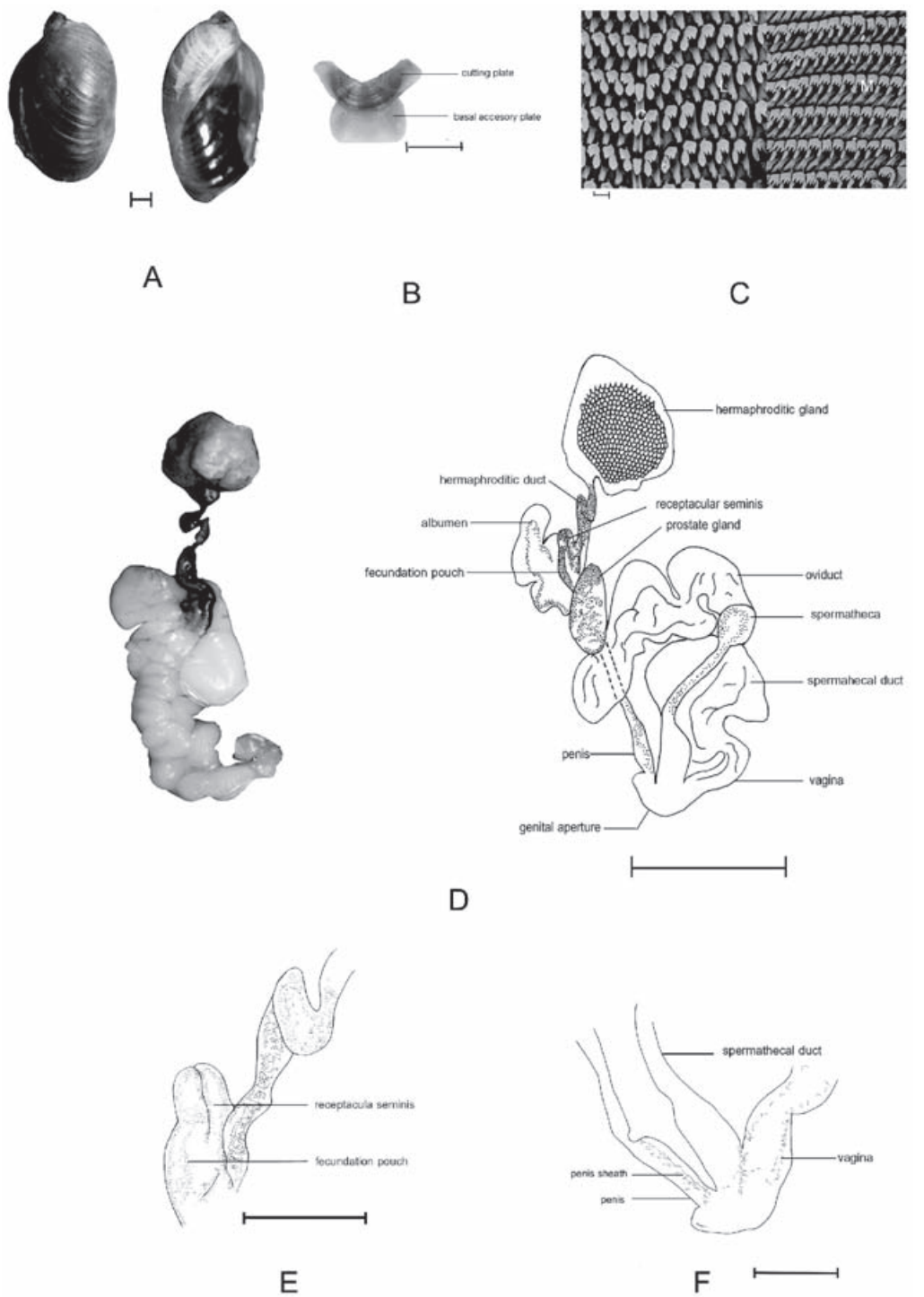
**Location:** specimens were collected from Khao Pratoon, Rayong Province. They were found on the leaves together with other species of snails including *Durgella* sp. and *Amphidromus* sp.

**Shell:** The shell is amber in color, very glossy inside and moderately shiny on the exterior surface. The shell is ovate-attenuate in shape, with $2\ ^1/_2$ whorls, low spire and aperture is oval (Figure 4A).

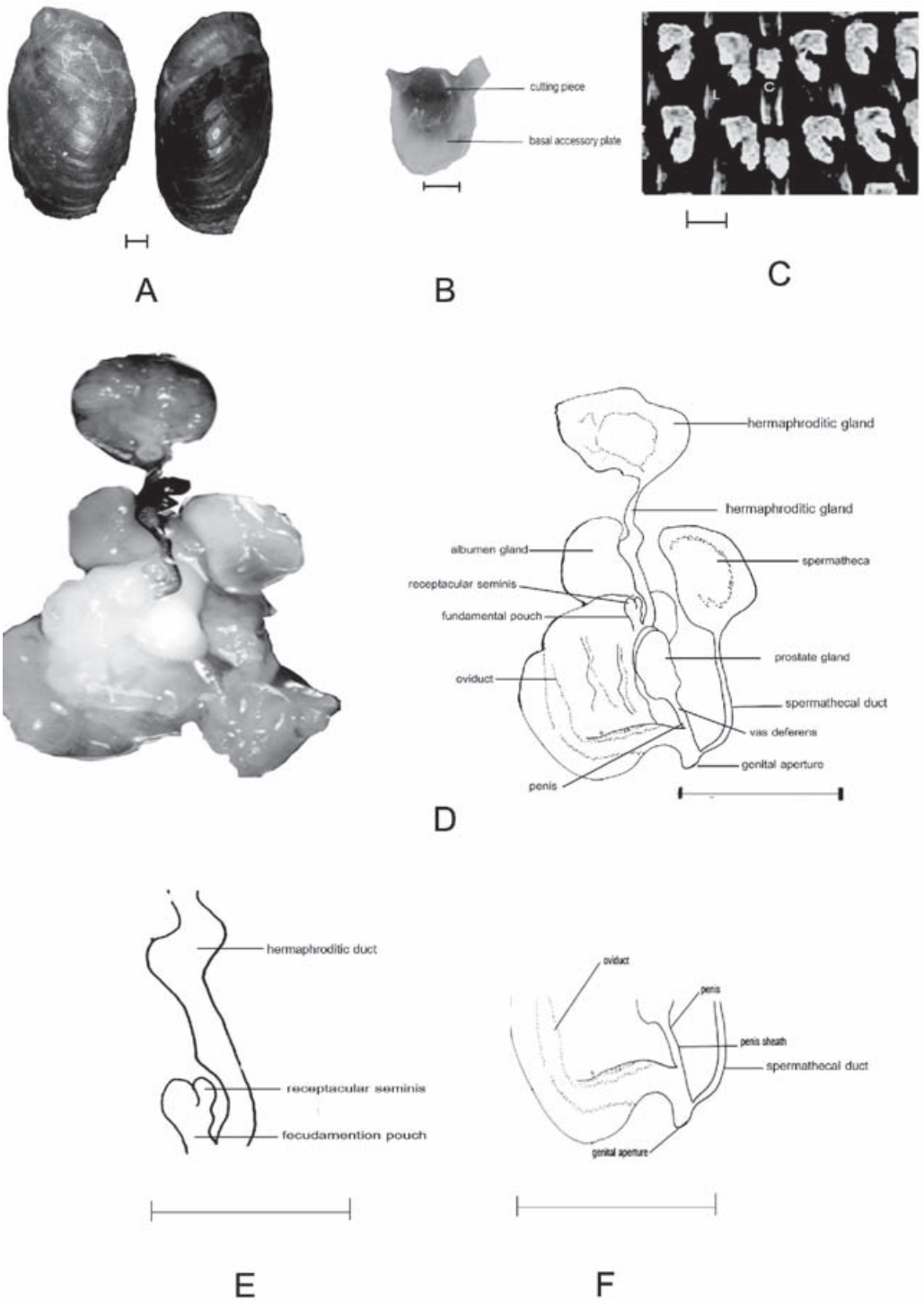
**Jaw:** The jaw is amber in color with the cutting piece and the basal accessory plate is nearly uniform in color and wider than its length. The anterior margin of the cutting piece is deeply folded. The sides of the basal accessory plate slant slightly inward. The posterior margin of basal accessory plate is irregular (Figure 4B).

**Radula:** The central tooth is quadrate and tricuspid, while the lateral teeth are also quadrate but either bicuspid or tricuspid. The marginal teeth are variable in shape. The radula formula of *Succinea* sp. 3 population is 82:7:1:7:82 (Figure 4C).

**Genitalia:** The hermaphroditic gland is composed of several acini. There are two receptacula seminis of equal length, white in color with a well-developed fecundation pouch. The




**Figures 3** Photographs and drawings of *Succinea* sp. 2 from Queen Rambhai Bharni Rajaphat University, Chantaburi Province., A: shell (scale bar = 1 mm), B: jaw (scale bar = 0.5 mm), C: scanning electron micrograph of radula (scale bar = 20 μm), D: reproductive anatomy (scale bar = 1 mm), E: receptacula seminis (scale bar = 1 mm),and F: genital opening (scale bar = 1 mm).




**Figures 4** Photographs and drawings of *Succinea* sp.3 from Khaopratoon cave, Rayong Province, A: shell (scale bar = 1 mm), B: jaw (scale bar = 0.5 mm), C: scanning electron micrograph of radula (scale bar = 20 μm), D: reproductive anatomy (scale bar =1 mm), E: receptacula seminis (scale bar = 1 mm), and F: genital opening (scale bar = 1 mm).

hermaphroditic duct, receptacula seminis and fecundation pouch are covered by a thin mostly black pigmented connective tissue. The white albumen gland is irregular in shape. The white prostate gland and the creamy white spermatheca are spherical in shape. The oviduct is gelatinous in texture, white in color and irregular in shape with several folds. The white vagina is moderately long. The penis is a tube, longer than the vagina which is well-developed, light purple sheath (Figure 4D, 4E and 4F).

***Succinea* sp.4**

**Location:** Khao Sukim, Chantaburi Province.

**Shell:** The shell is amber in color, very glossy inside and moderately shiny on the exterior surface. It is ovate-attenuate in shape, with 2 $^1/_2$ whorls, low spire and the aperture is oval (Figure 5A).

**Jaw:** The jaw is amber in color with the cutting piece and the basal accessory plate is nearly uniform in color. The arms of the cutting piece are short and posterior margin is straight. The convex anterior margin of the cutting piece is irregular with 2 folds on each side of a distinct median prominence. The basal accessory plate is nearly square (Figure 5B).

**Radula:** The central tooth is quadrate and tricuspid, while the lateral teeth are also quadrate but either bicuspid or tricuspid. The marginal teeth are variable in shape. The radula formula of *Succinea* sp.4 population is 82:7:1:7:82 (Figure 5C).

**Genitalia:** The hermaphroditic gland is irregularly pigmented with black granules. The hermaphroditic duct and the two equal receptacula seminis are covered by a thin connective tissue with scattered black pigment. There is a distinct fecundation pouch which resembles the shape of the receptacula seminis. The creamy yellow albumen gland is large. The creamy yellow prostate glands are irregular spheroids in shape. The white translucent spermatheca is spherical in shape. The oviduct is gelatinous-like with several folds. The white vagina is moderately long. The white penis sheath is well-developed, large and long (Figure 5D, 5E and 5F).

## DISSCUSSION

Shells are the most prominent and preservable morphological structure of gastropods and play a major role in their taxonomy. According to shell morphology, the spires of Thai succineid snails are considerably shorter than those of *S. putris* (Linnaeus, 1758). The jaws of all snails are composed of a cutting piece attached to a basal accessory plate but differences occur, on the anterior margin. Thus in *S. putris* (Linnaeus, 1758), the convex anterior margin of the cutting piece is irregular with two folds on each side of a distinct median prominence whereas the Thai succineid species have a straight anterior margin of the cutting piece and no median prominence. The cutting piece, posterior margin are slightly slanted. These characters represent the jaw morphology of *Indosuccinea* as reported by Patterson (1971). Radula differ in morphology among all species. Radula teeth are simple in structure with the quadrate and tricuspid central tooth. The lateral teeth are also quadrate, but either bicuspid or tricuspid while marginal teeth are variable in shape and the number of cusps. However, Patterson (1971) suggested that the radula does not possess characters useful in delineating genera but may, in some cases, possess taxonomically useful species specific features.

Thai succineid snails have a fragile shell, a characteristic shape, strongly chitinized jaw with beaker-like extremities to the arms and a large number of marginal teeth in the radula. These characters closely resemble those of the genus *Indosuccinea* (Rao, 1924). The genitalia of Thai succineid snails have two receptacula seminis of equal length, while those of *S. putris* (Linnaeus,

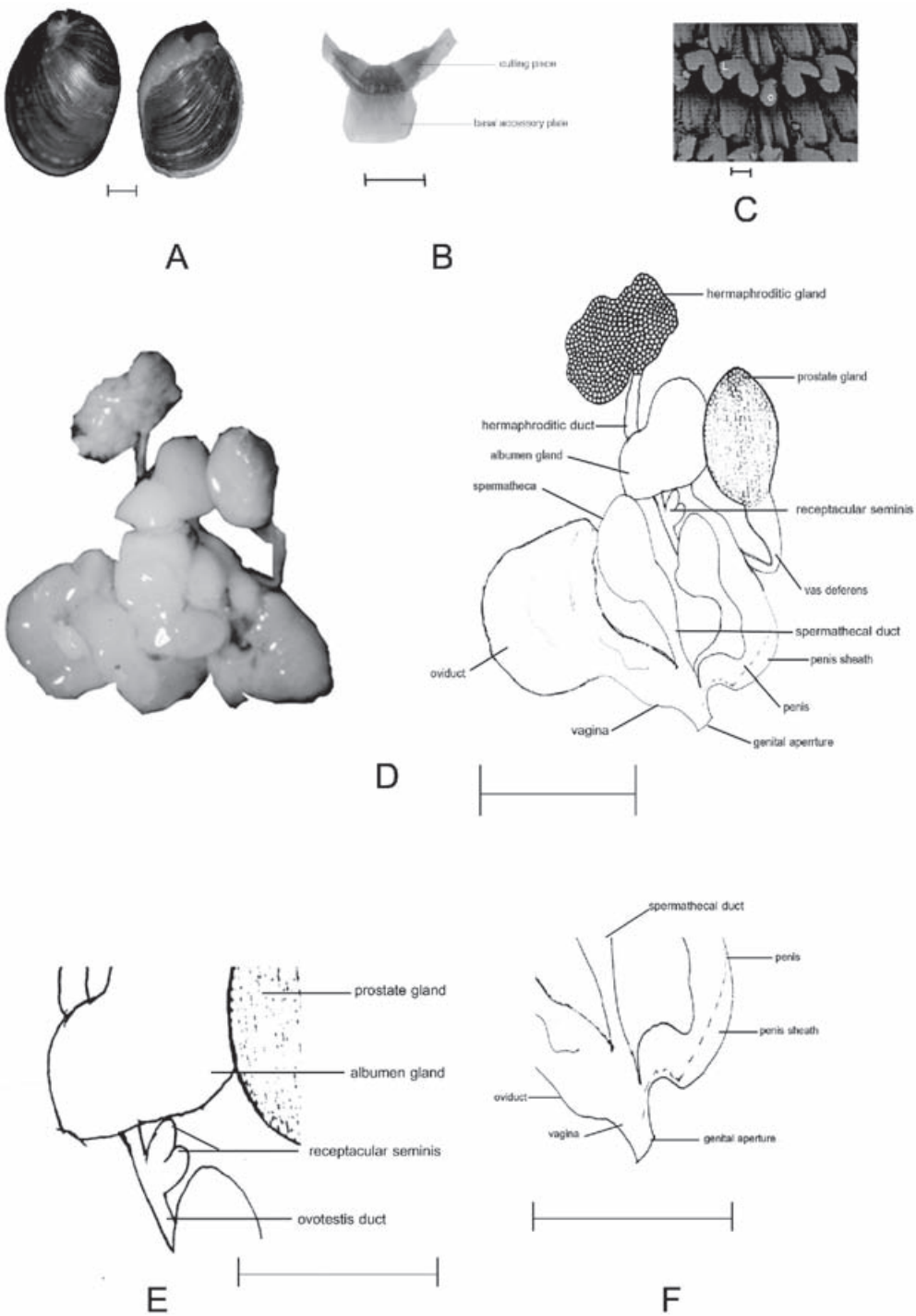



**Figure 5** Photographs and drawings of *Succinea* sp.4 from Khao Sukim, Chantaburi Province, A: shell (scale bar = 1 mm), B: jaw, (scale bar = 0.5 mm) C: scanning electron micrograph of radula (scale bar = 20 μm), D: reproductive anatomy (scale bar = 1 mm), E: receptacula seminis (scale bar = 1 mm), and F: genital opening (scale bar = 1 mm).

1758) are unequal in size. These characters that we found in all Thai succeinid snail samples clearly seperated snails of the genus *Indosuccinea* from those of *Succinea*.

## CONCLUSION

From our study, Thai succineid snails did not show the morphological characters of genus *Succinea* as previously reported. We suggested that they could be placed in genus *Indosuccinea*. This is a new record of Thai succineid snail. More data such as cytology, molecular biology will be combined in a future report for the taxonomic discrimination and systematics.

## ACKNOWLEDGEMENTS

This research was supported by a Research Development Grant from the Faculty of Science, Burapha University. We would like to thank Assoc. Prof. Dr. Somsak Panha, Chulalongkorn University and Prof. Dr. John B. Burch, University of Michigan, Museum of Zoology, Ann Arbor, for their kind help in supplying literature and Prof. Dr. F.W.H Beamish for his comments on the manuscript, and also to Ms. Khanita Nuamsee for the drawing of specimen.

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