RESIN-COATED FISHES:
A SIMPLE MODEL TECHNIQUE FOR
IN SITU STUDIES OF FISH BEHAVIOR

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RESIN-COATED FISHES: A SIMPLE MODEL TECHNIQUE FOR IN SITU STUDIES OF FISH BEHAVIOR. — Models, or dummies, have been used extensively in laboratory and field studies of animal behavior (Lehner, 1979). Models allow an experimenter to manipulate important stimuli in a systematic manner, thereby measuring qualitative and quantitative differences in the responses of test organisms. In field studies of the behavior of free-living fishes, models have been used during investigations of interactions associated with inter and intraspecific territoriality, predator-prey relationships, symbiotic relationships and reproduction. Commonly used methods involve placing live fish in transparent containers and presenting them to test animals (the "model-bottles" of Myrberg and Thresher 1974); passing inanimate objects of differing shapes, sizes and color patterns in front of or over test animals (the "clothesline" of Hurley and Hartline, 1974); presenting carved or molded replicas of fishes that are made from various materials (Colgan and Gross, 1977; Ehrlich et al., 1977; Losey, 1977); or using humans or diver-held cameras as intruders (Itzkowitz, 1979; Coates, 1980).

All of these techniques, as with any experimental manipulation, have their advantages and drawbacks. Fishes placed inside containers may behave abnormally or may be viewed by the test subject as a refracted, distorted image. Abstracted shapes represent a fraction of the stimuli that characterize a natural object. Cutouts or molded decoy-type models can be tedious and even expensive to produce. Human and camera intruders involve exceptionally large and unnatural stimuli that may give equivocal results. Valid controls are difficult to develop for some methods, and all techniques of model presentation introduce unknown variables.

Colleagues and I at the West Indies Laboratory in St. Croix have developed a method for producing inexpensive, realistic models of free-ranging reef fishes that we feel minimize many of the drawbacks of other methods. Basically, the technique involves formalin preservation and resin coating of fish specimens.

A 1-cm incision is made in the ventrum of a freshly-obtained specimen. Depending on whether negative or positive bouyancy is desired, cylindrical fishing weights or pieces of bouyant styrofoam are slid into the body cavity through the incision. Next, the body cavity is filled with silicon cement ("silastic"), again injected through the ventral incision. If this is not done, models develop an emaciated appearance. Excess silicon that protrudes from the incision or spear holes can be trimmed off later.

The specimen is then injected at several points, including the body cavity, with 100% formalin. It is then preserved at least overnight in >20% formalin solution. The specimen should be laid in a large container such that the body is not bent or otherwise deformed. Very compressed fishes can be hung in the preservative by sewing a thin line through the caudal peduncle and attaching the line at two points to a rod above the container. The purpose of the strong formalin solutions is to insure extreme hardness and to slow dilution of the fixative when the model is immersed in water during presentation trials.

Our work has involved species of fairly uniform or muted colors which are reasonably well retained, at least initially. For boldly colored fishes, a standard color preservative such as butylhydroxytoluene (BHT) might be added to the formalin, although we have not tried this. Color can be applied to the final resin-coated model with any paint that is compatible with fiberglass resin.

After preservation, the model is removed from the formalin and wiped lightly with paper toweling. The model should not be permitted to air dry, as this causes sunken eyes, shrinkage of muscles, wrinkling of skin, and other unnatural deformations. We next suspend the model with line hooked into the gill cavity on the ventral side in the region of the isthmus. A moderately thick coat of standard fiberglass resin / catalyst mixture is applied by brush. Upon drying, a second coat of resin is applied. To slow future dehydration, we usually apply extra resin to any wounds or openings into the body cavity and around the eyes and mouth. The resin coating seals the formalin in and adds rigidity to the body. Breakage of fins can be reduced by taping them with clear Mylar tape and trimming off the excess. Resin-coated fish initially have a reflective luster, but much of this shininess is lost upon immersion in water. We recoat a model with one or two layers of resin after every five immersions, or whenever obvious chips or cracks appear in the resin coat. Models have been successfully stored for up to four months.

Using this technique, we have produced realistic models of large-scaled and fine-scaled fishes of a variety of body forms, including synodontids, aulostomids, carangids, gerreids and mullids. These models are sufficiently realistic that on one occasion a moray eel attacked a trumpetfish model (N. G. Wolf, Cornell University, pers. comm.), and cleaner gobies (*Gobiosoma* spp.) have frequently inspected them.

Our most extensive use of resin-coated models has been in testing the responses of relatively sedentary prey species (small serranids, pomacentrids, gobiids) to models of foraging trumpetfish, *Aulostomus maculatus*. We have successfully tested variables of predator size, height above bottom, speed of movement and body orientation. Our best results have been obtained by presenting a model at the end of a clear plexiglass rod. To do this, a 5 cm long, 2.5 cm deep and 2 cm thick block of clear plexiglass is lashed to one side of the fish with clear Mylar tape. A 1-m long, 13-mm diameter clear plexiglass rod is then pushed into a hole drilled in the face of the block, with friction between rod and block preventing the model from rocking or slipping off the rod. Models are passed in a semi-circle at a constant height and speed above the test fish by a diver sufficiently weighted to kneel on the bottom. The clear plexiglass becomes almost invisible underwater. For controls, we present the rod/block combination alone. Prey fish respond very weakly to the controls, whereas escape responses are common when a trumpetfish is attached to the block. Other successful methods of presentation include placing a benthic predator model on the bottom in a natural setting and pose, or catapulting such models at prey in a simulated attack (N. G. Wolf, pers. comm.).

We feel that resin-coated models have potential beyond the predator-prey interactions that we have investigated. Bouyant models of solitary or aggregated species could be tethered over the bottom with monofilament fishing line, thereby simulating hovering predators or prey. Other applications could include tests of inter and intraspecific territoriality, responses of reproductively active individuals to potential mates, and social facilitation of feeding or investigatory behavior. The technique has obvious drawbacks. When a model is presented at the end of a rod, the test animal must be minimally disturbed by the diver at the other end. This problem could be partially eliminated by attaching the rod to a remote-controlled motor, although the sound of the motor would introduce an additional variable. Behavioral responses mediated by olfaction could be complicated by the formalin that diffuses from the models. Strong surge or current complicates the presentation technique. The method is most appropriate for model species that hover or rest on the bottom, or for active fishes that swim with relatively rigid bodies. We feel that the ultimate solution to many of the problems inherent in resin-coated and other model presentation techniques would be the in situ projection of holographic movies of model organisms.

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