## IV. THE REALM OF FRUITS AND SEEDS

Nature has devised as many ways to disperse fruits and seeds as pollination mechanisms for flowers. Here are some of the cornmon dispersal agents:

o Wind. Effective for light seeds (orchids, etc.), winged seeds or fruits, fruits or seeds with tufts of hairs. Some strategies are for relatively short distances, as with maple and ash samaras; others are long-distance travelers, such as the seeds or fruits of cattails and dandelions. Tumbleweeds use wind in a dramatic fashion: the entire plant, seeds and all, are designed to be rolled by the wind. Unrelated tumbleweeds include birdcage evening primrose (Oenothera deltoides), Russian thistle (Salsola kali), and tansy mustard (Sisymbrium altissimum).

o Gravity. The simplest method of dispersal: seeds fall from pods directly to the ground. This method is best for annuals, where competition with the parent plant is not intense, but this method also occurs in other groups. Gravity also affects round seeds, which often continue to roll after falling to the ground. Common examples include Douglas iris (Iris douglasiana), California buckeye (Aesculus californica), and wild canna (Canna edulis).

o Water. Although not common, some seeds are designed for being carried down streambeds during flash floods. This is particularly characteristic of certain desert shrubs and trees. Water is also involved in the flotation of seeds, usually seeds or fruits adapted to travel from beach to beach on tides. Sand dune plants with such mechanisms include sand verbena (Abronia spp.), sea rocket (Cakile spp.), beach morning glory (Calystegia soldanella) and, in the tropics, coconuts (Cocos nucifera).

o Glue. Several kinds of seeds are sticky or glutinous when wetted and adhere to animal fur and clothing. Groups with this method include phloxes (Polemoniaceae), trail plant (Adenocaulon bicolor), and the native annual glue-seed (Blennosperma nanum) in the daisy family.

o Self-planting. Occasionally seeds are directly sowed by the plant itself. Examples include the genus Cyclamen, where the fruiting stalk spirals downward toward the ground; skunk cabbage (Lysichiton americanum), where the whole flowering stalk flops over; and peanuts, where the fruit actually buries itself.

o Ants. A number of forest plants, particularly those from the redwood forest have seeds with special oil bodies (elaiosomes) which attract ants. The ants carry off the seeds, nibble off the oil body, and discard the main body of the seed. Examples include inside-out flower (Vancouveria), Trillium, violets (Viola spp.), and western bleeding heart (Dicentra formosa).

o Fire. Although not a dispersal agent per se, fire is often important in allowing seeds to be dispersed or germinate. Examples include the closed-cone pines and cypresses of California and many members of the Proteaceae and Myrtaceae from Australia. Many California native annual wildflowers have seeds requiring fire before germinating, including wind poppy (Stylomecon heterophylla), flame poppy (Papaver californicum), whispering bells (Emmenanthe penduliflora), and golden eardrops (Dicentra chrysantha).

o Sensitivity to touch or change in temperature. Many seed pods are "irritable: " that is, they explode on contact, or when temperatures rise. Such explosive pods include Impatiens spp., sorrels (Oxalis spp.), manroot or Indian cucumber (Marah spp.), and lupines (Lupinus spp.).

o Hitchhikers. Seeds or fruits that are provided with barbs, hooks, or prickles which catch on animal fur or clothing. Many of our most successful weeds fall in this category, including bur clover (Medicago lupulina), foxtail grass (Hordeum), and filaree (Erodium). Natives benefiting from this method include mountain forgetme-not or stickseed (Hackelia spp.) and sanicles (Sanicula spp.).

o Edible berries or other fleshy fruits. Seeds enclosed in fleshy coverings, (also arils, where a fleshy handle is attached to each seed) are attractive food to birds and mammals. Such seeds have tough coats, softened by passing through the digestive tract of said animals before being excreted.

o Edible nuts and other large, food-storing seeds. Such fruits and seeds are produced in enough quantity that some are sacrificed in order to get dispersed. Mammals or birds frequently cache these nuts for later use, and they germinate.

The design of fruits is not only intriguing but may often help in identification. There are many categories, but the principal groups are three: dry fruits that split open (dehisce); dry fruits that do not open (the whole fruit is dispersed); and fleshy fruits. We'll sample from each category.

Dry fruits that dehisce (open)

Follicle. Ovary of one chamber, which splits open along one lengthwise slit. Examples include columbine (Aquilegia), marsh marigold (Caltha), and larkspur (Delphinium).

Legume. Similar to the last, except that the ovary opens by two lengthwise slits, one on either side. Typical of most members of the pea family Fabaceae, including garden peas (Pisum sativum), beans (Phaseolus spp.), lupines (Lupinus spp.), wild sweet peas (Lathyrus spp.), and clovers (Trifolium spp.).

Capsule. A two- or more-chambered ovary, with each chamber opening to shed seeds. This is the most common type of dehiscent fruit and is found in numerous families and genera. The direction of splitting may be lengthwise, crosswise, or by pores at the top.

Schizocarp. Technically this kind combines one-seeded ovary segments in a multi-segmented fruit, each segment splitting apart from the others, but retaining its own ovary wall in the process. Examples include many members of the mallow family Malvaceae, such as apricot mallow (Sphaeralcea ambigua) and the fruits of the parsley family Apiaceae.

Dry fruits which are indehiscent (don't open)

Achene. This is the simplest form of this kind of fruit. A one-seeded, small ovary, where the whole fruit is shed as a unit. Examples are common in the buttercup family Ranunculaceae and daisy family Asteraceae. An unshelled sunflower "seed" is a good example. Achenes frequently have prongs or hairs for more effective dispersal.

Caryopsis. A specialized achene in the grass family Poaceae, where the ovary wall and seed coat are joined together. Any of our familiar grains are good examples.

Samara. A specialized achene that are winged for wind dispersal. Examples include ashes (Fraxinus spp.), hopbush (Ptelea crenulata), and maples (Acer spp.).

Nut. A usually large, one-seeded fruit with hard, shell-like ovary wall. Seeds inside nuts store abundant, energy-rich food. Examples include hazelnut (Corylus cornuta), coconut (Cocos nucifera), and oaks (Quercus spp.). Many so-called nuts are seeds surrounded by a pit and fleshy layer (as with almonds, walnuts, etc.)

Nutlet. A scaled-down nut, with tiny individual ovaries or ovary segments. Similar to an achene, but the ovary wall is tougher. Fruits of the forget-me-not family Boraginaceae and mint family Lamiaceae typically have nutlets.

Fleshy fruits

Berry. The most basic kind: an ovary with two or more compartments and many seeds. Common everyday examples include banana (Musa paradisica), eggplant, and tomato (Lycoperiscum esculentum). Many so-called berries are technically other kinds, although huckle- and blueberries are true berries (Vaccinium spp.).

Drupe. A one-seeded, fleshy fruit, often with a hard pit-like inner ovary wall around the actual seed. Examples include the stone fruits (apricots, peaches, plums, etc.), avocado (Persea americana), and walnut (Juglans regia). Several natives in the rose family Rosaceae (e.g., oso berry and native plums and cherries) have drupes.

Pome. Resembles a berry, BUT the fleshy layer is from the receptacle which grows around the ovary proper. The ovary itself is a papery sac surrounding the seeds and is easily seen when the fruit is sliced in half. Examples are common in the rose family Rosaceae, including apples (Malus) and pears (Pyrus). Natives with smaller pomes include toyon (Heteromeles arbutifolia), service berry (Amelanchier spp.), and mountain ash (Sorbus spp.).

Aggregate fruit. A cluster of fleshy fruits from one flower, as with raspberries, blackberries, and thimbleberry (Rubus spp.). Each tiny segment is actually a small drupe or drupelet.

Accessory fruit. An aggregate fruit, where the actually ovaries are tiny achenes embedded in a fleshy layer created by the growth of the receptacle around the achenes. Strawberry (Fragaria spp.) is our best example.

Multiple fruit. Fleshy fruit created by SEVERAL flowers whose ovaries later grow together. Examples are pineapple (Ananas comosa) and breadfruit (Arctocarpus altilis). There are few examples of natives with this kind of fruit; flowering dogwood (Cornus nuttallii) most closely approaches this situation.

## VEGETATIVE VERSUS SEXUAL REPRODUCTION

Many plants have two kinds of reproduction:

- vegetative. Reproduction by direct growth of root, stem or leaf. Examples include a strawberry with its runners and new plantlets, the air plant Bryophyllum with its line of baby plantlets along the leaf edge, and iris with new rhizomes which may break away from the parent. We use vegetative reproduction extensively in gardening, when we take cuttings or layer branches. We also use it for propagating choice fruit cultivars when we graft a scion on to a rootstock. The advantages to vegetative strategies are to increase the local area a species occupies. Vegetative spread may be particularly important to plants of specialized environments, such as those growing in marshes, forests, and sand dunes.

- sexual. This is reproduction through redistribution of genes in the complex set of circumstances that leads to seeds. For our studies here, we'll focus on flowers and seeds. The advantages of sexual reproduction are the new combinations of traits found in the offspring. This does mean, however, that a special cultivar or cultivated variety will not come true from seed. Sexual reproduction creates the new combinations that allow for adaptations to changing environmental conditions, and long-range dispersal strategies help allocate new territory and expand the already established limits of a species.