

Nisga'a Fisheries: Marine Conservation Youth Stewardship Lesson Plan 3

Title:

A British Columbia Teacher Curriculum Guide for the Theme:
Marine Ecosystems, Habitat Protection & Conservation, and Abalone
Species at Risk.

Lesson # 3:

Species at Risk Conservation – Abalone Biology, Life History,
and Resource Management.

By

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Nisga'a Fisheries: Marine Conservation Youth Stewardship Lesson Plan 3

Lesson: In this lesson, you will invite a biologist to give your class a presentation on abalone. The purpose of this lesson is to introduce youth to abalone biology, life history, and distribution. Feel free to use our Nisga'a Youth Marine Stewardship Program "Youth Abalone" power point presentation called "Northern Abalone" at the link <C:\Documents and Settings\Tracey\My Documents\NF Project.2009\NFAbalone2009\extra resources\Ocean Link Lesson #3\Youth.Abalone.ppt>. Please take a look at the "Nisga'a Coast Watch 2009-2010" newsletter at <http://oceanlink.island.net/Conservation/abalone/BHCAP/Nisga/ncw.html>. Your guest biologist can use the abalone slide show from Ocean Link (see lesson summary), and/or from our Nisga'a Youth Marine Stewardship Program!

1. What is an abalone? Have students pick out an abalone from a tidal pool poster (Fisheries and Oceans Canada <http://www.dfo-mpo.gc.ca/index-eng.htm>) and identify other organisms in its natural environment. Display an artifact sample (abalone shell), and show video imagery of abalone in its natural setting. Have students describe the sensory features of an abalone:
 - What does it look like?
 - What does it feel like?
 - What do you think it sounds like?
 - What do you think it smells like?
 - What do you think it tastes like?
2. Outline the basic anatomy of an abalone.
3. Describe the life stages of abalone (introduce terminology)
4. Introduce the global, regional and local distribution of abalone. Provide illustration of abalone mapping project and the different species of abalone, where they are located, and range of distribution.

The Abalone Mapping Project (Beautiful photo of Abalone)

<http://www.vetigastropoda.com/ABMAP/text/worldmap.html>

Navigate to Site/ Click on Map of Region/Show Geographic Range/Number of Species (Biodiversity)

5. Describe the physical habitat of abalone. Show video streams of abalone in their natural environment and learn about abalone biology
Media Support: Show On-line Video Casts of Racerocks.com documentation.
http://www.racerocks.com/racerock/jason/abal_seastar/index.html
<http://www.racerocks.com/racerock/archives/vidabescape2a.htm>
<http://www.racerocks.com/racerock/eco/taxalab/sallav.htm>
<http://seafood.ucdavis.edu/pubs/abalone.htm>
<http://www.fao.org/docrep/field/003/AB731E/AB731E01.htm>
<http://www.itresourcing.com.au/aquaculture/species/molluscs/molluscs.htm>

6. Probe students for general knowledge referencing background information in Appendix.

Why do you think that the abalone looks like a rock?

Where are Northern (Pinto) Abalones located in British Columbia? Queen Charlottes, West Coast Vancouver Island

What are the holes on the shell for? Breathing, ingestion of food and excrete waste

What does abalone eat?

Herbivores, algae and other plant material from rock (large brown algae, kelp and seaweed, or algae drifting in the water column), colour branding on shell is an indicator of the plant material eaten.

How does it eat?

Large, rough radulas (tongue) to scrape pieces of food from rock, filter feed through holes

What animals are predators of the abalone?

Crabs, lobsters, octopuses, starfish, fish and snails, Sea Otters, Man

Draw a food web for the abalone.

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Lesson: Continued from last page...

Describe the environment that abalone like to live in.

How does the abalone detect predators? Smell - Chemotaxis

Describe different ways the abalone may protect itself from predators?

Very hard shell – calcium carbonate, Foot –flees from, Closes foot, Emit cloud of blue particles

How can you distinguish the Northern (Pinto) abalone apart from other abalone?

Shape of the shell, colour of shell, colour of the foot, and tentacles, # of pores, and length of shell

Discuss why the Northern (Pinto) abalone is an endangered species and what caused the recent decline in the abalone population?

What is being done to ensure the continued existence of the abalone?

Captive broodstock program (raise and release in wild), Marine Protected Areas, Enforcement, Volunteer Groups (Coast Watch Program)

Lesson Summary:

Numerous animals, birds, fishes, and plants are endangered and at risk of extinction. Our endangered species at risk, and "champion-fighter to survive", is the Northern Abalone. The principles and application of this unit can be revised for any Species at Risk listed by Environment Canada (<http://www.sararegistry.gc.ca/sarredirect/>) or Parks Canada (<http://www.pc.gc.ca/eng/nature/eep-sar/index.aspx>).

In this lesson, you will invite a biologist to give your class a presentation on abalone! The purpose of this lesson is to introduce youth to abalone biology, life history, and distribution. Feel free to use our Nisga'a Youth Marine Stewardship Program "Youth Abalone" power point presentation called "Northern Abalone" at the link <C:\Documents and Settings\Tracey\My Documents\NF Project.2009\NFAbalone2009\extra resources\Ocean Link Lesson #3\Youth.Abalone.ppt>. Some of the slides from this presentation are included in the above Lesson section of this lesson plan.

As well, use the slide show presentation on the 'Ocean Link – All About the Ocean' website at http://oceanlink.island.net/Conservation/abalone/BHCAP/BCHAP_index.html. The pictures of the abalone shells are beautiful! "Abalone Advocates" on this website gives a unit that consists of five lesson plans. The themes of: environmental advocacy, complexities of ecosystems and natural balances, human actions and environmental impact, and designing your own community environmental action are all explored!

Ask the students to creatively show their learning using multiple intelligences such as: music, logic-math, linguistics, spatial, body movements, interpersonal, intrapersonal, and nature.

http://www.saskschools.ca/curr_content/constructivism/where/knoll/lap/latmultint.html

<http://www.context.org/ICLIB/IC27/Campbell.htm>

For example, students may choose from the following:

- Write a song about abalone.
- Write a creative story about an abalone.
- Write a short role play about abalone, and act it out.
- Work together as a team to design a colourful poster on abalone.

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Subject Area(s): Environment and Sustainability Across BC's K-12 Curricula. Science, Language Arts, and Social Studies.

Grade Level: Our summer camp chose to host students 6-12 years old in age. This unit is designed for teachers to adapt the unit for elementary, middle, and high school.

Standards: See Below

BC Ministry of Education Curriculum Prescribed Learning Outcomes:

Please see the "Curriculum Connections" section from the "Abalone Advocates" document on the Ocean Link website. Visit the link at

http://oceanlink.island.net/Conservation/abalone/BHCAP/BCHAP_index.html

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Lesson Objectives:

Students will:

- Listen to a guest speaker biologist give a slide show presentation on abalone species at risk.
- Watch a slide show presentation on abalone biology, life history, and distribution.
- Look at online video casts of abalone.
- Choose a learning activity that appeals to multiple intelligences.

Lesson Scope and Sequence:

The mission and purpose of this lesson and thematic unit "is to create a supportive learning environment in which youth reach their fullest potential as capable, competent, and caring eco-citizens, through restoration initiatives such as northern abalone recovery, and other marine species at risk, to a level that supports and maintains a community food fishery."

"Our youth have a story that needs telling... they must be a part of protecting and restoring marine species at risk, critical habitat, and traditional knowledge of marine resource users".

(As taken from the Nisga'a Coast Watch 2009-2010 newsletter

<http://oceanlink.island.net/Conservation/abalone/BHCAP/Nisga/ncw.html>.)

Nisga'a Fisheries has administered an award-winning fisheries program since 1992. The program includes stock assessment for salmon, bivalve, crab and eulachon, and catch monitoring for all marine and freshwater species.

Since 2003, Nisga'a Fisheries has been linked with ongoing and new abalone stewardship programs through participation in the Abalone Recovery Implementation Group.

Since 2006, Abalone has been incorporated into our non-salmon catch monitoring program's interviews. Other abalone stewardship activities included marine patrols, dedicated abalone patrols, designing a logo and brochure, and interviewing Nisga'a to assess knowledge of abalone use and distribution.

In 2007, a Community Action Plan was drafted, and the Nisga'a Abalone website developed <http://oceanlink.island.net/Conservation/abalone/BHCAP/Nisga/ncw.html>

Since 2008, our direction has focussed on public outreach via the web site, a community network site (www.nnkn.ca), Nisga'a Coast Watch Newsletter, brochures, special events (booth at Crab Fest), and community consultation.

In 2009, the first ever Nisga'a Youth Marine Stewardship program was launched, and twenty-four students from the Nass Valley, and Urban Locals (Terrace, Prince Rupert, and Vancouver) participated in the, "Youth Outreach, Education, & Activism For Marine Conservation & Biodiversity: A Nisga'a Fisheries Northern Abalone -Coast Watch Case Study" in 2009.

It is our hope that you will use this teacher guide to introduce several themes ranging from marine conservation, species at risk, biodiversity, to community leadership with your youth. We hope that you will take one eco-action project at a time...such as using this lesson within your classroom!

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Student Assessment:

- During the slide show presentation, listen to the discussions of the students with the biologist to assess understanding during the lesson.
- Assign students in small groups of three people. Ask the students to creatively draw and colour a large poster to demonstrate what they have learned from the slide show presentation.
- Ask the students to creatively show their learning using multiple intelligences such as: music, logic-math, linguistics, spatial, body movements, interpersonal, intrapersonal, and nature.
http://www.saskschools.ca/curr_content/constructivism/where/knoll/lap/latmultint.html
<http://www.context.org/ICLIB/IC27/Campbell.htm>

For example, students may choose from the following:

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Lesson Implementation		
Instructional Strategies	Grouping Options	Scaffolds/
Introduction to the lesson:	Whole group	<p>Invite a biologist to give your class a presentation on abalone. The purpose of this lesson is to introduce youth to abalone biology, life history, and distribution.</p> <p>Feel free to use our Nisga'a Youth Marine Stewardship Program "Youth Abalone" power point presentation called "Northern Abalone", and/or the slide show presentation on the 'Ocean Link – All About the Ocean' website!</p>
Practice:	Individual, pairs, and groups	<p>Assign students in small groups of three people. Ask the students to creatively draw and colour a large poster to demonstrate what they have learned from the slide show presentation.</p> <p>Or...</p> <p>Ask the students to creatively show their learning using multiple intelligences such as: music, logic-math, linguistics, spatial, body movements, interpersonal, intrapersonal, and nature.</p> <p>For example, students may choose from the following:</p> <ul style="list-style-type: none"> ▪ Write a song about abalone. ▪ Write a creative story about an abalone. ▪ Write a short role play about abalone, and act it out. ▪ Work together as a team to design a colourful poster on abalone.
Homework Assignment:		Work on the learning activity that the student chose.

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Review:		The students share their song, creative story, role play, and poster with the rest of the class.
Eco-friendly Action Project:		<p>Our eco-friendly action project was to:</p> <ol style="list-style-type: none"> 1. Listen to a guest speaker biologist give a slide show presentation on abalone species at risk. 2. Watch a slide show presentation on abalone biology, life history, and distribution. 3. Look at online video casts of abalone. 4. Choose a learning activity that appeals to multiple intelligences.
Application Work time:		Allow 1 hour for the guest biologist to present the slide show. Allow Additional time for the students to work on the learning activity that they chose. Allow time for the students to present and share their learning activity with the rest of the class.
Self-Evaluation and Critique:		Our youth appreciated the visual slide show presentation on abalone. They found some of the details of the anatomy of the abalone fascinating and were laughing with our guest biologist, Richard Bussanich (rb)! Our youth quickly could point out what an abalone looks like on the rocky shore posters, and they interacted well with the video online webcasts!
Accommodation Options: See Below		
ELL / IEP Students:		Hand out to all your youth their journals (with blank paper in it) to sketch, draw, and colour on while the guest speaker biologist gives the slide show presentation.

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Highly-Capable Students:	See above.
<p>Management/Organization Tips:</p> <ul style="list-style-type: none"> ▪ Provide a computer, projection system, and screen for the power point slide show presentation. ▪ Give your guest speaker biologist a thank you gift. ▪ Prepare the students' journals with blank paper. Hand out pencil crayons, crayons, and felt markers with the journals. 	
<p>Approximate Time Needed:</p> <p>Allow 1 hour for the guest biologist to present the slide show. Allow Additional time for the students to work on the learning activity that they chose. Allow time for the students to present and share their learning activity with the rest of the class.</p>	
<p>Prerequisite Skills: Take time to go over any abalone vocabulary and concepts of species at risk Before the slide show presentation.</p>	
<p>Materials and Resources Required for Lesson:</p> <p>See Management/ Organization Tips above.</p> <p>Adopted and other Audio/Visual: none</p> <p>Supplemental Resources (including Internet resources):</p> <ul style="list-style-type: none"> ▪ See Materials Above 	
<p>Supplies: See Materials Above</p>	

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Technology – Hardware (Click boxes of all equipment needed.)		
<input checked="" type="checkbox"/> Computer(s)	<input type="checkbox"/> VCR	<input checked="" type="checkbox"/> Projection System
<input type="checkbox"/> Printer	<input type="checkbox"/> Video Camera	<input type="checkbox"/> Camera
<input type="checkbox"/> Digital Camera	<input type="checkbox"/> Scanner (optional)	<input type="checkbox"/> Video Conferencing
Technology – Software (Click boxes of all software needed.)		
<ul style="list-style-type: none"> ▪ A computer, projection system, and screen will be needed for the power point slide show presentation. 		
Optional Technology Extensions:	Ask the students to post their learning activities on the school website. Have the students scan their learning activities on the computer to send to your guest biologist!	

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APPENDIX: BACKGROUND NOTES

Northern or Pinto abalones (*Haliotis kamtschatkana*) belong to the class of mollusks having a shell that consists of one piece. The genus they belong to is *Haliotis*, which means "sea ear" and refers to the flattened shape of the shell.

Description:

Pintos are the smallest abalones and they are commonly about 4 inches long, however the biggest individuals can grow as big as 6 inches long (12 cm). The shell is oval or rounded with a large dome towards one end; it is also irregularly mottled and narrow. The colour of the shell exterior is mottled greenish brown with scattered white and blue. The shell has a row of respiratory pores through which the abalone takes in water and filters dissolved oxygen from the surrounding water with its gills. Water that passes through the body leaves through the respiratory holes carrying away waste from the digestive system. Pinto abalones have from 3 to 6 open holes in their shells. The shape of these respiratory holes is oval and they are raised. The colour of the pinto abalones' epipodium is mottled greenish tan or brown. The tentacles are thin and the colour of them can vary from yellowish brown to green. Abalones' muscular foot has a strong suction power that permits the abalone to clamp tightly to rocky surfaces.

Abalone shells are rounded or oval with a large dome towards one end. The shell has a row of respiratory pores. The muscular foot has strong suction power permitting the abalone to clamp tightly to rocky surfaces. An epipodium, a sensory structure and extension of the foot that bears tentacles, circles the foot and projects beyond the shell edge in the living abalone. Nine species of abalone occur in North America: black (*H. cracherodii*), flat (*H. walallensis*), green (*H. fulgens*), pink (*H. corrugata*), pinto (*H. kamtschatkana*), red (*H. rufescens*), threaded (*H. assimilis*), Western Atlantic (*H. pourtalesii*), and white (*H. sorenseni*) abalone.

Habitat:

Pinto abalones have definite preferences in locations and habits. Pinto abalones range from Sitka, Alaska to Monterey, California. The only member of the genus is likely to be found in the Puget Sound region, on the open coast of Vancouver Island and Washington. Farther south pinto abalones become strictly sub tidal. Pinto abalones can be found clinging to rocks in kelp beds along open coastal environments that have a good water circulation. Their habitat is between the low inter tidal zone and sub tidally down to 70 feet (18 meters depth). Hold onto rocks with a suction force of more than 4000 times that of their own body weight. Seaweed, bryozoa and sponge form a covering on the outer shell of the abalone, providing it with handy camouflage.

Life cycle:

Abalone are solitary animals, aggregating only during the spawning season.

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Abalone are a broadcast spawner, that is they release their gametes (eggs and sperm) into the open water where they meet and fertilisation occurs. Mature females can release up to 1 million eggs per spawning although fertilisation and survival rates are very low.

The fertilised eggs are dispersed by currents until they hatch into motile larvae known as veligers. The veligers undergo a number of other development stages for 4-6 days until they settle. Once settled the juvenile abalone are called 'spat' and they graze on microalgae which is present on the substrate (rocks etc). Spat can actively select a suitable substrate depending on the type and level of food availability. Once the spat have reached approximately 5 mm in size, they make their way into rock crevices for protection and come out at night to feed on drift seaweed.

The life cycle of an abalone begins from an egg. Abalone female releases millions of eggs, but only about 1% (or even less) of the offspring survive the many challenges they have to face before maturity. The eggs turn into a free living larva and then after drifting with the currents about a week the abalone larva settles to the bottom and begins to develop the adult shell form.

Abalones reach sexual maturity at a small size, and fertility is high and increases exponentially with size. Sexes are separate and fertilization is external. The eggs and sperm broadcast into the water through the pores with the respiratory current. A 1.5 inch abalone may spawn 10,000 eggs or more at a time, while an 8 inch abalone may spawn 11 million or more eggs. The spawning season varies among species with black, green and pink abalone spawning between spring and fall, and pinto abalone spawning during the summer. Red abalone in some locations spawn throughout the year. The fertilized eggs hatch into floating larvae that feed on plankton until their shells begin to form. Once the shell forms, the juvenile abalone sinks to the bottom where it clings to rocks and crevices with its single powerful foot. Settling rates appear to be variable. After settling, abalones change their diet and feed on macroalgae.

Except for black abalone, hybridization for abalone species is not uncommon in areas where several species occur together. There are 12 recognized hybrids in southern California and northern Baja California.

Limited growth information is available for abalones. Commercial sizes of 6.25 inches for pinks, seven inches for greens and 7.75 inches for reds are reached after a minimum of 10 to 15 years in southern California. Pinto abalone reach about 2.5 inches in a minimum of 6 years.

Juvenile abalones feed on rock-encrusting coralline algae and on diatom and bacterial films. Adult abalones feed primarily on loose pieces of marine algae drifting with the surge or current. Large brown algae such as giant kelp, bull kelp, feather boa kelp and elk kelp are preferred, although other species of algae may be eaten at various times.

Abalone eggs and larvae are consumed by filter-feeding fish and shellfish. Predators of juvenile abalones include crabs, lobsters, gastropods, octopuses, seastars, and fishes. The bat ray in southern California and the sea otter in central California prey selectively on larger abalones.

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When spawning, eggs and sperm are released from the gonads of female and male abalone through a series of respiratory pores (apertures or holes) in the shell through which the abalone draws oxygenated sea water to its gill. This is known as broadcast spawning. One 37 mm abalone may spawn 10,000 eggs or more at a time, while 21 cm abalone may spawn 11 million or more. Spawning is usually controlled by factors such as water temperature or the length of the day. Additionally, the presence of eggs and sperm in the water may stimulate other abalone to spawn, thus increasing the chances of fertilization.

Fertilized eggs hatch as a microscopic, free living larva that drift with the currents for about a week. Then the larva settles to the bottom, shed their swimming 'hairs' (cilia), and begins to develop into their shell-bearing adult form. If a suitable habitat is located, the abalone may grow to adulthood. However, the chance that an individual larva will survive to adulthood in the 'wild' is very low.

It is interesting to note that while the sexes of the abalone are quite separate, they can be identified as either males or females (based on the colour of their gonads) as soon as they are about 25 mm in size (when the gonads have begun to develop).

Determining the age of an individual abalone is difficult, for unlike the hard parts of some animals the abalone shell has no regular pattern of growth marks or bands suitable for assigning age. However, it has been estimated that aquarium-bred juvenile abalone grow at the rate of 2-3 cm or more per year for the first two years. Tagging studies have provided some estimates of the rate of growth of larger abalone in the wild. For example, red abalone (*H. rufescens*) are mature at 4-5 cm, after which growth begins to slow with age. Therefore, an 18 cm red abalone may be 7-10 years old, while one only 2 cm longer may be 15 years of age or older.

Predators:

Abalone have many predators. They get eaten by other animals (crabs, lobsters, octopuses, starfish, fish and snails) and crushed to the rocks by strong waves. The sea otter was traditionally one of the most significant predators of abalones, although they have not yet moved into the Strait of Juan de Fuca, from the re-introduction several years ago to northern Vancouver Island.

Nutrition:

Pinto abalones, as all abalones, are herbivores. They use their large, rough radulas ("tongues") to scrape pieces of algae and other plant material from the rock surfaces. The adult abalone feeds on loose pieces of algae drifting in water. Abalones prefer large brown algae; mainly different kind of kelps and seaweed. The colour banding on many abalone shells is caused by the changes in the type of algae that the abalone has eaten.

Threats:

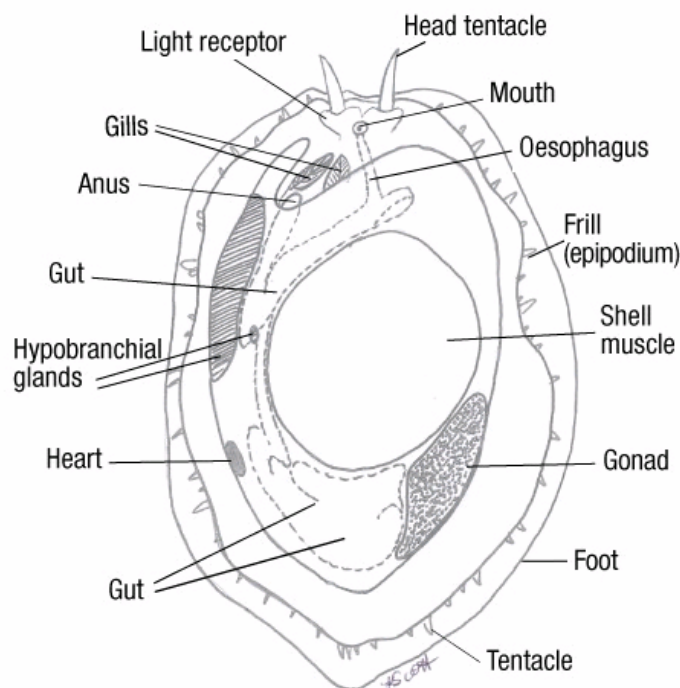
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Pinto abalones used to be subject to sports and commercial fishery. They suffered from over harvesting and habitat loss and poaching. There is now a permanent closure on all abalone fishing on the B.C. Coast. For the Pacific North West Coast First Nations People, the beautiful shells of abalone were used for jewelry and were also a seafood delicacy. They occur sub tidally and only in remote areas.

Prior to 1971, the British Columbia commercial pinto abalone fishery was sporadic and local. Shore picking was the main harvest method, but after 1960 some scuba gear was used. The fishery accelerated rapidly during the 1970's due to improved scuba gear, reduced access to herring and salmon fisheries, acceptance of the pinto abalone in the Japanese market, increased product demand, and the introduction of larger vessels with freezer capacity. Abalone landings peaked in 1977 at 474.8 metric tons (1,047,000 pounds) and then declined rapidly as management of the fishery began. Landings in 1990 totaled 110,000 pounds. The British Columbia abalone fishery was managed through a minimum size limit of 100 mm (3.9 inches), vessel license limitations, vessel and fishery quotas, seasonal restrictions, and local permanent area closures. In 1991, the commercial abalone fishery was closed to allow abalone stocks to rebuild.

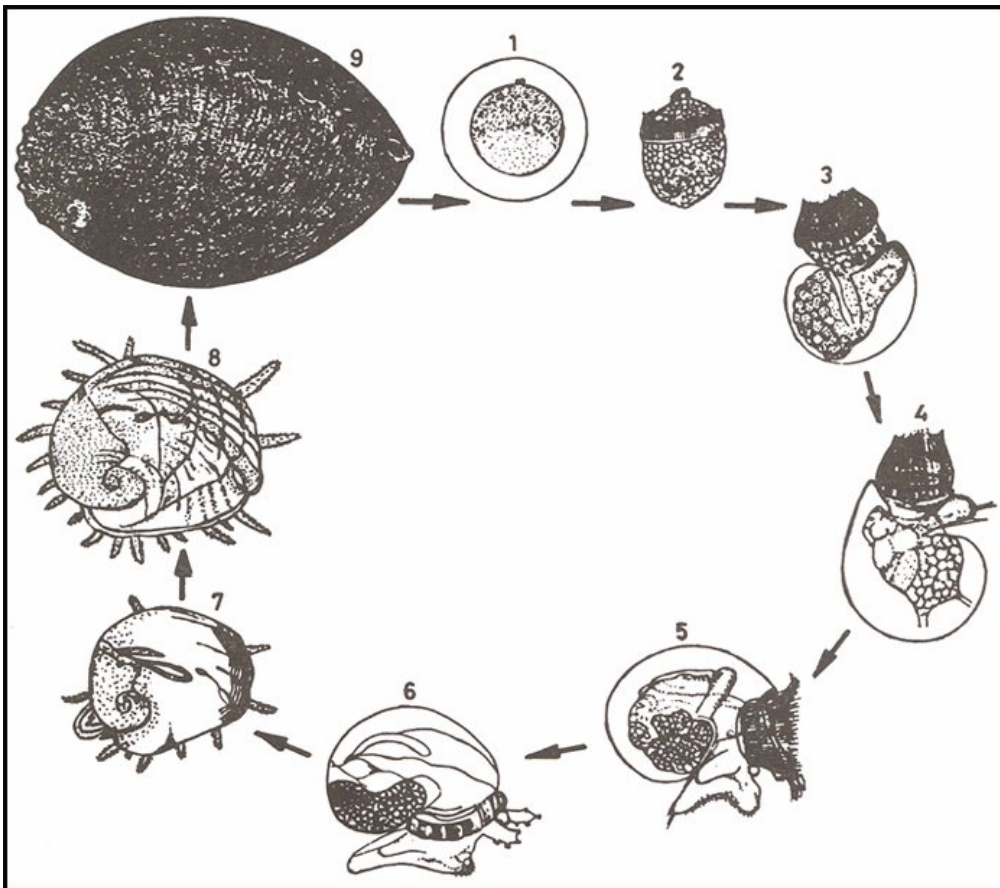
During the early years of the abalone fishery, abalones were dried and smoked, or canned for export, and sold fresh for local markets. Currently, most abalones are exported to Japan, either fresh or frozen whole. The U.S. market is primarily in California for live abalone for the sashimi market, and for some fresh and frozen steaks for restaurants.

Anatomy of an Abalone



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Life Stages of Abalone



*Lifecycle of Abalone (Japanese disc abalone). 1-Fertilised egg (egg diameter 0.23 mm and yolk diameter 0.18 mm), 2-Trochophore larvae swimming stage (19 hours after hatching), 3- Early veliger stage before torsion (29 hours, S.L. 0.29 mm), 4-Swimming veliger having stigmata and cephalic tentacles (2.5 days, S.L. 0.29 mm), 5-Full grown veliger in early creeping stage (5 days, S.L. 0.29 mm), 6-Creeping larvae begins to secrete peristomal shell (13 days), 7-Young having respiratory pores (140 days, S.L. 3.0 mm), 8-More developed young shell (160 days, S.L. 3.7 mm), Adult *Haliotis* (*Nordotis*), discus. Diagram copied from Bose, A.N., Ghosh, S.N., Yang, C.T., Mitra, A., 1991. Coastal aquaculture engineering. Edward Arnold, London, 365 pp.*