

ESTROGEN ACTION IN SCLERACTINIAN CORALS: SOURCES,
METABOLISM AND PHYSIOLOGICAL EFFECTS

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

OCEANOGRAPHY

AUGUST 2002

By

Ann M. Tarrant

Dissertation Committee:

Marlin Atkinson, Chairperson

Shannon Atkinson

Robert Bidigare

David Karl

Francis Sansone

Robert Kinzie, III

ABSTRACT

Steroidal estrogens are vertebrate hormones that also occur in invertebrates, where they have diverse biological effects. Estrogens are present in coral tissues, released during spawning events, and hypothesized to regulate coral reproduction. The source of estrogens measured in corals is unknown, and until now, no experiments have tested whether estrogens are biologically active in corals. This dissertation will: (1) describe uptake of dissolved estrogens by corals; (2) test the effects of estradiol on coral growth and reproduction; (3) describe metabolism of estrogens and androgens by corals. Corals removed estrone from the water column in a recirculating flume (initial concentrations 1000 - 2500 pg l⁻¹) at a rate proportional to concentration (rate = S[estrone]); the estimated first-order rate constant (S) was 85 x 10⁻⁶ m s⁻¹ (95% confidence limit ±24 x 10⁻⁶ m s⁻¹). This rate constant is close to the theoretical maximal uptake rate, based on mass transfer theory of nutrient uptake by corals. Tritiated estrone was taken up by live corals about twice as fast as estrone adsorbed to coral skeletons. Since concentrations of dissolved estrone are 50 to 1000 pg l⁻¹ over coral reefs, uptake rates of estrogen into coral communities from the water column are 0.37-7.3 x 10⁶ pg estrone m² day⁻¹ with estimated turnover times of 6-115 days. *Montipora capitata* coral colonies treated with estradiol (nominally 2.3 µg l⁻¹) for three weeks prior to spawning released fewer (29%) bundles than controls. *Porites compressa* nubbins exposed continuously to 2 ng l⁻¹ estrone for 2-8 weeks had lower (13-24%) skeletal growth rates than controls. Both estrone and testosterone resulted in thicker tissue among the larger nubbins. Coral homogenates metabolized estradiol into estrone and testosterone into

androstenedione and androstanedione. Thus, corals contain a functional 17β -hydroxysteroid dehydrogenase and 5α -reductase. Since corals can take up and metabolize steroids, they may also affect availability of these and similar compounds to reef biota. While the mechanism for estrogen action for corals remains unknown, these experiments represent the first account of biological activity of estrogens in coral. Together these results support the hypothesis that endogenous androgens and estrogens act as bioregulatory molecules in corals.